Applicability of Bankruptcy Models at Agricultural Companies

Použitelnost bankrotních modelů na zemědělské podniky

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Abstract

This part will be dedicated to the use of bankruptcy models in the evaluation of agricultural companies. Bankruptcy models are tools used for the evaluation and prediction of future development of companies. Their use is clearly linked to the problems associated with the use of bankruptcy models developed abroad. These models, resulting from different economic circumstances, often had difficulty in actually describing the real situation of companies in the Czech Republic. In this part were used 6 bankruptcy models for the analysis of agricultural companies (Z"-Score, Z-Score, ZETA, IN99, IN01, IN05 and a model created by Taffler and Tisshaw). The most successful models were Z-Score, ZETA and the Czech model IN99. The Czech model IN01 was identified as the least suitable model.

Keywords

model, bankruptcy, ratio indicator, agricultural companies

Abstrakt

Tento příspěvek bude věnován bankrotním modelům, které jsou velmi využívaným nástrojem hodnocení a predikce budoucího vývoje podniků. S jejich využitím jsou bezpochyby spojeny také problémy, související s možností využití modelů vytvořených v zahraničí. Tyto modely, vzniklé za odlišných ekonomických podmínek, mnohdy jen s obtížemi reálně popisují skutečnou situaci podniků v České republice. V tomto příspěvku bylo pro analýzu zemědělských podniků použito 6 bankrotních modelů (Z"-Score, Z-Score, ZETA, IN99, IN01, IN05 a model vytvořený Tafflerem a Tisshawem). Jako nejúspěšnější modely se ukázaly modely Z-Score, ZETA a český model IN99. Jako nejméně vhodný model se ukázal český model IN01.

Klíčová slova

model, bankrot, poměrový ukazatel, zemědělské podniky

Introduction

Financial analysis has recently progressed from one-dimensional models to so-called bankruptcy models (also known as the prediction of financial distress). These methods of financial analysis are the result of efforts to use a single indicator to determine whether a company is financially healthy or not.

One-dimensional models, which are represented by relative indicators, do not affect the company as a whole, but only a certain area. This disadvantage removes multivariate mod-

els that assess the overall situation by the individual ratios which are combined to produce a single value. The resulting figure would be a likely clue to the future development of the company. These models can be divided into two groups.

The first group is defined as credibility models. The result of these models is a rating that reflects the current creditworthiness of a company. This information is used to assess whether the company will be viable in the future or not. The result of these models is the inclusion of the company into one of the groups that characterizes the expected rating of the company. Examples of credibility models are the Grünwald model or the Kralicek Quick Test [1]. The second group consists of bankruptcy models, which aim to predict the impending bankruptcy of the company. An example of bankruptcy model is the Altman Index, written by E.I. Altman, which has been issued in the U.S. in a few modifications. In the Czech Republic, bankruptcy models were also developed based on economic conditions in the Czech Republic. The most popular are the IN Indexes created by Inka and Ivan Neumaier [6].

Bankruptcy models, which were generated abroad, and based on other business conditions, often do not include specific economic and business environment factors in the Czech Republic. In particular, insolvency, which affects many companies and subsequent secondary insolvency, in which companies receive as a result of unpaid debts incurred in insolvency business partners.

Important factors that may reduce the successful application of Altman models for Czech companies are different conditions under which the index was created and subsequently tested. This is the difference in the external economic environment of business (growth rate of inflation, etc.), legal environment (impact on payment discipline, the possibility of recovery of outstanding debts, enforcement of tax obligations, investment options) and different methodological conditions (different way to create input data, option pricing etc.).This part will deal with evaluating the success of selected Czech and foreign models applied to agricultural companies. It particularly aims at evaluating which models are most successful in predicting the possible bankruptcy of agricultural companies, which are the least successful.

On the other hand, from the available literature, studies and research conducted in the Czech Republic and abroad cannot be perceived that the bankruptcy model developed in one country cannot be successfully applied in another country. Mostly it is a "universal model" of its successful use depends on economic conditions in which businesses are located and the reliability of accounting data on which the model is based.

For example, from a study dealing with the application of bankruptcy models at 16 Czech agricultural companies implies that the best models for predictions of bankruptcy of agricultural companies is the S-Index (Springate), Tamari index and the Czech model IN95 [6]. From another similar study implies that the most successful models were the ZETA model and the Z-Score model. The model created by Taffler and Tisshaw was identified as the least suitable model [5].

The main reasons for selecting the agricultural sector for the analysis of explanatory power of selected models is the large number of bankruptcies in this sector and also the availability of financial data.

1 Bankruptcy Models Used and Chosen Companies

For the evaluation of bankruptcy models, only companies were used, which are legal entities. The reason was that these companies are registered in the commercial register and thus have an obligation to disclose their financial statements in the collection of documents in the Register of Documents.

1.1 Analyzed Companies

Due to the fact that when analyzing the success of bankruptcy models, the verification is performed on a group of prosperous and bankrupt companies, it was necessary to define these two groups.

Businesses that have been included in the sample companies which have gone to bankruptcy were selected from clusters defined in the database MAGNUS [9] follows:

- company is in liquidation,
- company is in bankruptcy,
- company is in preliminary reports,
- business is in alignment,
- company is in receivership.

The basic assumption for assessing the success of bankruptcy models is to obtain the necessary financial statements. Although Czech companies have incorporated the obligation to publish their financial statements in a collection of documents, this requirement is not met by all companies. This obligation is not fulfilled in particular companies that are in some form of insolvency (bankruptcy, liquidation, etc.). For the analysis, based on a larger number of financial statements, it is also desirable to have access to some paid databases.

Despite the above complications, I managed to get sufficient financial statements for presentation of the analysis of bankruptcy models. The main source used for subsequent analysis of the financial statements was:

- Database MAGNUS [9],
- Database Internet Securities [10]
- Information Server of the Czech judiciary [11].

The original set of financial statements consisted of approximately 1200 historical financial statements. These are companies that are currently in decline and companies which have been assessed as prosperous. For the analysis of companies in bankruptcy financial statements were used for the period up to five years before the crisis. This choice, however, I had to adjust and reduce due to incomplete data. It was mostly financial statements de-

rived from the database MAGNUS [9], where there was incomplete information for some companies which prevented their use for the calculation of bankruptcy models. Where missing data could not be completed from the database Internet Securities [10], these statements were not used for analysis.

Furthermore, the original choice had to be excluded from the financial statements, which did not provide the necessary data for analysis. Reasons needed for exclusion were as follows:

- shortened form of financial statements - the company publishes financial data only in abbreviated form, which is insufficient for the use of models based on much more detailed data (for example, the requirement for the amount of interest expense, short-term liabilities, etc.),
- the absence of some important items of financial statements - for example, sales of own products and services. This lack is probably due to an error in data processing,
- obviously incorrectly classified reports - some reports have been for two years in a row exactly the same, all the items of financial statements have been completed with the same number, etc.

Financial statements of problematic companies, which were used for subsequent analysis, the complete financial statements (full version balance sheet and profit and loss statement for years 2004 - 2008) over the five years prior to the time when it slipped into a crisis situation that is listed above. Among the analyzed financial statements were not included financial statements from 2008, which represents the deep period of the financial crisis. In this period there was a dramatic change in the health of companies, and so their comparability with data from previous years is limited. During the analysis it was found that the success of the bankruptcy models, using the group's financial statements for the years 2008 - 2009, was significantly higher, which reduces their overall comparability.

To select a group of prosperous companies, it was decided to use companies that have been identified as prosperous by the ranking of "The EVA Ranking Czech Republic" and by the sector ranking CZECH Sector Award [12]. The reason for choosing this form of prosperous companies is that the source of data is the paid database Magnus [9] that provides information about individual companies in the form of financial statements (balance sheet and profit and loss statement). From this database, it is possible to obtain information only with certainty about which company is insolvent (using specifications such as bankruptcy, receivership etc.). For companies that do not have these characteristics, it is impossible, without a deeper analysis of financial data, to state the smooth development of a prosperous enterprise and therefore there is no possibility of insolvency. Further selection was made based on criteria specified in the database Securities [10] (companies with the highest turnover, regular positive economic results, etc.).

Because of the potential access to the two paid databases of financial data of companies, I managed to get a sufficient number of financial statements (observation), which is listed in Table 1.

Table 1: Number of observations.

	ZETA	Z″ – Score	Z – Score	Taffler a Tisshaw	IN99	IN01	IN05
Bankrupt companies	502	502	501	499	499	96	96
Prosperous companies	472	472	472	472	470	400	400

Source: own elaboration.

Whereas that the selection of prosperous companies is more likely that some companies were wrongly included in the prosperous enterprise analysis group as they were selected for analysis in large quantities than companies in bankruptcy.

This gives in total 974 observations (from approximately 300 companies). The difference between the number of observations in the ZETA model and the IN05 model (bankrupt companies) is given a zero value of certain financial statement items entering into the financial ratios (e.g. interest income) and the IN05 model can not be compiled.

