TESTING POSSIBILITY OF ESTABLISHING CREDITWORTHINESS OF SMALL AND MEDIUM ENTERPRISES IN BOSNIA AND HERZEGOVINA BY APPLYING KRALICEK DF INDICATOR

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ABSTRACT

Banks in Bosnia and Herzegovina are exposed to credit risk the most, since loans make up the largest part of the total banking assets. The need to improve the decision-making process in credit business in banks in Bosnia and Herzegovina is confirmed by a rapid trend of participation of non-performing loans, especially loans to legal entities. The growth of low-quality assets results in a significant increase in bank reserves, which is further reflected in the achievement of their business results. In accordance with the foregoing, it is evident that the credit risk is dominant in banking business in Bosnia and Herzegovina, and that the reduction of credit risk to a level acceptable to a bank is crucial to its survival on the market and its successful business results.

Kralicek discriminant function is a model for the assessment of financial stability and solvency of companies. This model was developed based on sample of European companies, and it contains several key indicators, each of them of a corresponding weight. The assumption is that the financial indicators of failed companies, which have problems in business and orderly settlement of obligations, are different from the financial indicators of successful, financially healthy companies. In this paper we present the basic aspects of Kralicek discriminant function and test the possibility of its application to establish the creditworthiness of small and medium companies in Bosnia and Herzegovina. Kralicek DF indicator is used to determine the financial stability of two groups of companies: companies with the orderly repayment of credit obligations and enterprises with the delay in repayment longer than 90 days. We calculated the success of the model for properly categorized companies (the percentage of correct classification for companies that regularly settle their debt, for default companies and the overall average). The obtained results are presented and analyzed and appropriate conclusions and recommendations for future research have been made.

Keywords: Kralicek discriminant function, Credit risk, Creditworthiness of companies, Banks in Bosnia and Herzegovina.

JEL: G21, G33

INTRODUCTION

Under conditions of strong competition in the banking sector in Bosnia and Herzegovina (BiH), where banks are struggling for a bigger market share, improvement of business performance and profitability, the importance of the need to make appropriate decisions, when approving lending to legal entities, is emphasized. The growing complexity of doing business in the banking sector, large number of banking products, as well as the necessity for rapid generating of decisions by the holder of competences emphasize the need for quality data and indicators that would serve

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as the basis for deciding on the approval or rejection of potential borrowers.

Specifically, in the BiH banks loan portfolio makes the most important item of the total assets out of which 51.50% makes the loans to legal entities, in particular to non-financial public enterprises and private enterprises (Central Bank of Bosnia and Herzegovina 2011, pp. 88). Based on the available data on banks in BiH, a rapid upward trend in the participation of non-performing loans classified in categories C, D, and E in the period 2008-2012 is visible. Participation of non-performing loans in the total loans, loans disbursed to individuals as well as to legal entities, on December 31 2012 amounts to 13.19%. An additional thing that indicates the need for improving the decision-making process in the loan business with legal entities is the fact that only 69.88% of total loans granted to this sector in the Federation of BiH on December 31, 2012 is classified in category A, which means that loan repayment is delayed up to 30 days. (Banking Agency of the Federation of BiH 2012, pp. 37). In order to compare the above mentioned, the share of A category retail loans in the total loans amounts to 86.50%.

It is obvious that banks in the BiH market realize the bulk of their profits on the basis of loans to legal entities and households. Therefore, the crucial question is how to achieve growth in the credit portfolios while minimizing credit risk.

1. SHORT SUMMARY OF SIGNIFICANT RESEARCH

The issue of successful credit risk management is the topic of considerations by many eminent authors in contemporary banking literature, which has resulted in the development of a large number of models for prediction of insolvency and/or bankruptcy of enterprises. The remainder of this paper will present the most important models for predicting bankruptcy of the company.

Beaver model (1967) is a simple univariate statistical model. This model is the first modern statistical model for predicting the financial failure; therefore one can say that its emergence initiated the use and application of statistical methodology in the issues of credit risk. Beaver model is based on financial ratios that are calculated based on data from the financial statements. Beaver used a sample that consisted of 158 companies (79 financially failed and 79 financially non-failed ones) and he analyzed 14 financial indicators (Altman & