

# THE STRICTNESS OF TRADITIONAL INDICATORS FOR CREDITWORTHINESS MEASURING

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## Abstract

Creditworthy indicators are used as a tool for a rapid diagnosis of the financial health of a company. The classic models are the Q-test, the Credibility index and Rudolf Doucha's Balance analysis, all of which were created decades ago. Despite this, they are still popular. These three indicators are among the most frequently used in scientific publications.

The author asked a number of questions related to their practical use. Despite their age they have not yet been answered. For instance, do they still serve the purpose for which they were created? Does the assessment of financial health return the same results using these various indicators? Can individual indicators bring contradictory results describing the financial health of analyzed companies? Which is the best indicator describing companies' economic condition? To answer these questions a set of nearly 1500 companies was analyzed.

A key research finding is that the Credibility Index is the most accurate model for predicting creditworthiness and the accuracy of individual models varies. The results of the Q-test and the Balance Analysis I. using the Credibility Index can be very accurately predicted only on the basis of conditioned probability.

**Key words:** financial health, indicators, Q-test, Credibility Index, Balance analysis

**JEL Code:** G32, M10, C38

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## Introduction

Financial prediction models<sup>1</sup> (FPM) are used as a standard for the diagnosis and prediction of the financial situation of a company, but can also be used for evaluation of economic results of companies within cluster (Kovárník & Hamplová, 2014) or even for evaluation of the whole industry (Kuběnka & Králová, 2013).

Many of these purpose-built sets of indicators come from abroad and their application to the Czech economy conditions may limit their explanatory power.

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<sup>1</sup> Can be classified in two basic categories: a) models of predicting financial distress / failure, b)

Worldwide, bankruptcy prediction has a very long history. Approaches to the creation of these models have changed over the years. The ratio analysis was the first to be used to predict bankruptcy. The best known representative of this methodology was Fitzpatrick in 1932. In 1966 Beaver was the first to use the univariate analysis. The number one author of the bankruptcy model is Edward I. Altman who used as the first one multivariate analysis in 1968. Logistic analysis for model creation was used by Ohlson in 1980. In 1984 probit analysis was used by Zmijewski. In 1988 Messier and Hansen were the first to use neural network analysis. In 2001 Shumway created a model with using hazard modelling. In the recent years methods with utilizing artificial intelligence (neural networks) have been tested and hybrid models and mixed models also combined with fuzzy logic, e.g. (Li & Ho, 2009) or (Trabelsi et al., 2015) have been created.

Some specialists emphasize that the application of the above models to the Czech economic conditions faces serious problems, in particular the absence of sufficiently long time series of observed financial indicators. Also, the problem may be the validity of data and the impact of the dynamically changing socio-economic environment in the Czech Republic.

Model accuracy can be affected also by using non-identical accounting systems. It means e.g. using US GAAP to create a model vs. applying a model to IFRS or CAS accounting system. (Fosbre, et al., 2009) and (Honková, 2015) deal with accounting and with accounting differences in accounting systems. The key role of accounting as key information source for managerial analysis and determining of financial health is also emphasized by Myšková (Myšková, 2009).

Those are the models that describe the overall financial and economic situation and performance of a company using one comprehensive index. But do they have similar explanatory power? To what extent do we rely on them?

That is the question, since the global information research into testing the explanatory power of selected models (the Q-test, the Credibility Index and Rudolf Doucha's Balance analysis) failed to answer these questions. Research found that:

- (Fuerst, 2010) states that solely hard fact rating systems based on the Q-test by Kralicek are currently used in banks in Austria. Together with self-organizing maps and neural networks they form qualitative rating systems. The main purpose of such a rating system is to analyze company ratios and to calculate a rating score, which is a gauge of the financial situation and rigidity of a company.
- (Luňáček, 2015) Evaluated the explanatory power and accuracy of common credibility and bankruptcy models in construction industry in the Czech Republic. He compared

the Kralicek's Q-test, the Credibility Index, the Balance Analysis by Rudolf Doucha, Grunwald's index, D-score, Aspect Global Rating Altman's model, Taffler's model, Springate model, Zmijewski's model and all versions of IN indices. He found that the most successful model for determining bankruptcy are Aspect Global Rating with a success rate of 99% and a standard deviation of 0.5%, then the Zmijewski's model with a success rate of 95% and a standard deviation of 2.5% (these results, however, can not be clearly generalized as the accuracy of individual models is different<sup>2</sup> in various industries, as already demonstrated by many researches.)