1.2 Bankruptcy Models

For this analysis the following models were selected:

* **Model ZETA, created by E.I. Altman in 1977 [1],**

$$Z = 0{,}717 * A + 0{,}847 * B + 3{,}107 * C + 0{,}420 * D + 0{,}998 * E$$

WHERE
  A = Working Capital/Total Assets
  B = Retained Earnings/Total Assets
  C = Earnings before Interest and Taxes/Total Assets
  D = Market Value of Equity/Book Value of Total Debt
  E = Sales/Total Assets,

* **Model Z″- Score, created by E.I. Altman in 1999 [4],**

$$Z'' = 6{,}56 * A + 3{,}26 * B + 6{,}72 * C + 1{,}05 * D,$$

WHERE
  A = Working Capital/Total Assets
  B = Retained Earnings/Total Assets
  C = Earnings before Interest and Taxes/Total Assets
  D = Market Value of Equity/Book Value of Total Debt

* **Model Z - Score, created by E.I. Altman in 1968 [1],**

$$Z = 1{,}2 * A + 1{,}4 * B + 3{,}3 * C + 0{,}6 * D + 1{,}0 * E$$

WHERE
  A = Working Capital/Total Assets
  B = Retained Earnings/Total Assets
  C = Earnings before Interest and Taxes/Total Assets
  D = Carrying Value of Equity/Book Value of Total Debt
  E = Sales/Total Assets,

- **Model, created by Taffler and Tisshaw in 1977 [8],**

$$Z = 0{,}53 * EBT / KZ + 0{,}13 * OA / CK + 0{,}18 * KZ / A + 0{,}16 * T / A$$

WHERE

A = Earnings Before Taxes/ Short-Term Liabilities

B = Current Assets/ Amount Of Liability;

C = Short-Term Liability/ Assets;

D = Sales/ Assets.

- **Index IN99, created by Inka and Ivan Neumaier in 1999 [6],**

$$IN99 = - 0{,}017 * A + 4{,}573 * B + 0{,}481 * C + 0{,}015 * D$$

WHERE

A = Assets / Amount Of Liability   / Short-Term Liabilities

B = Earnings Before Interest and Taxes / Assets;

C = Sales / Assets;

E = Current Assets /(Short-Term Liabilities + Short Term Loans),

- **Index IN01, created by Inka and Ivan Neumaier in 2001 [6],**

$$IN01 = 0{,}13 * A + 0{,}04 * B + 3{,}92 * C + 0{,}21 * D + 0{,}09 * E$$

WHERE

A = Assets / Amount Of Liability   / Short-Term Liabilities

B = Earnings Before Interest and Taxes / Interest;

C = Earnings Before Interest and Taxes / Assets;

D = Sales/ Assets,

E = Current Assets /(Short-Term Liabilities + Short Term Loans),

- **Index IN05, created by Inka and Ivan Neumaier in 2005 [6].**

$$IN05 = 0{,}13 * A + 0{,}04 * B + 3{,}97 * C + 0{,}21 * D + 0{,}09 * E$$

WHERE

A = Assets / Amount Of Liability   / Short-Term Liabilities

B = Earnings Before Interest and Taxes / Interest;

C = Earnings Before Interest and Taxes / Assets;

D = Sales/ Assets,

E = Current Assets /(Short-Term Liabilities + Short Term Loans),

The reason for choosing the above models for subsequent analysis was mainly because the models developed by Altman and also the model, which was created by Taffler and Tisshaw in England [8] are among the world's most widely used models. The above-mentioned foreign bankruptcy models were also the basis for the development of a number of new bankruptcy models.

IN Indexes [6] are among models that are most used in the Czech Republic and therefore these have been included in the selection to be able to analyze the comparability of the explanatory power of models developed abroad, thus based on completely different economic conditions, with models based on the domestic economy and therefore should produce results that better reflect the actual state of the domestic economy.

As mentioned above, the evaluation of the use of bankruptcy models for domestic companies is also based on the assumption that the Czech bankruptcy models have to be applied on domestic companies with greater success and greater explicitness than the foreign bankruptcy models. From this reason, I chose both foreign and domestic bankruptcy models.

2   Evaluation at Bankrupt Companies

As shown in the Table 2 the most successful bankruptcy model was ZETA with 95% successful predictions of bankruptcy. As the second most successful foreign model was the Z-Score model which correctly classified 84% of companies in bankruptcy. From Czech models the IN99 model showed the best results. The bankruptcy model reached 90% correctly classified companies. Two other Czech models IN01 and IN05 achieved similar results (71% respectively 74%).

