THE COMPARATIVE RISK ANALYSIS OF SMALL AND MEDIUM ENTERPRISES

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Abstract: *This paper is dealing with the comparative analysis of corporate risk by applying of different risk quantifying methods used both in national and international literature. The investigation is based on selected number of anonymous small and medium sized enterprises' simplified financial annual report. In Romania, as in other Central European countries, the small and medium-sized enterprises play an important role on aspect of GDP stimulation and jobs creation. For this research, the data will be ensured by simplified financial reports of 173 small and medium-sized enterprises registered in County Bihor between 2011 and 2012. The selected enterprises are 135 trading firms (78,03%) and 38 manufacturing firms (21,97%). For the corporate risk quantification, firstly, I will use the dynamic risk measures: degree of operating leverage (DOL), degree of financial leverage (DFL) and the product of them degree of combined leverage (DCL). The first two risk ratios will be used further as main features in investigated enterprises grouping. The grouping of investigated enterprises will be carried out by using of K-means non-hierarchical cluster analysis. In the second part of research, I will also calculate the main dispersion measures of Return on Assets (ROA) for each clusters. So, I will carried out the quantification of corporate risk by the following dispersion indicators: standard deviation, semi-deviation, (semi-standard deviation), mean absolute deviation and median absolute deviation. For the better illustration of differences and similarities between each clusters, I will apply metric multidimensional scaling (MDS). The calculations will be carried out in R statistics software program by using kmeans and cmdscale functions. The results of analysis are different in case of investigated methods. According to cluster analysis, the major problem of enterprises is the operating risk, because the value of degree of operating leverage (DOL) shows extremely high (cluster 3.) and low (cluster 1.) values. In term of financial risk, we can conclude that enterprises are well situated, because the values of degree of financial leverage (DFL) are relatively low, only the firms from cluster 1. and cluster 3. should be careful in term of debt level. While the cluster analysis by dynamic risk indicators considers the firms from cluster 1., cluster 3., and cluster 11 as the most risky, the investigated dispersion measures class firms differently. According to this, the firms from cluster 1., and cluster 6. represent an average position and can be considered appropriate in term of risk. The enterprises from cluster 3. and cluster 11. are quite different on aspect of risk, because their points of MDS graphical representation are so far situated.*

Keywords: *risk; degree of operating leverage; degree of financial leverage; risk analysis; standard deviation; semi-deviation; mean absolute deviation*

JEL classification: *G3; G30; G32.*

1. Introduction

In case of majority of enterprises' life cycle, it is difficult to determine a short period in which the risk is absent. Achieving profit and thus shareholder's capital maximizing is a prerequisite of risk-taking, so the identification and measurement of risk is essential at company. In addition, rapid and unpredictable changes in the economic environment, the globalization, the increased competition put even more the importance of dealing with the risk assessment. In order to productive financial management, beside the main activities decisions, the company managers have to invest time and capital for risk management, which is a quite complex task. In the international literature, we can read about risk management as a holistic and business system integrated activity, which affects all divisions of the company. The definition of the main tasks of risk management is quite different from author to author, but I think that one of the key part consists in mapping and quantification of company's threatening risks factors. The aim of this paper consists in comparative analysis of results obtained by applying of different enterprise risk quantifying methods used in national and international literature.

2. Review of literature

Regarding to risk quantification, several questions arise, on one hand what is the meaning of risk and what distinguishes the risk from uncertainty. Another question is also how can we measure something what we don't know with certainty. After reviewing the international literature about this topic, it's difficult for researcher to decide about the most coherent measure of corporate risk, because the opinions about this are so different. Another difficulty related to risk quantification is the fact that the risk itself is difficult "to measure", because directly it's really can't be measured. This is why we often try to capture it through the changes of an economic variable (Kovács, 2011). In practice, the decision-makers often consider the risk as "the probability of negative event occurrence. According to Mun (2006), under the concept of risk, we can understand the probability that the achieved, real value of returns, yield is different from the expected, planned value. Therefore, in the risk quantification we can often find the concept of probability. This approach is simple and can be effective in risk measurement. We should take into account that this deviation from the desired return can be positive or negative, so this is why the researchers characterized the risk as a symmetric concept. Gallati (2003) try to accent both the positive and negative side of risk.

One of the most common method for risk measuring is variance and its root square, the standard deviation and the coefficient of variance. According to Eftekhari et. al. (2000) the most commonly used risk quantification measure in the financial area is the variance. One of the major disadvantages of the standard deviation is that it doesn't measure the risk directly, so the calculation of it is based on the deviation from mean of an economic variable (yield, return) selected by the researcher. According to Holton (2004) we can't put the sign of equality between risk and changes in return, or another selected economic variable, because the variances of return can be interpreted only as a proxy of risk.

In my opinion, the great financial changes from recent years have emphasized the need for the dynamic methods in financial risk investigation. One of the great merit of the dynamic methods is that there are able to take into account the temporal variability of risk factors, which is essential today. Regarding to these, in my paper

on risk analysis, I used risk quantification methods that are commonly used in both domestic and international analysis for determining company's financial and operating risk. In case of enterprises, the result is the main variable in which the amplifier effect of leverage appears, so the degree of operating leverage (DOL) and the degree of financial leverage (DFL) are often used to quantify the operating and financial risks. First, I will use the above-mentioned dynamic risk indicators (DOL, DFL) which further will be used as main features in firms grouping. In the second part of paper, I also intend to explain the companies' risk with main dispersion measures of Return on Assets (ROA): standard deviation, semi-deviation, (semi-standard deviation), mean absolute deviation and median absolute deviation. The reason of using this profitability indicator is that the changes in Return on Assets (ROA) is also essential in term of risk analysis.

3. Research methodology

In this article, the risk analysis is based on simplified financial reports for 2011 and 2012 of Romanian small and medium enterprises registered in County Bihor. Regarding to the economically dominant role of SMEs sector, for present research I use SMEs. In Romania, like in other Central and Central-Eastern European countries, SME's has essential role both in term of great level of GDP contribution and high level of employment rate. According to Romania Statistical Institute's publications, in 2008 were 18 798 companies registered in County Bihor at which the number of employees does not exceed 249 people. The major part of small and medium sized enterprises (39%) registered in County Bihor were trading companies, companies dealing with real estate transactions (16,09%), followed by manufacturing firms (11,92%) and transportation, storage and communication companies (10,06%). The great part of total turnover of Romanian SMEs' is provided by trading companies (nearly 50%), followed by manufacturing enterprises (nearly 20%). In this article, the risk analysis was performed by the k-means cluster analysis based on 173 simplified financial reports of small and medium enterprises registered in County Bihor for the years 2011 and 2012. The sample consists in 135 trading firms (78,03%) and 38 manufacturing firms (21,97%). According to Molak (1997) approach one of the most important component of risk is variability, which means temporal and spatial heterogeneity of values. After investigation of main statistics of degree operating and financial leverage ratios and some financial ratios it is clear that the analyzed sample presents great heterogeneity (high coefficient of variance) so the average value cannot be used for sample characterizing. The high values of coefficient of variance of the investigated ratios clearly show a strong volatility and riskiness of the analyzed firms. In order to obtain more homogeneous samples, I chose for enterprises grouping with k-means non-hierarchical cluster analysis. This was carried out by using the results of degree of operating leverage (DOL) and degree of financial leverage (DFL) indicators. The cluster analysis is used in many research fields such as science, medicine, economics, etc. (Härdle - Simar, 2011). The great merit of this method is that with researcher's specified criteria explores well the similarities and differences between analyzed individuals. In contrast to the hierarchical clustering methods, the non-hierarchical methods are considered more flexible. In this study, I applied non-hierarchical clustering, which allows the ulterior transfer of an object from one group to another (Johnson - Wichert, 2014). Among the non-hierarchical methods, one of the most well-know is the K-means clustering

in which the elements of sample is assigned to k-number of groups defined by the researcher (Szűcs, 2002). The method of non-hierarchical clustering method works on iteration principle. The iteration process aims to reduce the variability within the established clusters and to increase the spread between clusters. During the grouping of elements, the measurements of distances are based on Euclidean's distance algorithm.

In this paper, the calculations were carried out in an open source statistical software system, the R statistics, by using kmeans function. In R, the k-means clustering could be performed with several algorithms (Hartigan-Wong, Lloyd, Forgy, MacQueen), but the default and the most commonly used as well is the first from the enumerated before.

