Economic Value Added Prediction in Selected Industrial Branches: Case of Czech Republic

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Abstract: Qualitative methods determining financial health of a firm are not only time-consuming and expensive, but can also deliver distorted subjective evaluation. Quantitative methods do not include qualitative parameters, but they are usually time-saving and objective in the field of determining current financial condition. Index IN05 is a quantitative model created in 2005 as a successor of IN01 from 2001. The upgrade thus came already after four years of its existence. In 2005, IN05 was the most accurate model to predict a financial situation of a firm on the basis of EVA, but does it still apply today? The first objective was assessing current abilities of IN05 to predict financial health of a firm on the basis of achieving positive value of EVA (Economic Value Added). The second objective was to find a way how to increase the accuracy or decision making ability of the model for selected industries. The research was conducted by analysis of financial statements of more than 500 firms. All selected firms are in the field of processing industry. It was found that current accuracy of the model on the basis of EVA decreased over the time. As a result of modification of the evaluation criteria the accuracy slightly increased. The key contribution of the modification is a significant increase of decision making ability of the model.

Key-Words: EVA, financial performance, index IN05, financial prediction, financial health, distress, model accuracy

1 Introduction
A plethora of bankruptcy and financial health prediction models are used worldwide in many modifications. Banks, investors, and business partners use them to assess financial performance of a firm and to check its financial health. According to Svobodová [16] the increased need to assess a financial health of firms is justified by the rising number of insolvency proceedings in the Czech Republic. Kuběnka and Slaviček [10] claim that although financial health and bankruptcy models were created differently, their construction is similar, which means a combination of ratios and assigned weights of importance. Financial diagnostic and prediction models vary predominantly in their targeting. Creditworthy models are used to assess a current financial situation of a firm using one aggregate indicator. These models combine selected ratios and are based on theoretical assumptions and generally recommended values of these indicators, and, in the vast majority, do not use empirical evidence. Bankruptcy models were created in order to predict the probability of financial distress, thus these models were created on samples of selected firms.

Bankruptcy-financial health models combine financial health of the firm with its ability to meet its financial obligations.

The most widely used bankruptcy models are W. H. Beaver’s model of 1966 [5], Altman’s Z score models, especially Z score model of 1968 [1], ZETA score of 1977 [4], and Z” score of 1999 [2]. Other models include Taffler’s index of 1977 [17] and Beerman’s discrimination function of 1976 (see [3]). The latest bankruptcy models created in the Czech Republic are Index of Karas and Režňáková [8] 2014, where the indicated accuracy of placing a firm within the health zone is 97.89%, while the indicated accuracy of placing a firm within the distress zone is 69.91%. In 2014, another bankruptcy model was created by Homolka et al., for which the authors indicate the prediction accuracy of 90.96% [6].

The most popular financial health models in Europe are Tamari’s model of 1966 (see [18]), Grünwald’s financial health index of 1995, Kralicek’s Quick test of 1993, and Financial Health Index, which is used in Central Europe (above all in Germany, Austria and Switzerland).
The only bankruptcy-financial health models are IN01, created by the Neumaier couple [20] with prediction of EVA at 77% success rate (accuracy verified by the authors in 2005) and its upgraded successor IN05 of 2005 [15] with accuracy of EVA prediction at 83% (85% with large firms, 83% with medium-sized firms, and 77% with small firms). This model was based on data from more than one thousand and five hundred Czech companies, and it is the only one based on EVA.

2 Problem Formulation
All above mentioned financial prediction models are based on accounting data of a firm in the past and the present, and the models are able to predict the future of the firm based on the current trends with a relatively high probability. They are popular in the financial world and widely used for their speed and easy applicability. Prediction models render a certain percentage of failure, which increases over the time because of changes happening in the market environment. Therefore, it is necessary to constantly upgrade current models and also create new ones. A model created in 1970 would not work nowadays with the same success rate as it did then.

Kuběnka states [9, p. 364] that the accuracy of the existing models may be decreased for several reasons:
- the author created the model on a small sample of heterogeneous firms,
- the author failed to consider the differences and specificities of the sector in which the model should be applied,
- in determining the accuracy of the prediction model the author did not consider the possible disparity of the success of the prediction derived from the size of the analysed entities,
- both market conditions and legislation change with the passage of time, while some models are several decades old.