- (Kuběnka, 2015) checked the Credibility Index<sup>3</sup> (CI) accuracy with a data set of 1260 companies from processing industry sphere. He states that CI accurately predicted the credibility degree<sup>4</sup> at 41 % of companies. With the benevolence of difference by two degrees (two from the scale of 7 degrees) the accuracy increased to 85%. If we focus only on the ability of economic value added prediction the accuracy of the model is 76.39%.
- (Polo&Caca, 2014) tested a data set of 44 companies from Albania. They used Kralicek Quick Test to determine the indication of financial stability and efficiency to determine the financial state. But with all achievements in this direction, in the future it should be aimed at finding those models which better and quicker predict the rise and causes of crisis. It is a clear evidence that not all estimated indicators have the same importance.

The aim of the research is to find out the predictive power of selected creditworthy models on a large sample, and also to determine whether or not they have similar explanatory power.

## 1 Tested financial models

Creditworthy models are among the diagnostic models that assess the company using one synthetic coefficient based on purposefully selected set of indicators which allow for the most accurate description of the financial situation. Creditworthy models are mostly based on theoretical knowledge. Some of them allow determining the position of the company based on a comparison with the industry results (possibly with a larger set of compared subjects). However, this method requires that comparative data (usually quantile values) be obtained, as it is in cases of Tamari's Index and modified Kralicek's Q-test. For testing, three traditional

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<sup>2</sup> Moreover, the sample size and methodology used are not known, since the article is not publicly accessible.

<sup>3</sup> Under the name „Creditworthiness Index“

<sup>4</sup> Degree borders based on activity, payment troubles and the level of ROE (ROE < 0; ROE € <0; rf>; ROE € <re; rf>; ROE > re)

models have been selected. It was the Q-test, the Credibility Index, and the Balance Analysis I. by Rudolf Doucha.

### 1.1 Quick test

Austrian economist Peter Kralicek created this financial model in the year 1991. It is well known in the Czech Republic, Austria and Germany and usually it is called the Q-test, Quick test or Kralicek's Test. This model is different as with the increasing value achieved the insolvency probability increases as well. The evaluation scale uses the point evaluation from 1 up to 5. Evaluated areas are: level of self-financing / duration of the debt payment / CF in % of revenues / return on assets. The model does not distinguish different areas of importance, and thus it does not assign different weights. The final grade is the arithmetic average of evaluated areas  $Q_1$  &  $Q_2$  &  $Q_3$  &  $Q_4$ . A financially healthy company should be classified with the grade 1 or 2. Grade 4 expresses a bad financial health and grade 5 expresses bankruptcy. No. 3 can be considered as the border between a good and bad financial health. See more in Tab. 1.

**Tab. 1: The evaluation scale of the Kralicek's Q-test**

Evaluation	Ratios		Rating scale				
			1 Very good	2 Good	3 Mid	4 Bad	5 Danger of insolvency
Revenue situation	Q <sub>1</sub>	Quota of equity	> 30%	> 20%	> 10%	< 10%	negative
	Q <sub>2</sub>	Duration of debt payment from CF	< 3 years	< 5 y.	< 12 y.	> 12 y.	> 30 y.
Financial stability	Q <sub>3</sub>	Cash flow in % of revenues	> 10 %	> 8 %	> 5 %	< 5 %	negative
	Q <sub>4</sub>	Return on assets	> 15 %	> 12 %	> 8 %	< 8 %	negative

Source: Adapted according to (Kralicek, 1993). Own interpretation.

