FORECASTING FINANCIAL PERFORMANCE FOR QUARRIES

PŘEDVÍDÁNÍ HOSPODÁŘSKÉHO VÝSLEDKU LOMŮ

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Abstract

The paper highlights the importance of successful financial performance for companies, and provides for a brief review of foreign expert opinions on the most important factors that influence the financial performance of enterprises. Linear and quadratic discriminate analyses and a logistic regression analysis were applied to a sample file of 233 annual data from 3 countries (Czech Republic, Slovak Republic, Ukraine) for a period of 2008-2012 concerning quarries extracting building materials. These methods provided for distributing the sample file quarries into two classes of profitable and loss-making enterprises. Their financial performance had been known, which enabled to assess the classification accuracy of individual method applications. The average classification accuracy was about 86% and there were no significant differences in the specific method applications. The linear discriminate analysis calculations are the simplest ones in comparison with two other applied methods. The linear discriminate analysis also made possible to identify the most influential discriminators that contributed to the classification into the specific groups. In case of our investigation, prices per production unit, direct variable costs, and ratio of fixed costs to total costs were the most important factors of influence. The factors, if analysed, can provide for prediction of financial performance of quarries in future.

Abstrakt

Článek zdůrazňuje význam kladného hospodářského výsledku pro podnik a přináší stručný přehled názorů zahraničních autorů týkajících se faktorů, které hospodářský výsledek nejvýrazněji ovlivňují. Na souboru 233 ročních údajů z 3 států (Česká republika, Slovenská republika, Ukrajina) za období 2008-2012 spojených s lomy těžícími stavební suroviny byla aplikována lineární a kvadratická diskriminační analýza a logistická regresní analýza. Tyto vytvořily skupinu ziskových a ztrátových lomů. Jejich hospodářský výsledek byl znám, proto bylo možno určit míru úspěšné klasifikace jako podíl správně zatříděných lomů k počtu lomů ve skupině. Průměrná úspěšnost zatřídění se pohybovala kolem 86 % a mezi jednotlivými metodami se výrazně nelišila. Lineární diskriminační analýza umožnila určit, které diskriminátory nejvýrazněji přispěly k zatřídění do skupiny. V našem případě to byla cena produkce, jednicové variabilní náklady a podíl fixních nákladů na celkových nákladech. Lze se domnívat, že na základě analýzy těchto ukazatelů lze předvídat budoucí hospodářský výsledek lomů.

Key words: quarries, financial performance, discriminate analysis, logistic regression analysis

1 INTRODUCTION

The income from operations implies an aggregate statement on the operations' financial success. The information on the profit made is essential for both company's owners and their shareholders as it mirrors managerial success and provides for a positive public and entrepreneurial image of the company. Profitable companies are trustworthy commercial partners. On the contrary, operations of companies being in the red are grounds for serious concerns about abilities of honouring their commitments. The trading income represents an accountancy category. From the point of view of company's financial management, it is the cash flow that plays a major role. Nonetheless, the after-tax profit is a substantial cash flow constituent. Apropos of this, a question can be asked, namely why several comparable enterprises of the same industry branch operate successfully while the others fail.

Generally speaking, profit is influenced by many factors: natural factors (e.g. quality of soil for agriculture, geological conditions for mining industry); technological factors (e.g. specific technology and equipment for production); human factors (e.g. skills of employees, strategies of business management); external factors (e.g. demand in national economy).

The natural factors are important as they are given by natural conditions that are difficult to change. They are subject of specific interest, especially in agriculture: natural factors are considered as decisive factors of agriculture efficiency, natural circumstances have an important influence concerning harvest failures, and natural factors are considered primary causes of conifer forest decreases, oyster population development or soil productivity [1]. In other national industry branches, only some attention is paid to natural factors – e.g. the situation of Chile mining industry [1].

It is obvious that some corporate prosperity factors can be influenced by style of management, while other factors of profitability are beyond managerial control. As such, the identification and analysis of major prosperity factors is of vital importance for corporate governance practice and its success.

2 FACTORS AFFECTING FINANCIAL PERFORMANCE

In general, the trading income is the remainder of subtracting expenses from earnings. Prima facie, the volume of product sales and average selling prices are of decisive importance. In principal, the average selling price is a weighted arithmetic average of individual assortment volumes and their selling prices. The total costs (expenses) can be expressed as a product of sale volumes and unit costs. The latter can be specified as an aggregate of unit variable costs and the ratio calculated by dividing total fixed costs by sale volumes. This first level analysis provides for a hypothesis of predicting loss of an enterprise:

- Small sale volumes (imply decreased total earnings and increased ratios of fixed costs to production units),
- Low selling prices (imply low total earnings),
- High unit variable costs,
- High total fixed costs.

The question is: What are actual causes of these factors?

Low figures of total sales income and low selling prices may reflect low demand or economic depression. A high unit variable cost or total fixed costs rather result from the economic management of specific production units. Low sales can be taken as representing one of the most important default predicting factors. On the one hand, low sales reduce earnings, on the other hand, they cause a relatively high share of fixed costs per production unit which also implies a high total cost per production unit.

Nonetheless, this is rather a speculative reasoning as the considerations are based on algorithms of financial accounting without any support of exact science or methodical investigation. Several investigation results have been published and should be analysed accordingly. In view of the importance of the profitability factor for the assessment of specific business entrepreneurial success, it is rather obvious that both theoreticians of economy and its practitioners have focused on the items that might influence this decisive factor of profitability. Both the theory and practice try to specify circumstances that are of crucial importance for financial achievement. A priori, it is possible to assume that there will be as many voices as views on the matter, as the profit is a many-faceted indicator. Relatively high differences can be expected as regards various industries (agricultural profit will be surely influenced by weather in contrast to that of machine industry), and various national economies (varying degree of development, various state subsidies, etc.).

Various authors differ in the level of their specialisation (an independent company [2, 3, 4, 5, 6, 11], company in the framework of national economy [7, 9], company in the framework of world economy [8, 10]), in the quality of input information at their disposal, and in the methods applied for their investigation.

Let us confine ourselves on looking at industrial enterprises only. Here, the profit influencing factors can be listed (without being comprehensive but available for us) as follows:

Company level: For example, if oil industry is taken into account, capacity utilization, losses of scheduled or unforeseen interruption of production, and investment costs are usually highlighted [2]. Caan [3] considers sales volumes, expenses, and labour productivity to be factors of the profit influence. For the situation in Romania, stocks utilization, company indebtedness, financial lever, capital turnover, operational costs [4] or earnings and production volume [5] are profit influencing factors. For the companies operating in the Philippines, the profitability is conditioned by product prices, production volume, unit variable costs and fixed costs [6].

Company level with external condition acceptance**:** Hultgren and Pech [7] start with economic cycles that influence sales volumes, product prices, and unit costs of specific companies. In UK, the external factors of profitability are those of economic cycles, level of demand, competitive tension, and substitute product price. Among items of entrepreneurial financial success in UK, also cost development, fixed cost levels, efficiency of advertising campaigns, possibilities of price discrimination (different prices for different customers) can be found [8].

For US circumstances, sales influencing external (economy status, market stability, weather), and internal (marketing, production prices, payment conditions for customers) factors are listed. Apart from company sales, also input costs, labour costs, and accountancy methods (clearance of stocks consumption) [9] are referred to. In the German economic situation, the contributions are based on international economic and competition factors. At a level of individual companies, the profit is considered to be primarily depending on production prices [10]. The industries depending on natural conditions constitute an issue per se. Also mining industries can be subsumed under this heading. The Chile mining company operations can serve as an example where natural conditions of accessibility, quality, ore metal content, and geographical location play major roles [11].

The above given specifications support the assumed diversity of the approaches and results implied in the references quoted. It is obvious that performance of individual organisations depends on external conditions like world economy cycle, national economy, or tenseness of competition [10]. Nonetheless, executives can hardly influence the external conditions of entrepreneurial success. In this context, it is rather more fruitful to focus attention on the internal factors of the organisation successful functioning [2, 3, 4, 6, 7]. Relations among and between the internal factors are complex and several of them are of mutual correlation like the productivity of labour and production costs [3].

As such, it can be stated:

- Conclusions are too general and could be an a priori assumption (for example total costs),
- Conclusions are often based on empirical experience or result from questionnaire inquires. The only exception to the rule is the work, [4],
- Usually profit influencing factors are listed without hierarchical order of influence gravity. The only exception is the already mentioned reference, [4], under Romanian circumstances.

As such, it is possible to set objectives of the project assumed contribution:

- Application of several methods, inclusive their efficiency assessment as regards input information on the subject,
- Highlighting the factors that decisively influence profitability of company operations.

The positive knowledge of some enterprise parameters can provide for predicting the enterprise's success or failure. This knowledge is important for the enterprise commercial partners, as well as financial institutions and general public. It is obvious that the results depend on the quality, quantity, and structure of input information available for investigation.

3 ANALYSIS OF FACTORS AFFECTING FINANCIAL PERFORMANCE

The issue of profit influencing factor assortment and their hierarchy has been investigated in the framework of quarry extraction of building materials. The reason for choosing this industry for purposes of our investigation was in easiness of comparing individual items (quarries) as regards technologies, information availability, and economic cycle dependence. The quarries deliver minerals to building industries that are highly sensitive to current economic situation conditions and their imminent developments. An economic recession results in an immediate reduction of state and company budgets and investments oriented by building projects. Building industries are always the first victims of economic disturbances. The period of our investigation was 2008-2012, which was stigmatized by both European and world economy problems.

The input data file consisted of quarries owned by an international company with its headquarters in Europe. The file contained quarries operating in the Czech Republic, Slovak Republic, and Ukraine. Each quarry is accounted for as an individual unit with its own bookkeeping and statistical evidence. All quarries' financial management is conducted by the same cost accountancy method. The financial data are presented per annum. The European Currency Unit, €, is chosen as the monetary. This provides for an easy comparison to be made with no regard to the country, where the individual quarries operate. The information is classified and company name and localities of individual quarry operations cannot be specified in this paper. The reason is that the information is of a confidential character.

The input file comprised 223 quarries from 3 countries, of which 114 were financially successful and 109 operated in the red. These countries involved the Czech Republic with 96 profitable quarries and 75 unprofitable ones, the Slovak Republic with 18 successful quarries and 28 quarries operated in the red, and Ukraine with 6 unsuccessful quarries. The success means operational profit per annum or vice versa.

Each quarry has been characterized by annual production volume in tons, and by other 8 parameters deducted from bookkeeping documents of individual quarries. A priori, these parameters imply factors that can influence financial profitability of individual quarry operations. They were figured up as ratios for reasons of possible comparability of quarries of different size. Because of the method of discriminate analysis used for the investigation, 9 of the parameters are called discriminators. Among these are:
$x_1 =$ sales per production unit; $x_2 =$ total production sales/total gross revenue; $x_3 =$ variable costs per 1 ton of product; $x_4 =$ fixed costs per 1 ton of product; $x_5 =$ total fixed costs/total costs; $x_6 =$ total sub-deliveries/total variable costs; $x_7 =$ total machinery equipment costs/total fixed costs; $x_8 =$ total wage fixed constituent/total fixed costs; $x_9 =$ total annual production in tons.

These nine discriminators suggest:

x_1 **Average price per one ton of aggregate**;

x_2 **Revenue structure**, as gross income, apart from aggregate sales also contains earnings by transportation services for customers, sales of one's own oil, earnings from leasing of land, offices, machinery equipment. The price of aggregates also covers costs of transport to customers if the latter cannot realize the commodity transport by their own means. For reasons of easy comparability, the transportation costs are subtracted, which means that very often gross income figure is smaller than that of commodity sales;

x_3 **Quarry production technological and organisational levels**;

x_4 **Fixed costs dissolution;**

x_5 **Structure of costs**;

x_6 **Technological facilities and equipment and their exploitation.** Drilling and blasting costs are accounted for individually;

x_7 **Ratio of depreciations to fixed costs**;

x_8 **Ratio of fixed wages cost constituent to total fixed costs**;

x_9 **Quarry production capacity and its exploitation**.

The Tab. 1 gives discriminator averages for profitable and unprofitable quarries, inclusive standard deviations.

