$$c_{jl} = \frac{\sum_{i=1}^{N} w_{ij} x_{il}}{\sum_{i=1}^{N} w_{ij}} \quad (3)$$

d) The inner stability of the jth group is defined as

$$S^{(j)}(W) = \sum_{i=1}^{N} w_{ij} \sum_{l=1}^{K} (x_{il} - c_{jl})^2 \quad (4)$$

and its total inner group variance as

$$S(W) = \sum_{j=1}^{M} S^{(j)} = \sum_{j=1}^{M} \sum_{i=1}^{N} w_{ij} \sum_{l=1}^{K} (x_{il} - c_{jl})^2 \quad (5)$$

e) The distances between an object and a centroid can be calculated in this case by means of common Euclidean distances

$$D_E(\mathbf{x}_p, \mathbf{x}_q) = \sqrt{\sum_{l=1}^{K} (x_{pl} - x_{ql})^2} = \left\| \mathbf{x}_p - \mathbf{x}_q \right\| \quad (6)$$

f) The aim is to find a matrix $W^* = [w_{*ij}]$ that minimizes the sum of the squares of distances in groups from their centroids (over all M centroids), i.e.

$$S(W^*) = \min_W \{S(W)\} \quad (7)$$

The software MATLAB and its Global Optimization Toolbox are used for the software applications that can be utilized to solve these sorts of problems. The input data are represented by coordinates $x_1, x_2, \ldots, x_K$ that characterize the objects. It is possible to define any number of groups. The fitness function is the sum of squares of distances between the objects and centroids. The coordinates of centroids $c_{j1}, c_{j2}, \ldots, c_{jK}$ ($j = 1, 2, \ldots, M$) are changed. The calculation assigns the objects to their centroids. The whole process is repeated until the condition of optimum (minimum) fitness function is reached. The process of optimization ensures that the defined coordinates $x_{i1}, x_{i2}, \ldots, x_{iK}$ ($i = 1, 2, \ldots, N$) of objects and assigned coordinates $c_{j1}, c_{j2}, \ldots, c_{jK}$ of groups have the minimum distances. The fitness function is expressed by following formula:

$$f_{\min} = \sum_{i=1}^{N} \min_{j\in(1,2,\ldots,M)} \left(\sqrt{\sum_{l=1}^{K} (x_{il} - c_{jl})^2} \right), \quad (8)$$

where N is the number of objects, M the number of groups, and K the dimension. In the course of research, following parameters had been tested: N = 258, M = 3 a successively tested one-, two- and three-dimensional tasks.

The calculation of correlation was executed with help of Pearson correlation coefficient. The hypothesis on linear relationship was verified by a test on 0.05 significance level.

4 Results and discussion

By use of genetic algorithms, clusters of subjects were created according to the results of their financial performance parameters under:

1) EVA (spread RONA – WACC)
2) the results of financial analysis indicators in the form one-, two- and three-dimensional task. The examples in a graphic form are presented at Fig. 3 and 4 (with centroids highlighted).[3]

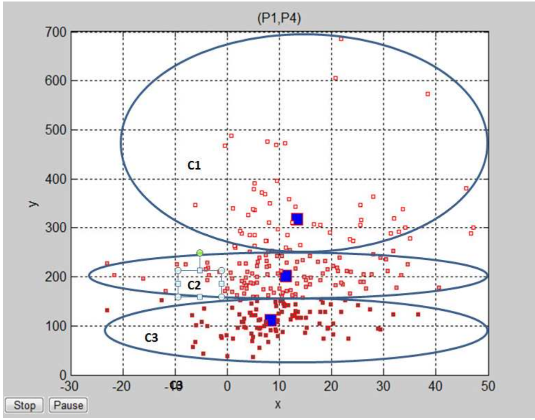

Fig. 3 Example of two-dimensional graph (P1,P4) for three clusters

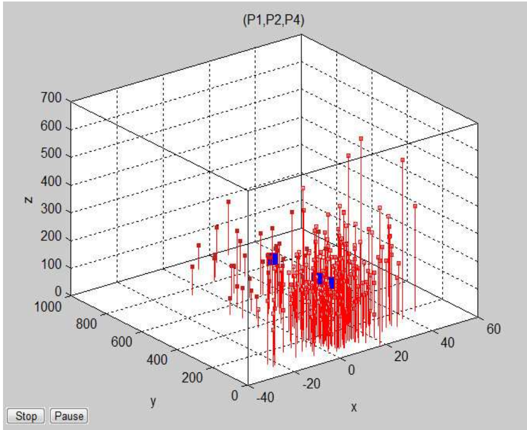

Fig. 4 Example of three-dimensional graph (P1,P2,P4) for three clusters

On the basis of linear relationship testing between EVA and selected financial analysis

[3] The aim of using genetic algorithm is to find a matrix that minimizes the sum of the squares of distances in groups from their centroids.

indicators with use of clustering on the basis of genetic algorithms it is possible to conclude that this relationship is proved on the 0.05 significance level for following parameters:

a) one-dimensional tasks (Table 1):
- return-on-assets (P1)
- assets turnover (P4)

Table 1 Results of testing of linear dependence of P(00) = f(Px)

3 clusters (P00)= f(PX)	Pearson coef.	t	Linearity
P(00) = f (P1)	0,1309	2,1120	Y
P(00) = f (P2)	-0,0761	-1,2211	N
P(00) = f (P3)	0,0811	-1,2211	N
P(00) = f (P4)	0,1678	2,7231	Y

b) two-dimensional tasks (Table 2):
- return-on-assets and current ratio (P1, P2)
- return-on-assets and assets turnover (P1, P4)
- current ratio and assets turnover (P2, P4)

Table 2 Results of testing of linear dependence of P(00) = f(Px,Py)

3 clusters, (P00)= f(PX, PY)	Pearson coef.	t	Linearity
P(00) = f (P1, P2)	-0,1223	-1,9720	Y
P(00) = f (P1, P3)	0,0748	1,2002	N
P(00) = f (P1, P4)	0,1678	2,7231	Y
P(00)A = f (P2, P3)	0,1066	1,7154	N
P(00) = f (P2, P4)	-0,1315	-2,1229	Y
P(00) = f (P3, P4)	0,0521	0,8353	N

c) three-dimensional tasks (Table 3):
- return-on-assets, current ratio and indebtedness (P1, P2, P3)
- return-on-assets, current ratio and assets turnover (P1, P2, P4),
- current ratio, indebtedness and assets turnover (P2, P3, P4).

Table 3 Results of testing of linear dependence of P(00) = f(Px,Py,Pz)

3 clusters, (P00)= f(PX, PY, PZ)	Pearson coef.	t	Linearity
P(00) = f(P1,P2,P3)	0,1651	2,6784	Y
P(00)= f(P1,P2,P4)	-0,1502	-2,4300	Y
P(00) = f(P1,P3,P4)	0,0908	1,4594	N
P(00) = f(P2,P3,P4)	-0,1865	-3,0366	Y

A group of relationships under scrutiny demonstrated the linear relationship and it is possible to utilize these parameters and their combinations for evaluation of performance of the companies. The most frequently represented parameters, which can be used for evaluation of the company performance proved to be return-on-assets (P1) and assets turnover (P4). It is also evident that indicator P3 (indebtedness expressed as equity share on capital) is not in correlation with EVA measured by spread. That is confirmed by a theoretical assumption that low indebtedness increases costs on capital in respect of the higher proportion of more costly shareholders capital and thus reduces the value of the spread. On the other hand, low indebtedness means lower risk and therefore lower value of costs of both loan and shareholders capital (see also [10]). Only in combination of P3 with the groups of indicators P1, P2 and P2, P4 the performance of a company correlation with the spread (EVA) development may be inferred. It is worth attention that the increase in the number of indicators (parameters) of financial analysis in fact does not cause an alteration of amount in dependency of the spread on these parameters.

The results of this research verify the hypothesis that finding indicators and their combinations, which in the framework of cluster groups demonstrate a linear relationship with the complex performance measure - EVA (calculated in a form of spread), is possible. These results may be used mainly when there is no sufficient input information indispensable for EVA calculation available, i.e. mainly by external evaluators (analysts), or eventually in the situation of a lack of will or room for implementation of EVA type of measures into the system of enterprise management. This solution is indeed simplified and substitutive, but it can yield better results than the partial evaluation of particular areas of management with no awareness of the mutual interconnections.

The weak spot of this research is a limited sample of companies under scrutiny, evidential quality and dependability of the reported data (in view of, for example, optimization of taxation).

5 Conclusion

The research dealt with measuring of performance of companies. Some traditional and modern concepts have been discussed and their strengths and weakness have been evaluated. It pointed out the importance in use of complex measures such as for instance the EVA concept; and at the same time it showed that the business practice clearly lingers with popular traditional financial analysis indicators that provide partial evaluation of particular areas of management in the companies. This popularity stems from unsophisticated character of calculations and seemingly simple interpretation of the results. This simplicity in construction has been discussed in the first part of this paper – the results and evaluation of partial indicators are not always clearly connected. The results of this research moreover proved that even in spite of the disadvantageous use of partial indicators, it is possible to use those indicators for measurement of performance of a company and overcome the abovementioned weak spot of the analysis with the use of clustering on the basis of genetic algorithms. Output results then may be used in the business practice of companies in various evaluation processes, notably conducted by external entities. Furthermore, they also may be exploited in the construction of creditworthiness and bankruptcy prediction models.

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