In order to use the Q-Test on a data set it is necessary to calculate the values  $Q_1$  &  $Q_2$  &  $Q_3$  &  $Q_4$  stated in the Tab. 1. The used methodology used to calculate  $Q_1$  &  $Q_2$  &  $Q_3$  &  $Q_4$  is:

- a) Quota of equity = Equity / Total assets
- b) Duration of debt payment from CF = Foreign capital / Cash flow (CF)
- c) Cash flow in % from revenues = Cash flow / Revenues
- d) Profitability of assets = EAT / Total assets
- e) Revenues = Revenues from sold goods + Revenues from products and services
- f) Cash flow = Economic result (profit) + Depreciations + Change in reserves

## 1.2 The Credibility Index (CI)

This model is based on MDA (multivariate discriminant analysis) and many others. The CI formula includes six ratios in following form:

$$CI = 1,5X_1 + 0,08X_2 + 10X_3 + 5X_4 + 0,3X_5 + 0,1X_6 \quad (1)$$

where:  $X_1$  = Cash Flow / Total liabilities and Equity

$X_2$  = Total Capital / Total liabilities and Equity

$X_3$  = EBIT / Total Capital

$X_4$  = EBT / Revenues

$X_5$  = Inventory / Total Assets

$X_6$  = Equity / Total Capital

Achieved CI value must be compared with following rating scale.

**Tab. 2: Rating scale of the Credibility Index**

Result	Rating	Company
$IC \in < 3 ; \infty )$	extremely good financial position	creditworthy
$IC \in < 2 ; 3 )$	very good financial position	
$IC \in < 1 ; 2 )$	good financial position	
$IC \in < 0 ; 1 )$	problematic financial position	
$IC \in < - 1 ; 0 )$	bad financial position	bankrupt
$IC \in < - 2 ; - 1 )$	very bad financial position	
$IC \in < - \infty ; - 2 )$	extremely bad financial position	

Source: Kuběnka, 2015

Reached rating value 0 is the main threshold because it is the boundary between the area of creditworthiness and bankruptcy.

## 1.3 Rudolf Doucha's Balance analysis I.

Rudolf Doucha's Balance analysis was created in the country's economic environment<sup>5</sup> and has three variants (three levels different in demands and accuracy). It uses four basic ratios and weighted average of their results:

$$Index\ of\ stability\ (S) = \frac{Equity}{Total\ assets} \quad (2)$$

$$Index\ of\ likquidity\ (L) = \frac{(Short\ term\ financial\ property + receivables)}{2,17 \times Current\ liabilities} \quad (3)$$

<sup>5</sup> unlike the Q-test and Credibility Index.

$$\text{Index of activity (A)} = \frac{\text{Gross revenue}}{\text{Total liabilities}} \quad (4)$$

$$\text{Index of rentability (R)} = \frac{8 \times \text{EAT}}{\text{Equity}} \quad (5)$$

$$\text{Total (T)} = \frac{(2 * S + 4 * L + 1 * A + 5 * R)}{12} \quad (6)$$

For all the partial results (S & L & A & R) and the total score (T) the interpretation of ratings is the same. The result values higher than 1 represent a good financial situation of the company. The results values lower than 1 indicate a poor financial situation of the company.

## 2 Data set & Methodology

For testing of selected creditworthy models, companies from the manufacturing industry were selected for many reasons. Manufacturing industry is the most important industry of the national economy in terms of gross domestic product.

According to (MIT, 2015), the assets of all manufacturing companies were in total amount of 2 703.50 billion CZK in 2012, of which the analyzed sample represents 46.30 %. Total turnover in the industry in the same year was 3 823.01 billion CZK, of which the tested sample of companies generated 46.22 %. The registered number of units, regardless of size, was 173 889 companies, of which the sample covers 0.86 % (medium and large companies). Thus, the input data for the research were financial statements from 2012 gathered from 1492 companies. These data were obtained from the database MagnusWeb from Bisnode.