The least accurate model was created by Taffler and Tisshaw, which reached only 54% success rate. This corresponds to the results which receive Kopta in his study [5].

Table 2: Evaluation of bankrupt companies.

Model	Bankruptcy	Grey Zone	Prosperity
ZETA	94.6%	4.0%	1.4%
IN99	90.2%	6.2%	3.6%
Z - Score	83.8%	5.6%	10.6%
IN05	74.0%	8.3%	17.7%
IN01	70.8%	13.5%	15.6%
Z" - Score	60.4%	21.7%	17.9%
Taffler a Tisshaw	54.1%	14.4%	31.5%

Source: own elaboration.

From the Table 2 is clear that the ZETA model incorrectly ranked only 1.4% of companies in bankruptcy as prosperous companies. The second most successful model was the IN99 model which incorrectly ranked only 3.6% bankruptcy companies as prosperous companies.

Other Czech models showed more inaccuracies and as prosperous companies ranked 17.7% (IN05) and 15.6% (IN01) companies in bankruptcy. The worst results were shown by the Z"-Score model (17.9%) and the model created by Taffler and Tisshaw, which ranked among the prosperous companies even 31.5% of companies in bankruptcy.

From the Table 2 it is clear that the ZETA model ranked poorly in the gray area with only 4% of the analyzed sample of companies. The second most successful model was the Z-Score model which ranked, in the gray zone, only 5.6% of the companies threatened by bankruptcy. Czech models showed more inaccuracies when included in the gray zone with 6.2% companies (IN99), 8.3% (IN05) and 13.5% (IN01). The worst results were shown by the

Z"- Score model and the model created by Taffler and Tisshaw which included in the gray zone 14.4% (Z"- Score) and 21.7% of companies in bankruptcy (Taffler and Tisshaw).

3   Evaluation of Prosperous Companies

Table 3 shows the percentage success of selected bankruptcy models in prosperous agricultural companies.

As shown in the table below, in the prediction of prosperity, model created by Taffler and Tisshaw was the most successful model with 98% successfully classified companies. The second model, which achieved above average results was the Z"- Score model. This model correctly classified 78% prosperous companies. From Czech bankruptcy models the highest result was achieved by the IN05 model which correctly classified 37% of prosperous companies.

Table 3: Evaluation of prosperous companies.

Agriculture	Prosperity	Grey Zone	Bankruptcy
Taffler a Tisshaw	98.1%	1.1%	0.8%
Z" - Score	78.4%	19.7%	1.9%
Z - Score	40.7%	50.8%	8.5%
IN05	36.8%	56.0%	7.3%
IN01	30.3%	67.8%	2.0%
ZETA	4.4%	64.6%	30.9%
IN99	2.8%	31.9%	65.3%

Source: own elaboration.

From Table 3 it is quite clear that the model created by Taffler and Tisshaw poorly ranked among companies threatened bankruptcy, only 0.8% of the analyzed sample of prosperous companies. The second most successful model was the Z"- Score model which ranked only 1.9% companies threatened bankruptcy. Czech models showed inaccuracies, since most companies classified in the so-called the gray zone (IN05 56.0% and IN01 67.8%). Among the companies threatened by bankruptcy the N05 model classified 7.3% of the analyzed sample of prosperous companies and the IN05 model only 2% of prosperous companies. The exception is the IN99 model which classified the group of companies threatened by bankruptcy, 65.3% of prosperous companies. This model was definitely the worst of the selected bankruptcy models. The most successful model for the identification of prosperous companies was the model created by Taffler and Tisshaw.

4   Evaluation of the Success of Bankruptcy Models

The following chart shows the order bankruptcy models based on success in bankruptcy prediction of bankrupt agricultural companies.

1.   ZETA   94.6%
2.   IN99   90.2%
3.   Z - Score   83.8%
4.   IN05   74.0%
5.   IN01   70.8%
6.   Z" - Score   60.4%
7.   Taffler a Tisshaw   54.1%

The above order shows only the ability of bankruptcy models to correctly identify the bankrupt agricultural companies. To assess the appropriateness of the use of models for prediction of impending bankruptcy of companies, it is also necessary to determine its success in the identification of prosperous companies. Although models are mainly focused on bankruptcy, it is appropriate to take into account their ability to recognize prosperous companies and thus ensure that their success in identifying bankrupt companies is not only due to their setting, when most companies are automatically placed between companies threatened with bankruptcy. Given that some models are bankruptcy models, whose primary function is the ability to identify a company threatened by bankruptcy, take into account in evaluating the more the ability to identify bankrupt companies than the ability to identify prosperous companies. This evaluation is shown in the Table 4.

Table 4: Evaluation of prosperous companies.

Used model	Correctly classified bankrupt companies	Points (2.5 times achieved)	Correctly classified prosperous companies	Points (achieved %)	Total Points
Z - Score	83.8%	209.6	40.7%	40.7	250.3
ZETA	94.6%	236.6	4.4%	4.4	241.0
Taffler a Tisshaw	54.1%	135.3	98.1%	98.1	233.4
Z" - Score	60.4%	150.9	78.4%	78.4	229.3
IN99	90.2%	225.5	2.8%	2.8	228.2
IN05	74.0%	184.9	36.8%	36.8	221.6
IN01	70.8%	177.1	30.3%	30.3	207.3

Source: own elaboration.

Bankruptcy models Z-Score, ZETA and IN99 achieved very good results in the identification of bankrupt companies. All three models were able to correctly identify more than 80% of bankrupt companies. The Z-Score model could correctly classify 83.8% of bankrupt companies and 40.7% of prosperous companies.

In the case of the ZETA and IN99 model the success was achieved even above 90% (ZETA 94.6% and IN99 90.2%). However, these models correctly included only 4.4% respectively 2.8% of prosperous companies. This result reflects the facts that the models are quite strict and most companies (whether prosperous or bankrupt) are immediately included in bankrupt companies. Thereby their informative value slightly declines.

The model developed by Taffler and Tisshaw correctly assessed 98.1% of prosperous companies and achieves the best results in area of analyzing prosperous companies. In contrast, analysis of bankrupt companies, it achieved the worst result when it correctly classified only 54.1% of companies in bankruptcy.

The Czech bankruptcy models achieved very good results in identifying companies threatened by bankruptcy, but on the other hand, did not great success in the analysis of prosperous companies. This result is due to their strictness, where most companies are included in companies threatened by bankruptcy.

For overall evaluation of the success of bankruptcy prediction on bankrupt agricultural companies, it is necessary to take into account the erroneous inclusion of bankrupt companies in prosperous companies.

The following Table 5 takes into account the erroneous inclusion of bankrupt companies in prosperous companies and the final order of bankruptcy models.

Table 5: Evaluation of bankruptcy models.

Used model	Number of points obtained	Incorrect classi-fication of bank-ruptcy. companies	Adjustment points	Total Points	Final Ranking
Z - Score	250.3	10.6%	-10.6	239.7	**1**
ZETA	241.0	1.4%	-1.4	239.6	**2**
IN99	228.2	3.6%	-3.6	224.6	**3**
Z´´ - Score	229.3	17.9%	-17.9	211.4	**4**
IN05	221.6	17.7%	-17.7	203.9	**5**
Taffler a Tisshaw	233.4	31.5%	-31.5	201.9	**6**
IN01	207.3	15.6%	-15.6	191.7	**7**

Source: own elaboration.

For bankruptcy models, it is necessary to eliminate the possibility of incorrect classification of companies threatened by bankruptcy, in prosperous companies. As is evident from the above table, most companies threatened by bankruptcy, were included in prosperous companies by the model created Taffler and Tisshaw (31.5%). This percentage is very high, so this model fell in the final ranking to sixth place and therefore is inappropriate for identification bankruptcy in agriculture. The most successful models are Z-Score, ZETA and the Czech model IN99. Before considering erroneously inclusion of bankrupt companies

in prosperous companies it was obvious that the least suitable model for bankruptcy prediction is the Czech IN01 model.

Conclusions

In the previous section, the success of models in predicting bankruptcy of agricultural companies was described. Below is the final order of the success of the bankruptcy models which based on a correct identification of bankrupt companies and correct identification of prosperous companies. The final evaluation of the usefulness of models for the bankruptcy identification is as follows:

1. Z - Score
2. ZETA
3. IN99
4. Z" - Score
5. IN05
6. Taffler a Tisshaw
7. IN01

Although the model developed by Taffler and Tisshaw achieves the best results in prosperous companies, in analysis of bankrupt companies achieved the worst result when it correctly classified only 54.1% of bankrupt companies, so therefore it is inappropriate for identification bankruptcy in agriculture.

The most successful models are Z-Score, ZETA and the Czech model IN99. The Czech model IN01 was identified as the least suitable model.

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