One of the disadvantages of classical risk measurement methods (standard deviation, variance, coefficient of variance) is that, they ensure so called symmetrical approach of risk, because they treat same the values situated below and above the mean. So, these methods do not make difference between profit and loss and during the calculation of risk, treat them similarly. According to these risk measurement methods, the enterprises' profit is considered as risky as companies' loss. The solution for this inconvenient is provided by semi-variance or semi-deviation (semi-standard deviation), which works only with values situated below the average. In this approach, only the firms' losses are considered unfavorable, risky event. So, both semi-variance and semi-deviation (semi-standard deviation) are named one-sided or asymmetrical risk indicators. According to Eftekhari et. al. (2000) one of the inconvenient of standard deviation and semi-deviation is that are relatively sensitive to outliers. This problem can be avoided by usage of mean absolute deviation, which works with the arithmetic average of absolute deviation from mean. While the majority of the researchers consider as advantage the fact that mean absolute deviation is less sensitive to outliers, Bugár and Uzsoki (2006) considered this as a disadvantage, because it underestimates the probability of high losses occurrence in critical periods like crisis. As the variance and standard deviation, the mean absolute deviation can be considered a symmetric, two-sided dispersion indicator. In addition to the indicators mentioned above, I calculate the median absolute deviation, which is an arithmetic average of deviation from the median. The four dispersion indicators will be calculated for each cluster, which contains more than 10 enterprises. In order to improve the transparency on differences and similarities between clusters I used multidimensional scaling (MDS). Multidimensional scaling is a statistical method, which includes elements in at least two-dimensional system, in order to illustrate the differences between the analyzed data. One of the major merit of this method unlike other methods is that the similarities and differences between analyzed elements are visualized in a graphical representation, in two or more dimensions coordinate system. The analyzed elements appears as points, and the similarities and differences between the points are indicated by the distances between points (Kruskal – Wish, 1978).

In this study, I applied metric multidimensional scaling, because the indicators used for scaling are variables explained by ratios (Kovács, 2006). Against to other statistical method, one of the major advantage of multidimensional scaling (MDS) is that doesn't assumes any requirement for the sample data, except the fact that the data have to be expressed in the same unit and these have to bear some information, features about investigated sample. Another merit of this method is that the efficiency of it isn't affected by the presence of outliers and by the correlation between data

(Kristof, 2008). In this paper, the classic two-dimensional scaling is applied by using cmsdscale function from R statistics statistical software. According to Takács (2013) by using the Euclidean's distances algorithm, the classical multidimensional scaling provides also the optimal solution and graphical representation.

4. Results of research

As I mentioned before, in this study I made the grouping of companies by k-means non-hierarchical analysis. The k-means cluster analysis is based on County Bihor SMEs' simplified financial reports for 2011 and 2012. The grouping of firms were carried out by two factors, according to the values of the degree of operating (DOL) and financial leverage (DFL) indicators. Among the obtained clusters, were selected for further analysis only the clusters which ones contained more than 10 companies. According to this, in 2012, four clusters was analysed in details. Over 80% (142 enterprises) of analysed sample were classified in these four groups.

The distribution of enterprises after clustering is the following:

1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
37	1	**10**	2	4	**82**	8	3	6	2	**13**	5

The mean values of degree of operating and financial leverage of the selected clusters are presented in the following table. We can see in Table no. 1 the main risk and financial characteristics of clusters containing more than 10 enterprises. We can observe among the indicators liquidity, indebtedness, profitability ratios, which can be associated with the analysed leverage indicators.

Table 1. The analysed clusters risk and financial indicators in 2012

Indicators	**Cluster 1.**	**Cluster 3.**	**Cluster 6.**	**Cluster 11.**
Number of enterprises	37	10	82	13
Risk indicators				
Degree of operating leverage (DOL)	-463,28	106,23	0,75	31,65
Degree of financial leverage (DFL)	1,95	1,61	0,74	0,54
Degree of combined leverage (DCL)	-904,86	171,07	0,56	16,97
Financial ratios				
Liquidity ratio	1,30	1,28	1,42	1,57
Total indebtedness (%)	66,19	68,95	62,67	62,99
Return on Assets (ROA - %)	5,16	0,53	6,66	3,86

Source: Own calculations

In 2012 the cluster 1. contains 21,39% of the analyzed sample. The cluster 1. contains enterprises which can be characterized by extreme operating because the degree of operating leverage takes negative value. This extremely low value of the indicator attract attention to an extremely high degree of volatility, which can be a signal for very high operational risk. This high value means that an increase in turnover with 1% causes a substantial decrease in operating result. This extremely high sensitivity of results are probably caused by the high value of operating costs. For this reasons, the companies belonging to the cluster 1. should pay more attention to the operating cost optimization. Better coverage of costs can be achieved by increasing of revenues and with reducing of operating costs. The negative value of degree of operating leverage (DOL) also attract attention to the sales volume which is below the break-even sales volume which can be interpreted as an unfavorable situation. The degree of operating leverage shows the greatest fluctuation near the break-even point, so this extremely high change in operating results indicates that companies sales is near to the break-even sales, but it doesn't reach it.

In case of companies from the cluster 1. can be seen a high level degree of financial leverage (DFL), which shows considerable variability in the net income. In comparison with other clusters, this group shows the highest value of financial leverage which indicates significant financial risk. It is clear, that the leverage ratio exceeds the upper limit of recommended value 1,33 so 1,5, which means an unfavorable situation. The unfavorable situation is also shown by the interest coverage ratio, which can be calculated as a fraction between earnings before interest and taxes (EBIT) and the financial expenses. The practice shows that the average value of this ratio is between 1,5 and 2,5. However financial institutions expect a higher value to their customers, around 5. The value of 1,95 of the financial leverage is associated with a lower interest coverage rate (2,05), which refers to a limited financial freedom in term of results utilization, so the interest expenses represent a great proportion of the operating result (48,72%). This means that only 51,28% of the results can be used for other purposes. But companies should take into account that in addition of interest expenses, they have also the obligation of loan repayment, what should be covered from the net income. According to the literature, there is direct correlation between the value of degree of financial leverage (DFL) and the level of indebtedness. According to this, the higher foreign capital may lead to financial risk increasing. This rule is clearly true in case of cluster 1., because the level of total indebtedness reached 66,19%. Bigger value of credit means higher value of interest expenses, resulting in lower interest coverage rate, what indicates a lower financial freedom.

The program listed in cluster 3. the companies with extremely high operating leverage, because in this case the ratio exceeds 100 points. The high operating leverage indicate increased variability which could be assessed as a very dangerous situation in term of risk. We can read in the literature that close to the beak-even point, the operating leverage is most sensitive, so the more sales volume exceeds the break-even sales volume, the value of operating leverage decrease. In case of positive result, the considerable variability take an amplified effect on operating profit, but if the conditions take negative turn, the same degree of profit decrease can be achieved. The decision makers should take into account the importance of solving the above mentioned problems in a short time and in appropriate manner, because otherwise the increasing of operational risk even more will result. We can

see in Table 1., that the extremely high operating leverage ratio can be associated with the very low value of return on assets (ROA).
In the cluster 3., were included the firms which score slightly exceed the 1,5 acceptable value of financial leverage (DFL). Although, the value of financial degree is higher than 1,33, I consider that this value can still be considered as acceptable. The obtained value indicates relatively moderate net income sensitivity caused by operating result changes. This level of variability is still acceptable, because it shows an assumable level of financial risk, which can be linked to 'healthy' business growth. It is clear that the companies, which use foreign capital for their activities financing, also have to deal with the financial risk, but companies should be careful in term of mentioned indicator's level. It is essential, that companies take also into consideration the cost of foreign capital, because if it exceeds the return on the assets (ROA) the effect of result multiplication cannot be achieved. It is also important for companies to evaluate the interest coverage ratio and if it is high, an extra borrowing may be allowed. In case of this cluster, value of financial leverage (1,61) can be associated with the average level interest coverage ratio (2,64). This means that the operating result represents the threefold of interest expenses which is admissible. This also means that companies dispose free the 62,11% of operating leverage. This shows an average, acceptable financial freedom in term of result usage. Despite of relatively high indebtedness of enterprises from cluster 3., the degree of financial risk remains at reasonable, bearable level. We can see that in case of this cluster, the foreign capital plays an important role. This is well illustrated by the value of the total indebtedness, which takes the highest value from analyzed clusters.
The cluster 6. contains the major part of enterprises, the 47,40% of the investigated sample. In the case of this cluster, the operating leverage (DOL) is below 1, which means that the leverage effect cannot be interpreted. This is the result of the fact that the change of sales does not cause any change in operating result. If we examine the data, it is clear that in case of this cluster the leverage effect is absent. Similar situation can be seen by the examination of financial leverage (DFL) because this not reach the value 1. This also means that the degree of financial leverage cannot be interpreted. Despite the fact that, we susceptible to characterized the above mentioned situation as a favorable, in fact this shows the absence of amplifier effect. This is basically the consequence of fact that the operating leverage decrease is higher than the net income decrease.
The cluster 11. contains the enterprises with extreme working, because the operating leverage (DOL) exceeds 30 points. The significant value of operating value attract the attention on exceptionally high risk level. This high value also indicates that fix costs of companies aren't on adequate control. The high level of fix operating costs determine a very high operating leverage, reflecting an unfavorable situation. Based on the received value, serious operating fluctuation can be observed as the effect of sales changes. The positive value of operating leverage, shows a very high amplifier effect, which can be interpreted as favorable, but also very dangerous in term of risk. The great value of operating leverage also denotes, that the companies sales volume do not exceed the break-even point sales volume, which can lead to serious functioning problems. Improving present situation is essential in order of better functioning. The high operating leverage can be connected with low assets efficiency, revealed by the return on assets ratio (ROA).

By analyzing the financial leverage (DFL), we can conclude that in case of companies from cluster 11. the results show the absence of amplifier effect, because the value of this indicator is less than 1. It may be noted, that in this cluster, the great part of developments are financed from fix costs, rather than foreign borrowing.
As we can see from Table 1., the degree of combined leverage (DCL) shows extremely low (cluster 1.) and high (cluster 3.) which means that this groups can be considered as outliers on aspect of risk. The cluster 11. which represents the 7,51% of investigated enterprises, also takes high risk level because of great level of operating risk (31,65). The great part of investigated sample is classed in cluster 6. (59,85%). In case of this group the result amplifier effect, the leverage effect can't be interpreted.
We can conclude, that at the big part of investigated companies, the operating leverage (DOL) is the indicator which takes extremely high values (cluster 1., cluster 11.) or very low values (cluster 1.). According to this, a very radical position it draws in term of companies functioning, which can be appreciated as unfavorable situation. In some cases very high, sometimes too low operating leverage values, indicates the deficiencies in term of fixed cost covering. But the problem is that this gap should be covered and the big part of companies resort to borrowing, which may increase considerably the degree of financial leverage (DFL). The high foreign capital costs, which exceed the value of return on assets (ROA) value may have destructive effects on the results. Therefore, the collective and systematic monitoring of both operating and financial leverage can be the key for success, because in this way can be revealed interrelated problems to the decision-makers that otherwise remain hidden. Detection of this can be essential, because it can avoid the less efficient operating, the insolvency, and the more dangerous the companies' bankruptcy.
It were been calculated the following dispersion measures of return on assets (ROA) – financial indicator for each cluster: standard deviation, semi-deviation, mean absolute deviation, and the median absolute deviation. The values of below mentioned measures are presented in Table 2. The reason why I use the return on assets (ROA) is the fact that the risk can be explained as the fluctuations in results.

Table 2. The investigated clusters main dispersion measures in 2012

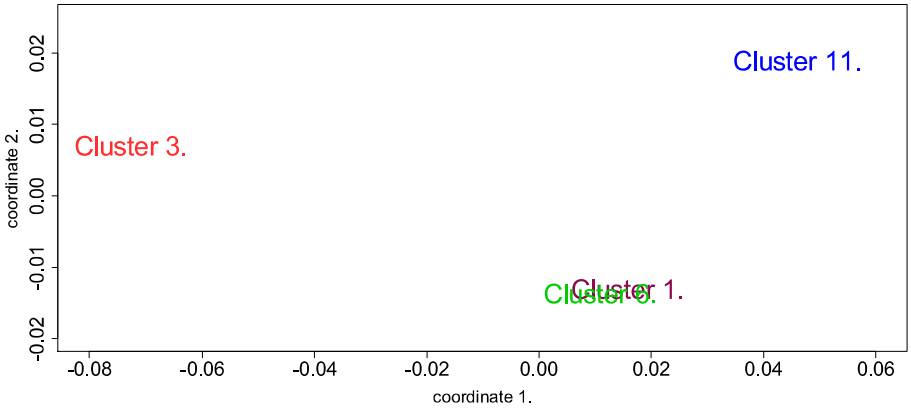
	Cluster 1.	Cluster 3.	Cluster 6.	Cluster 11.
Standard deviation	0,11	0,16	0,11	0,11
Semi-deviation	0,07	0,14	0,07	0,04
Mean absolute deviation	0,07	0,09	0,09	0,06
Median absolute deviation	0,07	0,08	0,07	0,04