The research has two objectives:

- 1) To determine the predictive power of selected creditworthy models.
- 2) To determine whether they have a comparable explanatory power.

**Fulfillment of objective 1:** It has been achieved based on a comparison of rating in 2012 (company identified as creditworthy<sup>6</sup> or bankruptcy<sup>7</sup> by individual models) with the ROE value<sup>8</sup> achieved in the following year 2013. This method of determining the accuracy of a model was used, for example, by Neumaierová (Neumaierová, 2005) and Kuběnka (Kuběnka, 2016).

**Fulfillment of objective 2:** It has been achieved based on comparing the results of application of selected models to data set. This will answer the question whether the company

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<sup>6</sup> Value 1 assigned to the result

<sup>7</sup> Value 0 assigned to the result

<sup>8</sup> Value 1 assigned to positive ROE value and value 0 assigned to negative ROE value

is identified as creditworthy or bankrupt by individual models and to what extent do companies vary in ratings.

### 3 Calculations and results

Given that each model has a different range of evaluation of results, a different border must also be set to divide the companies into two groups (see Tab. 3). One group consists of companies diagnosed with a poor financial situation („bankrupt area“) and the other group are financially stable and prosperous companies („creditworthy area“).

**Tab. 3: Bankrupt and credibility area borders**

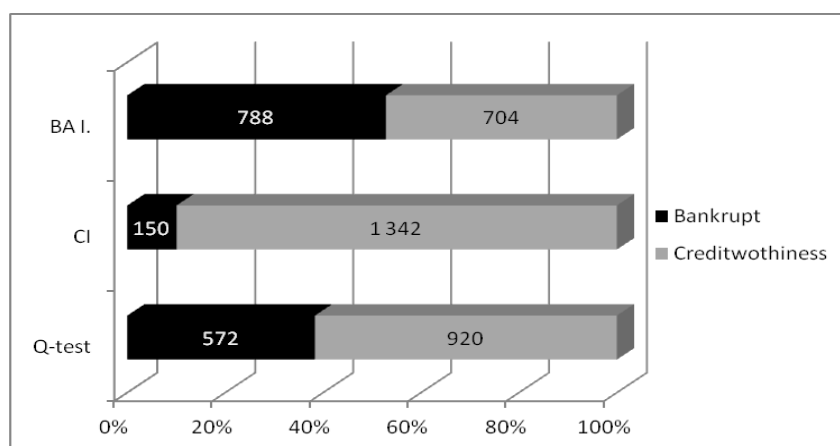
Financial model	No. of rating degrees	Threshold	Bankrupt Area	Creditworthiness Area
Q-test	5	3	> 3	< 3
Credibility Index	7	0	< 0	> 0
Balance Analysis I.	2	1	< 1	> 1

Source: own

#### 3.1 Procedure and calculations results to meet the objective 1

The sample of 1492 manufacturing companies was evaluated using three selected creditworthy models. None of the 1492 companies showed signs of decline in the form of insolvency or negative equity. Also, 1247 companies in the sample (83.58 %) had a positive ROE value in 2012 and 1268 companies, i.e. 84.99 % in 2013. Still, the Balance Analysis I. model (BA I. in Fig. 1) identified 788 companies, i.e. 52.82 % as companies in a poor financial situation. The Q-test evaluated the group of companies more positively as it marked 38.34 % companies as financially troubled and 61.66 % as financially healthy. The Credibility Index (CI in Fig. 1) evaluated the companies the most positively as it ranked only 10.05 % companies in the bankrupt area and the remaining 89.95 % in the creditworthy area.

**Fig. 1: Result of classification of companies in 2012**



Source: own

In order to meet the objective 1 the classification of companies in 2012 was compared with the ROE value achieved in 2013. Balance Analysis I. showed the worst prediction power. It predicted correctly positive or negative ROE in 57.24 % of cases a year earlier. The Q-test model was better in predicting ROE value, namely in 69.17 % of cases, and the best was Credibility Index predicting correctly even in 84.99 % of cases (i.e. 1268 of 1492 companies).

### 3.2 Procedure and calculations results to meet the objective 2

The objective 2 was to determine the consistency or inconsistency of selected models in identifying companies to be financially healthy or financially unstable. In other words, the objective was to determine whether or not is the usefulness of the models similar.

**Tab. 4: Agreement in creditworthiness prediction**

Area 1.			Area 2.			Area 3.		
Probability*			Conditioned probability* – direction A			Conditioned probability* – direction B		
Models	Abs.	Rel.	Models	Abs.	Rel.*	Models	Abs.	Rel.*
Q-t vs. CI	918	61.53%	Q-t vs. CI	918 / 1342	68.41%	CI vs. Q-t	918 / 920	<b>99.78 %</b>
Q-t vs. BA	588	39.41%	Q-t vs. BA	588 / 704	<b>83.52%</b>	BA vs. Q-t	588 / 920	63.91 %
CI vs. BA	695	46.58%	CI vs. BA	695 / 704	<b>98.72%</b>	BA vs. CI	695 / 1342	51.79 %

\* probability of agreement in prediction of creditworthiness. Source: own

Table 4 area 1 indicates probability that both of two models will predict creditworthiness when applied to a specific company. The most consistent are the Q-test and the Credibility Index (Q-t vs. CI) that identically predict creditworthiness in 61.53 % of cases. The best consistency in creditworthiness prediction at the conditioned probability (Tab. 4 area 2 & 3) was 83.52 % found in the Quick test and the Balance analysis I. (Q-t vs. BA I.) In CI



vs. BA I. it was 98.72% and in CI vs. Q-t even 99.78 %. Some links between models appear to be very strong, however, it should be understood that this is a conditioned probability. For example, the strongest links CI vs. Q-t mean that if the Q-test identifies a company as creditworthy, there is a 99.78 % probability of being identified as creditworthy by Credibility Index as well.

## Conclusion

Financial prediction models can be considered an interesting way to fairly comprehensively summarize and assess the financial situation of companies on the quantitative basis. However, it should be noted that the reliability of the overall assessment is not absolute and the identification of a company as creditworthy or bankrupt only applies to a certain probability. However, if information about the reliability of a particular model is not known at all, its use makes little sense. For this reason, testing of selected models was performed on a large sample, which guarantees the statistical significance of the results and subsequent conclusions of the research. The accuracy of the Q-test, the Credibility Index and Rudolf Doucha's Balance analysis I. was tested based on comparison of the results of their application to the financial statements of companies (from 2012) with achieved return on equity (ROE) value a year later (in 2013). Thus, the models were tested in terms of their power to predict an economic result. Credibility Index has the greatest predictive power as it correctly predicted a positive or negative ROE in 84.99 % of companies. The research had one more objective, which was to determine whether the models are interchangeable in terms of usability, without significantly decreasing the probability of a correct diagnosis of the company evaluated. The strongest link was proved between the Q-test vs. the Credibility Index with a 61.53% probability of both identifying the same company as creditworthy. The strongest link in terms of conditioned probability goes for CI vs. BA I. 98.72% and even 99.78 % for CI vs. Q-t. It means, for example for CI vs. Q-t that if the Q-test identifies a company to be creditworthy, there is a 99.78% probability of it being identified to be creditworthy by the Credibility Index as well. In conclusion, we can say that the predictive power of Credibility Index is very high and therefore, it can be recommended as the most suitable model for practical use. As for the interchangeability of use of analyzed models we can conclude that they are interchangeable only in terms of conditioned probability (CI vs. BA & CI vs. Q-t). This corresponds with the previous result claiming that Credibility Index achieves the highest accuracy.

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