The reported prediction strength of IN05 model was related to a group of Czech firms in the field of processing industry. Nonetheless, processing industry, according to CZ-NACE (Classification of Economic Activities of Czech Statistical Office), comprises 21 fields.

That was the reason why the authors focused on the factor of a particular industrial field (processing industry being a too wide term, involving inhomogeneous subjects of activity) and the factor of time (model obsolescence depending on changes of the market environment).

The objective is to determine the ability of the IN05 model to predict EVA for selected industrial fields and to find an option how to increase accuracy and decision making ability of the IN05 model ten years after its creation.

3 Problem Solution

3.1 Formulas and methodology
2.1.1 Index IN05 and EVA construction
The IN05 index as an upgrade of the IN01, differs from its predecessor by having gray zone interval changed, namely from the interval (0,75; 1,77) to (0,9; 1,6). Also, the weight of the indicator ROA (i.e. Return on Assets) was increased. According to Neumaierová and Neumaier [14] the index has the following form:

\[ \text{IN05} = 0.13X_1 + 0.04X_2 + 3.97X_3 + 0.21X_4 + 0.09X_5 \] (1)

where:
- \( X_1 \) - total assets / liabilities
- \( X_2 \) - earnings before interest and taxes / interest paid
- \( X_3 \) - earnings before interest and taxes / total assets
- \( X_4 \) - revenues / total assets
- \( X_5 \) - current assets / current liabilities

Table 1: IN05 Assessment

<table>
<thead>
<tr>
<th>Result</th>
<th>Result interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{IN05} \leq 1.6; \infty )</td>
<td>health zone (positive EVA)</td>
</tr>
<tr>
<td>( \text{IN05} \in (0.9; 1.6) )</td>
<td>gray zone</td>
</tr>
<tr>
<td>( \text{IN05} \in (-\infty; 0.9) )</td>
<td>distress zone (negative EVA)</td>
</tr>
</tbody>
</table>

There are more ways to calculate EVA. One of them is, according to [7] [11], the following:

\[ EVA = (\text{ROE} - \text{re}) \times E \] (2)

where:
- ROE – means EAT / Equity
- \( \text{re} \) - cost of equity
- E - equity

The calculation according to [13] is used in statistics of Ministry of Industry and Trade of the Czech Republic and has this form:

\[ r_e = \frac{W_{ACC} \times P^S}{A} - (1-t) \times \frac{W_{L} + 0}{A} \left( \frac{P^S \times E}{A} \right) \] (3)

where:
re - implicit costs of shareholders’ capital
PS - are paid sources (bank loads, obligations, shareholders’ capital),
WACC - weighted average costs of capital,
A - total assets,
t - tax rate,
I - cost interests,
BL + O - bank loans and obligations,
E - equity

The WACC value was calculated according to the methodology of Ministry of Industry and Trade [13]:

\[ WACC = r_f + r_{\text{company}} + r_{\text{finstab}} + r_{\text{LA}} \]  \quad (4)

where:
- \( r_f \) - rate of the risk-free assets
- \( r_{\text{company}} \) - extra charge for the volume of business risk,
- \( r_{\text{finstr}} \) - extra charge for the risk resulting from capital structure,
- \( r_{\text{finstab}} \) - extra charge for the risk that the company is not able to pay back its liabilities,
- \( r_{\text{LA}} \) - is the risk extra charge for the size of company.

The source for risk extra charges for WACC calculation (\( r_f, r_{\text{company}}, r_{\text{finstab}}, r_{\text{LA}} \)) is statistics [12].

### 3.2 Methodology of determining prediction strength of IN05 for EVA prediction

According to (2), EVA is positive if \((\text{ROE} - \text{re}) < 0\). This is deemed as a sufficient condition. The research used economic data of firms for 2012 and 2013. For determining the IN05 prediction accuracy:

a) **correct prediction of a positive value of the EVA indicator** in case when EVA predicted for 2012 is positive (it means IN05 \( \geq 1.6 \)) and the real value of EVA for 2013 is also positive.

b) **incorrect prediction of a positive value of the EVA indicator** in case when EVA predicted for 2012 is positive, but the real value of EVA for 2013 is negative.

c) **correct prediction of a negative value of the EVA indicator** in case when EVA predicted for 2012 is negative (it means IN05 \( < 0.9 \) without the gray zone) and the real value for 2013 is also negative.

d) **incorrect prediction of a negative value of the EVA indicator** in case when EVA predicted for 2012 is negative, but the real value of EVA for 2013 is positive.

Resulting accuracy of the IN05 model for prediction of financial health (+/-EVA) is then determined as a percentage in the following manner:

\[ \text{IN05 Accuracy} = \frac{a+c}{a+b+c+d} \times 100 \]  \quad (5)

### 3.3 Data structure

The research focused on firms whose core business is processing industry. The three selected fields are: CZ-NACE 17&18: Manufacture of paper and paper products, and Printing Industry (in 2013 making 2.7% of total processing industry sales), CZ-NACE 22: Rubber and Plastics Industries (6.7%), CZ-NACE 29&30: Vehicle manufacturing (leading 24.7% of total processing industry sales). The financial statements of the firms for the years 2012 and 2013 (balance sheet and profit and loss statement) were exported from MagnusWeb application of the Bisnode database. None of the firms in the studied sample for the years 2012 and 2013 showed signs of bankruptcy.

### Table 2: Data structure

<table>
<thead>
<tr>
<th>Field</th>
<th>Number of Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper and Printing</td>
<td>146</td>
</tr>
<tr>
<td>Rubber and Plastics</td>
<td>196</td>
</tr>
<tr>
<td>Vehicles</td>
<td>198</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>540</strong></td>
</tr>
</tbody>
</table>

Source: Own calculation

### 3.4 Results and discussion

#### 3.4.1 NACE 17&18: Manufacture of paper and paper products, and Printing industry

IN05 model classified the sample of 146 firms into the distress category in 52.05% of cases, the gray zone, where the model cannot decide, comprised 26.71% and the health zone had 21.24%. If we focus on the ability of correct prediction of financial health, then according to (4) the prediction strength of IN05 is as follows.

### Table 3: IN05 ability to predict EVA

<table>
<thead>
<tr>
<th>EVA prediction success rate*</th>
<th>No. of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) correct prediction + EVA</td>
<td>22 20.56%</td>
</tr>
<tr>
<td>b) incorrect prediction + EVA</td>
<td>9 8.41%</td>
</tr>
<tr>
<td>c) correct prediction – EVA</td>
<td>56 52.34%</td>
</tr>
<tr>
<td>d) incorrect prediction – EVA</td>
<td>20 18.69%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>107 100%</strong></td>
</tr>
</tbody>
</table>
not including the gray zone (39 out of 146 firms were classified as belonging to the gray zone or the “zone of indecision)  
Source: Own calculation

The resulting accuracy of the model is then 72.89% \((22+56)/(22+9+56+20))\). However, if we included the firms in the gray zone (39 firms), the accuracy would drop to 53.42%.

To increase accuracy of the model for the NACE 17&18 sector, shifting of the evaluation boundaries was tested. It was found that when shifting the gray zone to IN05\((0.90; 1.00)\) the model accuracy according to the methodology (4) in fact did not change, (72.86%), while the gray zone shrank to 4.11% of the whole sample. To verify whether this interval change has a statistically significant weight, the confidence interval was calculated. This proves that shifting the evaluation scale (0.90; 1.00) does not increase the IN05 model accuracy with a statistical significance, however, the model is capable of classifying 22.6% more firms than before (the original gray zone encompassed 26.71% of the sample, now only 4.11%).

3.4.2 CZ-NACE 22: Rubber and Plastics Industries

The classification of the sample of 196 firms by the IN05 model rendered similar results as with the CZ-NACE 17&18 sector. The distress category comprises 54.08%, the gray zone has 26.53% and 19.39% firms indicates financial health. If we focus, again, on the ability of correct prediction of financial health only, then according to (4) the prediction strength of IN05 is as follows.