Source: Own calculations

As we can see from Table 2., in case of three clusters from the four investigated no significant differences can be observed in term of standard deviation (cluster 1., cluster 6. and cluster 11.). According to this, in 2012, the highest level of risk can be seen in case of enterprises included in cluster 3. It is clear, that the standard deviation is not the most coherent indicator for explaining risk, because it doesn't shows any differences in term of risk in case quite different enterprises groups. If we explain the risk level only with the deviation situated below the mean (semi-deviation) the riskiness of analyzed clusters seems to be different. According to semi-deviation, the enterprises belonging in cluster 1. and cluster 6. are similar in term of risk, while the cluster 11. is least risky. Both standard deviation and semi-deviation class the cluster 3. as the most riskiness. By analyzing of the mean absolute deviation

indicator, we can see the greatest values in case of cluster 3. and cluster 6., which means that these are the most risky. In case of cluster 1. and cluster 11. a lower mean absolute deviation can be observed. According to median absolute deviation similar risk level can be observed at the cluster 1. and cluster 6. The median absolute deviation also characterized the cluster 3. as the most riskiness.
The median absolute deviation is lowest in case of cluster 11., which means that the enterprises from this cluster are the least riskiness. According to the last three investigated dispersion measures, the companies from cluster 11. can be considered the less riskiness. For the better illustration of similarities and differences between each analyzed clusters, I applied multidimensional scaling by below analyzed four dispersion measures. The spatial localization of each investigated clusters, is presented in the following two-dimension coordinate system. For the multidimensional scaling of the objects (clusters) I used as main features the four dispersion indicators.

Graph 1. The result of multidimensional scaling by the four dispersion measures (2012)



Source: Own calculation

As it is shown in Figure 1., the four clusters are located in different points in the two-dimensional coordinate system. The distance between cluster 3. and cluster 11. is larger, because of significant differences between them. At the opposition side, the cluster 1. and cluster 6. are relatively closer, which indicates the similarities between these groups. From the localization of cluster, we can see that the cluster 3. and cluster 11. are characterized by extremely high and low risk, so there is significant difference between them. In contrast with this, are clusters 1. and cluster 6., which represent an intermediate situation regarding risk, because they are located between two extreme positioned clusters. Essentially, we reach similar findings from the above investigated dispersion measures presented in Table 1., but I think that representing clusters in this way ensures much more relevant and transparent view of the main differences and similarities between analyzed objects (clusters).

5. Conclusion

The comparative analysis of corporate risk provides quite different results. The dispersion of investigated enterprises is quite different in case of cluster analysis by dynamic risk indicators and multidimensional scaling by the main dispersion measures. The results of dynamic risk indicators shows that operating risk is which one may be a problem for analyzed enterprises, because the degree of operating leverage (DOL) shows high values. In term of financial risk, the enterprises from cluster 1. and cluster 3. have to be careful in the future. The high values of degree of financial leverage (DFL) at this clusters can be also connected with higher level indebtedness.

According to cluster analysis and the degree of combined leverage (DCL), the firms from cluster 1. (21,39%) and cluster 3. (7,29%) can be considered the extremist on aspect of risk, while the cluster 1. reached the lowest value of DCL, in case of cluster 3. the highest value can be observed. In case of companies from cluster 11. representing 7,51% of investigated sample, the risk is also high as a consequence of great level of operating risk (31,65). The major part of investigated firms were classed in cluster 6. (59,85%) and can be characterized as firms where the result amplifier effect, the leverage effect can't be interpreted.

The multidimensional scaling by main dispersion measures shows another hierarchy of investigated companies. According to this method, the enterprises from cluster 3. and cluster 11. can be considered as extremist in term of risk, because the distance from points representing them are so far from each other. By the results the cluster 3. is the most risky and the cluster 11. can be considered the less risky. The firms from cluster 1., and cluster 6. support an average position and can be considered appropriate in term of risk.

In conclusion, I consider that the results of this research also confirm that researchers have a great task when they choose the best fitting, the most coherent risk quantification measure. As we can seen from results of present research, the dispersion, the hierarchy of companies may be different. I consider that the effectiveness of investigated methods is not questionable, but the choosing between risk measurement methods seems to be a great task for researcher. In my opinion, before we choose the best fitting risk measure, we have to clarify the main aim of research. According to the researchers goals, can be used dynamic risk methods or the main dispersion measures.

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