Tab. 1 Discriminator comparison for profitable and loss making quarries

Discriminator	Average		Standard deviation	
	Profitable	Unprofitable	Profitable	Unprofitable
Sales per production unit	6.655	5.715	1.444	2.033
Total production sales/total gross revenue	1.070	1.048	0.112	0.594
Variable costs per 1 ton of product	2.774	3.266	1.722	1.172
Fixed costs per 1 ton of product	2.480	3.745	1.130	2.939
Total fixed costs/total costs	0.361	0.504	0.982	0.154
Total sub-deliveries/total variable costs	0.271	0.358	0.224	0.482
Total machinery equipment costs/total fixed costs	0.336	0.261	0.165	0.168
Total wage fixed constituent/total fixed costs	0.236	0.170	0.104	0.384
Total annual production in tons	255 365.500	117 627.853	276 471.110	91 390.890

The outliers of the input sample file of profitable and loss-making quarries were removed. The modification was oriented by the standard normal distribution. Concerning the quarries of our study, the outlier observation distances were mainly the result of accounting inconsistences and errors or they were implications of constrained operations or stoppages resulting from technical problems or caused by insufficient customer demand.

The outliers were identified by two methods [12]:

- Univariate method: Discriminator outliers are identified by so called inner fencing;
- Multivariate method: Discriminator outliers are identified by the Mahalanobis distance from a data mean value.

Outlier identification by inner fencing
Each discriminator value is considered to be an outlier if it lies outside the interval

$$\left(B_D^*; B_H^*\right),$$

$$B_D^* = \tilde{x}_{25} - K\left(\tilde{x}_{75} - \tilde{x}_{25}\right), \quad (1)$$

$$B_H^* = \tilde{x}_{75} - K\left(\tilde{x}_{75} - \tilde{x}_{25}\right), \quad (2)$$

$$K = 2{,}25 - \frac{3{,}6}{n}, \quad (3)$$

where:

n – sample size,

$\tilde{x}_{25}$ – lower quartile [€/t, €/1€ or tons/year],

$\tilde{x}_{75}$ – upper quartile [€/t, €/1€ or tons/year].

The quarries whose one or more discriminators had been identified as outliers, were excluded from further investigation. Thus, the original sample file of 114 profitable and 109 loss-making quarries was reduced to 93 profitable and 88 loss-making enterprises.

Outlier identification by Mahalanobis distance

All multi-dimensional data are taken as outliers if

$$d_i^2 = \left(\boldsymbol{x}_i - \bar{\boldsymbol{x}}\right)^T \boldsymbol{S}^{-1}\left(\boldsymbol{x}_j - \bar{\boldsymbol{x}}\right) > \chi^2_{1-\frac{\alpha}{2}}(m) \quad (4)$$

where:

$\mathbf{x}_j$ – discriminator vector of individual quarries $\left(j = 1,\ldots,n\right)$,

$\bar{\mathbf{x}}$ – vector of sample averages of individual discriminators,

$\mathbf{S}^{-1}$ – inversion matrix to co-variance matrix,

$\chi^2_{1-\frac{\alpha}{2}}(m)$ –quantile, χ^2 distribution of freedom degree, m ,

m – number of discriminators,

α – significance level,

n – number of individual class quarries.

The Mahalanobis distance specification provides for exclusion of outliers as regards both classes of profit and loss making quarries.

As such, the original sample of 114 profitable and 109 loss-making quarries was reduced to 109 profitable and 98 loss-making enterprises.

4 ANALYSIS RESULTS AND DISCUSSION

The method of the discriminate analysis has provided for classifying quarries as profitable or loss-making businesses. This method enables evaluation of differences between two or multi-part groups of objects that are characterized by a number of variables (discriminators). Such evaluation provides for distribution of objects (quarries of our investigation) into classes. There are two forms of the discriminant analysis–linear and quadratic [13].The linear discriminant analysis is of advantage if the variables of the two classes are of multi-size normal distributions that differ from each other only in mean values. In practical terms, it is rather difficult to satisfy conditions of multi-size normality, and it is assumed that the models are robust enough to give acceptable approximations even without fulfilling the multi-size normality conditions. The application of the discriminant analysis quadratic form is necessary if there are major differences between the covariance matrixes of classes. If the conditions of multi-size normality cannot be fulfilled, an alternative method of classification by logistic regression can be employed [12]. The discriminant analysis method was applied by some members of the research team also in the past [14].

Linear discrimination application for 2 classes

The point of departure is in the knowledge of input matrixes $\boldsymbol{X}_1 = (\boldsymbol{x}_{11} \quad \boldsymbol{x}_{12} \cdots \boldsymbol{x}_{1m})$ of size $n_1 \times m$, for the first class of profitable quarries, and $\boldsymbol{X}_2 = (\boldsymbol{x}_{21} \quad \boldsymbol{x}_{22} \cdots \boldsymbol{x}_{2m})$ of size $n_2 \times m$, for the second class of loss making quarries,

where:

$\boldsymbol{x}_{1j}$ – n_1 – size vectors making for columns of the matrix, $\boldsymbol{X}_1$,

$\boldsymbol{x}_{2j}$ – n_2 – size vectors making for columns of the matrix X_2 ($j = 1,\ldots,m$).

Each line of the matrix, $\boldsymbol{X}_1$, consists of discriminators of profitable quarries; each line of the matrix, $\boldsymbol{X}_2$, consists of discriminators of loss making quarries. Each column of the matrix, $\boldsymbol{X}_1$, consists of discriminators of all profitable quarries; each column of the matrix, $\boldsymbol{X}_2$, consists of discriminators of all loss making quarries.

The linear function coefficients, $L(\boldsymbol{x}) = \boldsymbol{a}^T \boldsymbol{x}$, can be estimated from

$$\hat{\boldsymbol{a}} = (\bar{\boldsymbol{x}}_1 - \bar{\boldsymbol{x}}_2)\, \boldsymbol{S}^{-1}, \tag{5}$$

where:

$\bar{\boldsymbol{x}}_1$, $\bar{\boldsymbol{x}}_2$ – sample averages of profitable or loss making quarries,

$\boldsymbol{S}^{-1}$ – inversion matrix to the common covariance matrix, $\boldsymbol{S} = \dfrac{(n_1 - 1)\boldsymbol{S}_1 + (n_2 - 1)\boldsymbol{S}_2}{n_1 + n_2 - 2}$,

$\boldsymbol{S}_1$, $\boldsymbol{S}_2$ – sample covariance matrix for profitable or loss making quarries.

Furthermore, an invariable needs to be calculated:

$$\hat{b} = -\frac{1}{2}\hat{\boldsymbol{a}}^T (\bar{\boldsymbol{x}}_1 + \bar{\boldsymbol{x}}_2)\,. \tag{6}$$

Whether a quarry, which has been characterized by discriminators, $\boldsymbol{x}_0$, is classified profitable or loss making, this is decided by the inequality

$$\hat{\boldsymbol{a}}^T \boldsymbol{x}_0 + \hat{b} > 0 \tag{7}$$

or $$\hat{\boldsymbol{a}}^T \boldsymbol{x}_0 + \hat{b} \le 0 \text{, respectively.} \tag{8}$$

Quadratic discrimination application for 2 classes

The quadratic discriminant function can be expressed as

$$Q(\boldsymbol{x}) = \boldsymbol{x}^T \boldsymbol{G}\boldsymbol{x} + \boldsymbol{h}^T \boldsymbol{x} + C\,, \tag{9}$$

$$\boldsymbol{G} = \frac{1}{2}\left(\boldsymbol{S}_2^{-1} - \boldsymbol{S}_1^{-1}\right), \tag{10}$$

$$\boldsymbol{h}^T = \bar{\boldsymbol{x}}_1 \boldsymbol{S}_1^{-1} - \bar{\boldsymbol{x}}_2 \boldsymbol{S}_2^{-1} \tag{11}$$

$$C = 0{,}5 \ln\frac{|\boldsymbol{S}_2|}{|\boldsymbol{S}_1|} - 0{,}5\left(\bar{\boldsymbol{x}}_1^T \boldsymbol{S}_1^{-1} \bar{\boldsymbol{x}}_1 - \bar{\boldsymbol{x}}_2^T \boldsymbol{S}_2^{-1} \bar{\boldsymbol{x}}_2\right), \tag{12}$$

where:

$\boldsymbol{S}_1^{-1}$, $\boldsymbol{S}_2^{-1}$ – inverse matrixes for sample covariance matrixes, $\boldsymbol{S}_1$ and $\boldsymbol{S}_2$.

If a quarry of the discriminator value, $\boldsymbol{x}_0$, is classified, and if a quadratic inequality,

$$\boldsymbol{x}_0^T \boldsymbol{G}\boldsymbol{x}_0 + \boldsymbol{h}^T \boldsymbol{x}_0 + \boldsymbol{C} > 0 \text{, is valid,} \tag{13}$$

then the quarry is classified as profitable.

If an inverse inequality,

$$x_0^T G x_0 + h^T x_0 + C \le 0 \text{ , is valid,} \qquad (14)$$

then the quarry is classified as loss making.

Logistic regression

The method of logistic regression differs from the discriminate analysis in that it predicts probability of classification in relevant groups. It uses logit transformation that leads to a sigmoidal relation between the dependant variable and the vector of independent variables – discriminators.

The linear and quadratic discriminant and logistic regression functions were calculated for the sample file of profitable and loss-making quarries characterized by 9 discriminators. The function calculations were made for the original files, and those reduced by inner fencing or Mahalanobis distance methods. The functions enabled classification of quarries into two classes of profit and loss making enterprises. As their financial performance had been known, it was possible to figure out the classification success ratios of correctly classified – profitable or loss-making – quarries to the total numbers of the quarries investigated. Tab. 2, 3, and 4 give the results.

Tab. 2 Linear discriminant analysis

	Classification accuracy [%]		
	Profitable quarries	Unprofitable quarries	Quarries total
Original sample file	85.09	83.49	84.30
Sample reduced by inner fencing	92.86	78.49	85.86
Sample reduced by Mahalanobis distance	92.66	79.81	86.38

Tab. 3 Quadratic discriminant analysis

	Classification accuracy [%]		
	Profitable quarries	Unprofitable quarries	Quarries total
Original sample file	91.23	82.57	87.00
Sample reduced by inner fencing	91.84	80.65	86.39
Sample reduced by Mahalanobis distance	88.99	80.77	84.98

Tab. 4 Logistic regression analysis

	Classification accuracy [%]		
	Profitable quarries	Unprofitable quarries	Quarries total
Original sample file	91.23	81.65	86.55
Sample reduced by inner fencing	86.73	86.02	86.39
Sample reduced by Mahalanobis distance	89.91	84.62	87.32

In terms of the discriminate analysis, the calculation practice was facilitated by the Microsoft Excel. The discriminant function calculations and their subsequent assessments were more difficult as regarded the quadratic discrimination. The creation of the linear discriminant function asks for the calculation of 9 coefficients, whereas the creation of the quadratic discrimination function requires 53 of them. In a view of the similar discrimination accuracy of both functions, it can be preferred to use the linear model. Also the possibility of interpreting the linear discriminate function coefficients testifies in favour of the latter. The logistic regression calculations would be possible without any special software.

The results make it obvious that classification success differences of individual method applications are minimal. The linear discriminant analysis calculations are the most easily made. Apart from this advantage, this analytical method enables assessment of individual variables (discriminators) as regards their hierarchy, i.e. how important they are for classifying objects into specific groups. 'The discriminator relative impact can be assessed by standardized discriminant coefficients. The latter can be calculated if the discriminant function coefficients are multiplied by relevant standard deviations. The discriminators of relatively high coefficients are of greater impact on distributing object into specific classes.'[12]

If we focus on the linear discriminate analysis results for the sample of the highest classification success, i.e. the sample classified by the Mahalanobis distance, the biggest values of the standardized discriminant coefficients are those of the following discriminators: product sales (prices), variable costs per one ton of product, and fixed costs/total costs. As such, it is possible to assume that these factors decide about final financial success of the quarry enterprise. It is obvious that these variables are influenced by external conditions (economic cycle, market competition) as well as the quality of management. Nevertheless, the external factors were not part of this project analysis. The international corporation, which operates quarries in different European countries, is profit oriented without paying heed to local country conditions that are considered as out of their control. The results prove the fact that it is the production price factor that is of major importance for the unified management of individual quarries. Production prices are implications of the local geology condition and they can only be influenced to only a certain degree (for example by assortment variations) by a managerial action. Nonetheless, specific quarries can exercise influence on the proportion of fixed to overall costs, utilising their specific quarry production capacity. It can be assumed that a major option for profit oriented managerial action is offered by control of variable costs.

5 CONCLUSION

The quarries of known financial performance were classified into profitable and loss-making groups by means of the linear and quadratic discriminate analyses as well as the logistic regression analysis. Based on 9 variables (discriminants), the classification success rate of averages was in an interval from 85.69% (linear discriminate analysis) through 86.12% (quadratic discriminate analysis) to 86.75% (logistic regression analysis). It is obvious that the results do not differ much. If the simplest linear discriminate analysis is applied, variables (discriminants) can be specified that are of the greatest impact on the final classification. These were prices per production unit, direct variable costs, and ratio of fixed costs to total costs. It can be assumed that the analyses performed can provide for predicting future financial performance of quarries.

As a result, the linear discriminate analysis can be recommended as a classification tool for industrial enterprises. The method can be used in industry as a general method. Our results can be useful especially in open cast mining.

Quarrying is connected with strong environmental impacts – land disturbance, noise, dust, entry limitation. Local communities are involved in the process of obtaining mining rights and they do not agree. The acquisition of mining rights is difficult due to the local community opposition. It is less difficult for large mining organisations to purchase quarries from private owners who acquired them in the process of privatisation or restitution in the nineties of the past century. Big companies are primarily interested in assets with good prospects. The knowledge of major factors of organisation financial success facilitates decisions on the acquisition of new mining capacities.

It is necessary to note that our input variables were aggregated. Further investigation could be performed taking into account a greater number of parameters, which might serve the purpose of better practical applicability of results.

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RESUMÉ

Hospodářský výsledek patří mezi nejdůležitější informace pro majitele firmy a akcionáře, protože zisk ukazuje na úspěšné řízení firmy a její pozitivní image pro veřejnost a podnikatelské prostředí. V této souvislosti vzniká otázka, proč v určitém výrobním oboru dosahují podobné podniky zisk a jiné utrpí ztrátu. Vzhledem k významu ukazatele zisku pro hodnocení podniku není překvapující, že faktory ovlivňující zisk podniku přitáhly pozornost příslušníků teoretické fronty i manažerů v podnicích. Obě skupiny se pokoušejí najít faktory mající vliv na dosažený výsledek hospodaření, resp. určit, které faktory mají dominantní vliv.

Problém výběru faktorů nejvýrazněji ovlivňujících hospodářský výsledek jsme řešili v podmínkách lomového dobývání stavebních surovin. Výchozí soubor zahrnoval 233 lomů ve 3 státech, z nichž 114 bylo ziskových a 109 ztrátových. Každý lom byl charakterizován velikostí roční produkce v tunách a dalšími 8 ukazateli určenými z účetnictví jednotlivých lomů. Tyto ukazatele a priori vycházely z faktorů, které mohou ovlivňovat hospodářský výsledek lomu. Byly vypočteny jako relativní hodnoty z důvodu srovnatelnosti bez ohledu na velikost lomu. Výchozí soubor ziskových a ztrátových lomů byl očištěn o vybočující hodnoty. Cílem úprav bylo přiblížení dat normálnímu rozdělení.

Na roztřídění lomů do skupiny ziskových a ztrátových jednotek lze použít metodu diskriminační analýzy. Tato metoda umožňuje hodnotit rozdíly mezi dvěma nebo více skupinami objektů, které jsou charakterizovány určitým počtem znaků (diskriminátorů). Na základě tohoto hodnocení pak lze zkoumané objekty (v našem případě lomy) klasifikovat do tříd. Na základě 9 diskriminátorů pro soubor ziskových a ztrátových lomů byla vypočtena lineární diskriminační funkce, kvadratická diskriminační funkce a logistická regresní funkce. Pomocí těchto funkcí byly soubory rozděleny na ziskové a ztrátové lomy. Protože jejich hospodářský výsledek byl znám, bylo možné vypočíst úspěšnost klasifikace jako poměr správně zatříděných lomů do ziskové nebo ztrátové skupiny a celkového počtu lomů ve skupině.

Použijeme-li výsledky lineární diskriminační analýzy u souboru s největší úspěšností zatřídění, jsou nejvyšší hodnoty standardizovaných diskriminačních koeficientů u následujících diskriminátorů: *tržby za jednicové produkty (ceny)*, *variabilní náklady na 1 tunu produkce* a *fixní náklady/náklady celkem*. Lze se tedy domnívat, že se jedná o faktory nejvýrazněji ovlivňující dosažený hospodářský výsledek, na základě analýzy těchto ukazatelů lze předvídat budoucí hospodářský výsledek lomů. Je zřejmé, že tyto proměnné jsou ovlivněny vnějšími podmínkami (stav hospodářského cyklu, konkurence na trhu) i úrovní řízení. Faktory vnějších podmínek však do analýzy nebyly zahrnuty.