Table 4: IN05 ability to predict EVA

<table>
<thead>
<tr>
<th>EVA prediction success rate*</th>
<th>No. of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) correct prediction + EVA</td>
<td>30 20.83%</td>
</tr>
<tr>
<td>b) incorrect prediction + EVA</td>
<td>8 5.56%</td>
</tr>
<tr>
<td>c) correct prediction – EVA</td>
<td>67 46.53%</td>
</tr>
<tr>
<td>d) incorrect prediction – EVA</td>
<td>39 27.08%</td>
</tr>
<tr>
<td>Total</td>
<td>144 100%</td>
</tr>
</tbody>
</table>

* not including the gray zone (52 out of 196 firms were classified as belonging to the gray zone or the “zone of indecision)  
Source: Own calculation

The resulting accuracy of the model is 67.36 % excluding the gray zone. When the gray zone is included, the accuracy falls to 49.49% \(((30+67)/196))\).

When shifting of the evaluation boundaries was tested, the gray zone interval (0.90; 1.00) would not influence the model accuracy with a statistical significance, increasing it to 67.58% only. The shifting the interval would again increase the gray zone, which would now apply to 7.14% of the sample only (compared to 26.53% with the original gray zone (0.90; 1.60)).

3.4.3 CZ-NACE 29&30: Vehicle manufacturing

The sample of 198 firms was classified with similar results as other sectors. 52.02% fell into the distress category, 32.83% stayed in the gray zone, and 15.15% indicated financial health. The model ability to predict EVA is as follows.

Table 5: IN05 ability to predict EVA

<table>
<thead>
<tr>
<th>EVA prediction success rate*</th>
<th>No. of firms</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) correct prediction + EVA</td>
<td>26 19.55%</td>
</tr>
<tr>
<td>b) incorrect prediction + EVA</td>
<td>4 3.01%</td>
</tr>
<tr>
<td>c) correct prediction – EVA</td>
<td>65 48.87%</td>
</tr>
<tr>
<td>d) incorrect prediction – EVA</td>
<td>38 28.57%</td>
</tr>
<tr>
<td>Total</td>
<td>133 100%</td>
</tr>
</tbody>
</table>

* not including the gray zone (65 out of 198 firms were classified as belonging to the gray zone or the “zone of indecision)

Source: Own calculation

The resulting accuracy is 68.42%, again excluding the gray zone. After including the gray zone, the accuracy plummets to 45.96%.

After shifting the gray zone interval to (0.90; 1.00) the model accuracy would increase 72.43% (without statistical significance). The key contribution is again shrinking the gray zone, which in this case comprises 6.57% firms of the sample only (compared to 32.83% with the original gray zone (0.90; 1.60)).

4 Conclusion

On the basis of testing a sample of 540 firms, the ability of the IN05 model to predict added economic value proved to deteriorate significantly over the past 10 years. A great weakness of the model showed to be a high probability of classifying a firm within the gray zone, where the model is unable to decide between the distress zone (– EVA) and the financial health zone (+ EVA). With all three analysed sectors, the gray zone exceeded 26% (CZ-NACE 17&18 26.71%; CZ-NACE 22 26.53%; CZ-NACE 29&30 even 32.83%).
The research also found that the model ability to predict a positive or a negative value of EVA differs depending on the industrial sector of the firm (72.89% / 67.36% / 68.42%). Unfortunately, this difference could not be proven statistically.

The analysis of changes of the IN05 model accuracy depending on shifting the evaluation interval boundaries brought a slight increase of this model accuracy within two out of three explored fields. There was no change with CZ-NACE 17&18, however there was an improvement of 0.2% with CZ-NACE 29&30. Nonetheless, the crucial contribution of changing gray zone boundaries from (0.9; 1.6) to (0.9; 1.1) was shrinking the gray zone and thus enabling a higher decision making ability of this model by 19 up to 26% depending on the field.

It can be assumed that better results might be achieved in the future only through respecting other specifications of analysed firms, and implementing these specifications into financial prediction models already during their creation or during subsequent weight adjustment of individual components or shifting evaluation boundaries, as was done in this case.

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References: