# CLUSTERING OF AGRICULTURAL ENTERPRISES

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## Abstract

BERANOVÁ MICHAELA, BASOVNÍKOVÁ MARCELA, MARTINOVIČOVÁ DANA: *Clustering of agricultural enterprises.* Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 2013, LXI, No. 2, pp. 289–296

Agricultural business is a very specific branch which is characterized by very low financial performance while this characteristic is given mainly by external factors as market pricing of agricultural commodities on one side, and production costs of agricultural commodities on the other side. This way, agricultural enterprises recognize negative values of gross margin in the Profit and Loss Statement but positive value of operating profit after even there are items of costs which are deducted. These results are derived from agricultural production subsidies which are recognized as income in the P/L Statement. In connection with this fact, the government subsidies are a substantial component of financial performance of agricultural enterprises.
Primary research proceeded on the statistical sample of one hundred agricultural companies, has shown that also other specifics influencing financial performance of these businesses exist here. In order to determine the influences, the cluster analysis has been applied at using more than 10 variables. This approach has led to construction of clusters (groups) of agricultural business entities with different characteristics of the group.
The objective of this paper is to identify the main determinants of financial performance of agricultural enterprises and to determine their influences under different economic characteristics of these business entities. For this purpose, the regression analysis has been subsequently applied on the groups of companies coming out from the cluster analysis. Besides the operating profit which is the main driving force of financial performance measured with the economic value added (EVA) in agricultural enterprises, also capital structure and cost of capital have been observed as very strong influences on financial performance but these factors have different directions of their influence on the economic value added under different financial characteristics of agricultural enterprises.

agricultural enterprises, cost of capital, cluster analysis, economic value added, financial performance, regression analysis

Performance of a business entity can be seen from multiple views while different subjects could interpret the performance meaning differently. Also measurement of business entity performance is modified in different ways than. Substantial research question here is how to measure it objectively (Kislingerová, 2009). In general, performance is meant as an entity's ability to achieve some given results, and it is often connected to productivity. There are two basic parameters influencing productivity which are percentage of resource employment and production speed of resource. But productivity of resources is influenced by other interconnected resources as well. Also in this area, agriculture is quite specific branch; e.g. in the context of production speed of a resource, there is no possibility how to influence this factor from the side of agricultural enterprise. From a managerial side, productivity is often connected to decrease in cost while in agriculture, such an approach is quite doubtful (Beranová & Basovníková, 2011).

The first essential of the agricultural enterprises' performance is inequality of realization of costs and revenues. In the agrarian sector, the costs are spent through the whole year but the substantial part of revenues, especially in the vegetable production, is realized after the harvest. Moreover, the selling prices of production are uncertain at the beginning.

On the other hand, the costs are connected to the natural conditions where the probability plays a substantial role as well. It means that financial planning here is possible but with high level of risk in so far (Bečvářová, 2009). The second risk that substantially influences the agricultural business is the agricultural market itself. This market is directed in accordance with the Common Agricultural policy and with the policy of the World Trade Organization. Very specific factor is also the labour market in agriculture which is characterized by seasonality and low mobility of workers in agriculture (Špička, 2009).

## METHODS AND RESOURCES

From the financial point of view, agriculture is a very specific sector of national economy. Financial performance of agricultural enterprises which is given by specifics of doing business in this branch is generally very low. Positive results are achieved only through agricultural subsidies. Than these subsidies are an important element influencing profits of agricultural companies and keeping it above zero. This article concurs to previous work of the authors which deals with components of financial performance of agricultural enterprises (for more see Beranová & Basovníková, 2011).

Objective of this paper is to identify determinants of financial performance of agricultural companies and to define their influences on overall financial performance of agricultural enterprises of different economic characteristics. For this purpose, statistical method of the cluster analysis has been primarily applied. Subsequently, within the clusters found, the multiple regression analysis has been used in order to determine directions of influences on the financial performance of agricultural enterprises. The work is based on the primary research proceeded on the statistical sample of one hundred agricultural enterprises, business companies and cooperatives, farming in the Region of Zlín and the South Moravian Region. Financial performance of these enterprises has been measured with the economic value added (EVA). This financial indicator has been decomposed for its elementary components and significance of influence of each component on the value of EVA has been investigated in every cluster.

### Results of Cluster Analysis Application

Cluster analysis as statistical method has roots in psychology where it has originated in order to determine whether some objects are similar enough to be divided into groups, clusters. Generally accepted objective of the cluster analysis is to find cluster or to define taxonomies (Řezanková *et al.*, 2007). In general terms, cluster analysis works with $N$ statistical objects while $k$ statistical characteristics are observed and measured. Then, clustering methods are based on similarity, respectively non-similarity of these statistical objects, and based on this these objects, data points are divided into clusters which are mutually disjunctive (Meloun & Militký, 2002; Minařík, 1998).

For purposes of this paper, the cluster analysis has been elaborated by using clustering technique which is meant as the most often used in literature (see e.g. Čermáková & Rost, 2009); it is the method of agglomerative hierarchical clustering. In this method, in the first stage of clustering, each statistical object is considered as individual cluster and subsequently, these objects are grouped to superior cluster which are grouped again based on the distance between them while the objects with the smallest distance between are grouped together. After, on the highest level of clustering, all the statistical objects are joined into one cluster. For measurement of the distance between the objects the metric of Euclidian distance has been used; i.e.

$$v_{YZ} = \sqrt{\sum_{i=1}^{k}\left(\left|y_i - z_i\right|\right)^2} \,,$$

where
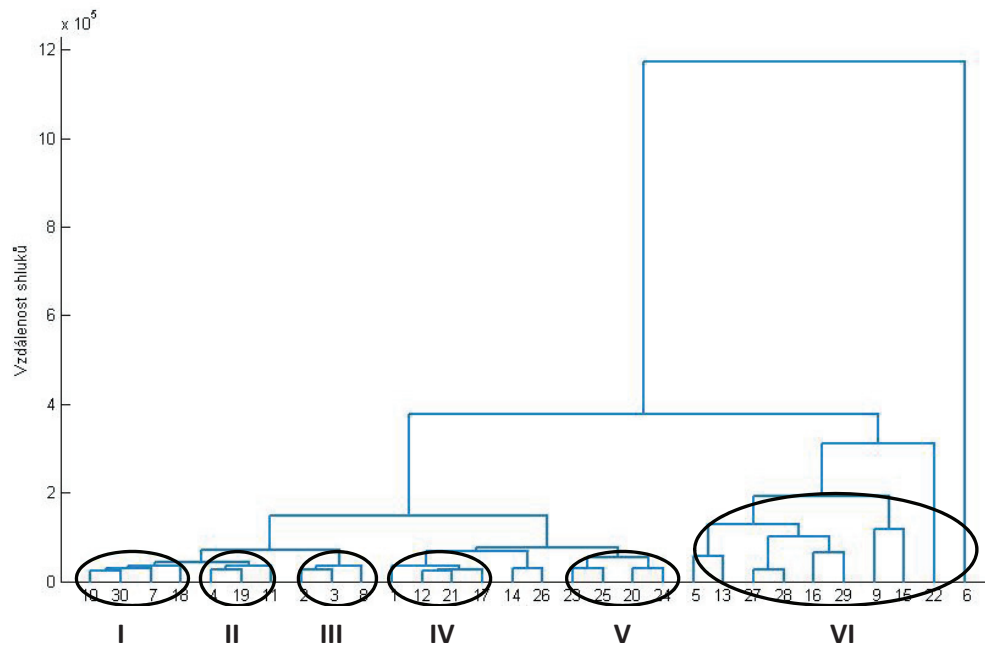$k$ ................ marks the statistical characteristics observed on subjects,
$y_i$ and $z_i$ .... are two k-dimensional data objects (Čermáková & Rost, 2009; Hendl, 2004).

In their previous work (see Beranová & Basovníková, 2011), the authors have identified net operating profit, capital structure of company and cost of equity reflecting summarized financial position and performance of a company, as the significant factors determining the economic value added in agricultural enterprises. By the mean of cluster analysis, influences of these factors have been investigated in detail within the identified clusters. The cluster analysis has been elaborated for nine variables which are as follows:
● Economic value added,
● Net operating profit,
● Size of business entity measured with total assets,
● Share of debts bearing interest in the capital structure,
● Cost of debts,
● Risk premium on the size of company,
● Premium on entrepreneurial risk,
● Premium on risk of financial instability,
● Premium on risk of financial structure.

The above mentioned risk premiums are components of the cost of equity presenting complex view on business performance. Share of equity in the capital structure is a supplement to share of debts then.

Dendrogram which is the outcome of elaborated cluster analysis is presented in Fig. 1. The most of statistical objects, 59 per cent, is distributed within four primary clusters marked with no. 2, 3, 7 and 8 while three of these four clusters are joined to one superior cluster marked as III. Agricultural enterprises in this cluster could

1: *Dendrogram for agricultural enterprises*

I: *Summary of Statistical Characteristics of Objects in the Superior Cluster III*

| Variable | Characteristic | Cluster | | | |
|---|---|---|---|---|---|
| | | 2 | 3 | 8 | III |
| EVA | E(X) | −2 605,26 | −1 888,06 | −969,87 | −1 767,91 |
| | S(X) | 2 382,53 | 2 861,74 | 1 178,36 | 2 353,51 |
| NOPAT | E(X) | 1 934,00 | 1 664,94 | 353,20 | 1 282,44 |
| | S(X) | 1 989,82 | 1 593,86 | 1 312,13 | 1 767,75 |
| Total Assets | E(X) | 54 118,67 | 33 743,19 | 12 484,13 | 32 013,28 |
| | S(X) | 3 868,42 | 6 605,96 | 4 538,48 | 17 266,02 |
| Risk Premium on the Size of Company | E(X) | 0,0500 | 0,0500 | 0,0500 | 0,0500 |
| | S(X) | 0,0000 | 0,0000 | 0,0000 | 0,0000 |
| Premium on Entrepreneurial Risk | E(X) | 0,0459 | 0,0381 | 0,0597 | 0,0478 |
| | S(X) | 0,0301 | 0,0267 | 0,0328 | 0,0313 |
| Premium on Risk of Financial Instability | E(X) | 0,0139 | 0,0222 | 0,0239 | 0,0205 |
| | S(X) | 0,0278 | 0,0380 | 0,0389 | 0,0360 |
| Premium on Risk of Financial Structure | E(X) | 0,0293 | 0,0359 | 0,0324 | 0,0328 |
| | S(X) | 0,0326 | 0,0369 | 0,0370 | 0,0359 |
| Cost of Debts | E(X) | 0,0549 | 0,0666 | 0,0332 | 0,0517 |
| | S(X) | 0,0302 | 0,0470 | 0,0369 | 0,0419 |
| Share of Debts Bearing Interest in the Capital Structure | E(X) | 0,2263 | 0,2383 | 0,3298 | 0,2669 |
| | S(X) | 0,1699 | 0,2042 | 0,3573 | 0,2651 |
| Share of Equity in the Capital Structure | E(X) | 0,7737 | 0,7317 | 0,6702 | 0,7331 |
| | S(X) | 0,1699 | 0,2042 | 0,3573 | 0,2651 |

Source: Authors' elaboration

be generally described under the term "average agricultural enterprise". Statistical characteristics of primary clusters joined in superior cluster III are summarized in the Tab. I.

In the Tab. I, the characteristics of primary clusters accompanying increases in values of the EVA indicator are clearly visible. These effects are as follows:
- Decreasing operating profit,
- Decreasing size of company (decreasing total assets),
- Increasing share of debts in the capital structure.

However, risk premiums which values, risk-free interest rate included, form the cost of equity do not pattern such an explicit trend.

Consequently, the very significant influence of net operating profit has been proved here. Influence of the size of company, respectively of the total assets of agricultural enterprises is of the same significance. As another important cluster, the cluster 7 has been identified. Objects, agricultural enterprises in this cluster are characterized with the mean of EVA of –6 494,36 thousand CZK with the standard deviation of 3 380,40 thousand CZK. Net operating profit is described with the mean of 3 246,36 thousand CZK with the standard deviation of 2 655,54 thousand CZK and average of total assets has the value of 89 086,09 thousand CZK with standard deviation of 6 228,87 thousand CZK. These three characteristics correspond with the three trend mentioned above, nevertheless the share of debts bearing interest in the capital structure develops differently in this case. This variable has the mean of 15,04 per cent only and its standard deviation is 13,64 per cent.

When comparing results in the cluster III with the averages of variables' values in the whole statistical set, the values of EVA are above-average but operating profits are significantly below-average. These objects are below-average again regarding to their size. Total assets do not reach even half value of the average of the whole statistical sample. From the viewpoint of values of the risk premium on the size of company, these enterprises are smaller but unchallenged as of the other risks. Risk premiums are of quite low values when their maximum values of 10 per cent are considered. Averages of risk premiums in the cluster III are around the averages in the whole statistical set.

By use of the multiple regression analysis, effects of single variables on the outcoming economic value added have been investigated in this superior cluster III. Again, the positive effect of debts share and negative effect of equity share in the capital structure has been observed here. The same negative effect on the economic value added has been observed for the total assets in this cluster. Regarding the algebraic signs described before it is necessary to add that determination coefficient of the regression function has the value of 0,6310. Considering the number of variables in this model, this result is quite good.

In subsequent clustering, cluster 7 is classified to the superior cluster marked as I where an important role is played also by the primary cluster 10. Another two clusters here counts only for one object each. Complex numerical description of this superior cluster I is presented in the Tab. II, nevertheless just because of the clusters 18 and 30 consist only of one enterprise each and values of variables here are relatively significant, the overall numerical description of the superior cluster is not provided here because these values would be biased.

As visible from the table above, in this cluster, the patterns described as consequences in the superior

II: *Summary of Statistical Characteristics of Objects in the Superior Cluster I*

| Variable | Characteristic | Cluster | | | |
|---|---|---|---|---|---|
| | | 7 | 3 | 18 | 30 |
| EVA | E(X) | –6 494,36 | 521,48 | –19 400,00 | –12 000,00 |
| | S(X) | 3 380,40 | 2 216,97 | x | x |
| NOPAT | E(X) | 3 246,36 | 6 845,00 | –5 969,00 | 5 126,00 |
| | S(X) | 2 655,54 | 3 751,37 | x | x |
| Total Assets | E(X) | 89 086,09 | 72 162,25 | 80 807,00 | 65 233,00 |
| | S(X) | 6 228,87 | 1 072,12 | x | x |
| Risk Premium on the Size of Company | E(X) | 0,0455 | 0,0500 | 0,0500 | 0,0500 |
| | S(X) | 0,0144 | 0,0000 | x | x |
| Premium on Entrepreneurial Risk | E(X) | 0,0492 | 0,0311 | 0,1000 | 0,1000 |
| | S(X) | 0,0210 | 0,0095 | x | x |
| Premium on Risk of Financial Instability | E(X) | 0,0066 | 0,0293 | 0,0000 | 0,0000 |
| | S(X) | 0,0112 | 0,0407 | x | x |
| Premium on Risk of Financial Structure | E(X) | 0,0167 | 0,0142 | 0,0040 | 0,0214 |
| | S(X) | 0,0234 | 0,0097 | x | x |
| Cost of Debts | E(X) | 0,0668 | 0,1320 | 0,0957 | 0,0570 |
| | S(X) | 0,0544 | 0,1206 | x | x |
| Share of Debts Bearing Interest in the Capital Structure | E(X) | 0,1540 | 0,1840 | 0,0386 | 0,1390 |
| | S(X) | 0,1364 | 0,0557 | x | x |
| Share of Equity in the Capital Structure | E(X) | 0,8460 | 0,8160 | 0,9614 | 0,8610 |
| | S(X) | 0,1364 | 0,0557 | x | x |

Source: Authors' elaboration

cluster III are not observed here nevertheless it is possible to find dependences here. These dependences have been measured by use of the Spearman's rank correlation coefficient while strong statistical interconnection ($r = 0.8$) has been found between values of EVA and values of net operating profit and absolute positive correlation ($r = 1.0$) has been observed between economic value added and share of debts in the capital structure. On contrary to the superior cluster III where absolute negative correlation exists between values of EVA and the size of company, respectively the values of total assets, these variables are independent here ($r = 0.0$).

Values of the EVA indicator in this superior cluster I can be described as below-average while values of net operating profit and of total assets are below-average as well even if these values are significantly higher than those in superior cluster III. As of the risk premiums, substantial differences can be found only in values of risk premiums on financial instability and on financial structure. In the context of these two risk premiums, significantly lower is the share of debts in capital structure but in the contrast to this, their cost of debts are higher that disaccord the theoretical framework interconnection of financial risk of a business entity and interests required by creditors for providing long term debts.

Multiple regression analysis on the superior cluster I has been applied in two variants where clusters 18 and 30 were included and excluded. Results of both have provided the same results as of the algebraic signs of regression coefficients. These signs differ from those resulting from multiple regression elaborated on the superior cluster III. Here the influence of the share of equity in capital structure is positive the regression coefficient has the "plus" sign. But after exclusion of 18 and 30 clusters, the positive effect of equity in capital structure is weaken while the positive effect of company's size is strengthened in this new regression function that has the coefficient of determination with the value of 0,8959.

On the dendrogram presented above (see Fig. 1), beside the superior clusters described in previous, on the right side, there is visible a distinct group of primary clusters marked as IV. From the graphical presentation, based on the length of dendrites it is clear that distances between these primary clusters are rather big, respectively that characteristics of these cluster are rather far from each other. Among others, each of these primary clusters counts only for one statistical object, one agricultural enterprise. The characteristic joining these objects together is the size of company. These agricultural enterprises belong to the group of very big companies, mostly the joint stock companies with total assets exceeding the amount of 300 million CZK while all of them have positive financial results, profits. All of them have also the zero risk premiums for financial instability. But in order to find other shared characteristics, it is necessary to divide these statistical objects at least into two groups; those

which have positive economic value added and those of negative EVA. Companies where negative economic value added was observed, the cost of equity is about 20 per cent where the highest is the risk premium for financial structure, if risk premium on the size of business entity that is around 4.5 per cent is left aside. These companies are also joined with higher rate of debt in capital structure; higher risk premiums for financial instability are resulting from this then. The rate of debts in capital structure goes up to 30 per cent here. Nevertheless, these companies have the lowest cost of debts, only about 5 per cent in average. With regard to existence of two differing groups of agricultural enterprises, it has no logical basis to apply the multiple regression on this superior cluster because prediction ability of resulting regression function would be very low. Irrelevant is also an application of regression analysis on the two sub groups because of the number of statistical objects there; these groups count for five agricultural enterprises each. Nevertheless, also in this case the conclusion is that the cost of debts are not important for the financial performance here neither because it virtually does not correspond with the U-shape curve of the cost of capital.

Agricultural enterprises which are classified into the superior cluster IV rather belong to the category of big companies as well. Amount of their total assets exceeds 130 million CZK, and also amount of their equity exceeds 100 million CZK. Then it is obvious that these agricultural enterprises are funded with debts only in small rate. The rate of debts in the capital structure is only 13 per cent as maximum. But all of them are characterized with negative economic value added on one hand, but on the other side, all of them have positive operating profits and cost of equity about 15 per cent. The multiple regression analysis has been applied on this superior cluster and its results show negative influence of size of company (total assets) and positive influence of debts in capital structure again. But the same positive effect has the rate of equity in capital structure here. Regression coefficients for all the cost of these two capitals are negative.

The last superior cluster that is more distinct here is marked as V. Statistical objects which are classified into primary cluster constituting this superior cluster also belong to the group of big companies. Their total assets are in amounts from the interval from 190 million to 250 million CZK and with the equity exceeding 100 million CZK, these companies are of a "middle" risk, respectively the risk premium does not arrive at the maximum of 5 per cent. What is typical for these agricultural enterprises, these are the financial results; their net operating profits are substantially lower but still positive. In these companies, the costs of equity are relatively on higher level, 18 per cent in average. In comparison with the other agricultural enterprises, these companies have also higher costs of debt which are about 9 per cent in average even if the rate of debts

in capital structure of these companies is only 10 per cent. Application of multiple regression in this superior cluster has led to already more or less standard results when the influence of total assets (size of enterprise) on economic value added is negative as well at the influence of share of equity in the capital structure, in the opposite, employment of debts influences economic value added positively. In this case, the positive influence of net operating profit on EVA is substantially enforced.

The last identified superior cluster is the one marked as II. This cluster consists of 10 statistical object which are commonly characterize only by the risk premium on the size of company because all of them belong to the group of "risky" enterprises; amount of their equity is 50 million CZK in average and this risk premium is on its maximal level of 5 per cent. The total assets or these enterprises are in amounts from 100 million to 115 million of CZK. Indicator of the economic value added divides these enterprises into two groups, those of positive economic value added and those of negative economic value added. At consequent analyses of differences based on the criteria of EVA, the entities with positive values of EVA show four times higher operating profits. Differences are found also in the cost of equity. The cost of equity that is related to the enterprises of positive EVA is about 13 per cent while for negative economic value added agricultural enterprises the cost of equity is even 21 per cent. Application of the multiple regression in this superior cluster has led to the same results as the multiple regression in the superior cluster IV, where regressors have the same algebraic signs which means that also the share of equity in the capital structure has the positive influence on the economic value added.

Regression coefficients of single multiple regressions on each superior cluster are summarized in Tab. III. Coefficient of determination for every regression function that measures the prediction ability of the function is also presented there.

At evaluation the influences of single factors it is necessary to take the algebraic signs of the factors into accounts, not to take their absolute values into account because these are connected to the metric for measurement of the variable. Important conclusions which come out from the summary presented above are joined especially with influence of share of debts in the capital structure which is overall positive regardless an economic situation of a given enterprise. In the opposite, the share of equity in the capital structure has different effect in different enterprises especially because of the methodology of calculation of risk premiums at determining the cost of equity.

The most misrepresenting here is the risk premium on the entrepreneurial risk which is derived from Return on Assets (ROA). The most of analysed agricultural enterprises has the negative ROA even if their operating profit is positive. This way, the risk premium on entrepreneurial risk is overestimated. On the other hand, the enterprises where is the opposite situation are not an exception. With regard to the fact that economic value added would primarily measure the performance level of operating activities, it is not quite suitable to input the whole profit of the year to the complex analysis of company's financial performance.

## CONCLUSION AND DISCUSSION

From the analyses provided above it clearly stands to reason that the substantial factors influencing the economic value added, respectively the financial performance of agricultural enterprises are:
- Net operating profit;
- Share of debts bearing interest in the capital structure.

Significant is also the influence of the cost of equity but this factor is derived from both, from the profit and from the level of employment of debts in the capital structure as well.

Without any doubts, it is just the operating profit that is the most significant influence on the economic value added. But in the agricultural enterprises, the most part of this profit consists of agricultural subsidies. After elimination of these revenues the agricultural business is highly loss-making. The agricultural subsidies are spoken not only as an important source of funding of agricultural enterprises but as there are connected

III: *Summary of Results of Multiple Regression Analyses on Superior Clusters*

| CLU | Description of EVA | Regression Coefficient of the Variable | | | | | | Deter. Coef. |
|---|---|---|---|---|---|---|---|---|
| | | NOPAT | Total Assets | Share of Debts | Cost of Debts | Share of Equity | Cost of Equity | |
| (I) | Average Negative | 0,6374 | −0,2498 | 19 062 | 13 480 | 19 567 | −40 234 | 0,8959 |
| (II) | Above-average | 0,6764 | −0,3789 | 58 725 | −50 698 | 40 066 | −46 775 | 0,9422 |
| (III) | Above-average but Negative | 0,7659 | −0,0675 | 4 407 | −1 673 | −113 | −8 012 | 0,6310 |
| (IV) | Below-average Negative | 0,4937 | −0,1514 | 76 904 | −64 142 | 40 202 | −21 287 | 0,9869 |
| (V) | Highly negative | 1,3667 | −0,0792 | 12 762 | 41 260 | −81 696 | −44 452 | 0,9959 |

Source: Authors' elaboration

with rather high level of uncertainty, these subsidies are also critical source of operating risk in these business entities. In this context, subsidies are currently very important resource of financial performance of the agricultural enterprises. Then, all the recommendations concerning to the management of economic value added should be directed just to the management of operating activities and their results in agricultural enterprises. Nevertheless, cost management and especially the management of revenues in agricultural enterprises are the challenges which are possible to respond only in much limited extent on the company level especially because the agricultural policy applied on country level as well as on the level of the European Union.

## SUMMARY

Agriculture is a specific sector of economy. Its specifics are given by timing of costs spending and revenues realizations, by inability to influence a production speed of resources and level of their utilization, by serious dependence on natural conditions, and also by the consequences of the Common Agricultural Policy. All these factors are projected in the financial performance of agricultural enterprises then.

Objective of this paper is to identify determinants of financial performance of agricultural enterprises and to define their influences on overall financial performance of these business entities of different economic characteristics. For purposes of this paper, the financial performance is taken as the economic value added. Conclusions of the work are made based on the primary research proceeded on the statistical sample of one hundred agricultural enterprises farming in the South Moravian Region and the Region of Zlín. At using nine statistical characteristics, by application of the cluster analysis, these agricultural enterprises have been grouped into 30 clusters and subsequently 6 superior clusters have been identified where the common characteristics were observed. After the method of multiple regression has been applied on each superior cluster; the economic value added was defined as dependent variable and its components have been used as regressors, independent variables.

These overall analyses have marked the net operating profit and the share of debts bearing interest in the capital structure as the most significant influences on the value of EVA while both are positive influences. Significant influence has been observes also regarding to the cost of equity but this is the complex variable consisting of overall financial situation of a company. On the other hand, the very interesting finding is differing influence of the share of equity in the capital structure. But globally the most significant influence on the economic value added has the net operating profit. This variable leads just to the discussions about the agricultural subsidies and the agricultural policy because subsidies are very important part of the operating profit in agricultural enterprises and without them agriculture would be the loss-making business. In this situation, one could made some recommendations for managing costs or revenues in general, but regarding the specifics of agricultural business and agricultural enterprises, these recommendations would be just a blank sheet. In agricultural enterprises, to manage the profit, costs and revenues, is the challenge which is possible to respond only in very limited extent because of the agricultural policies applied.

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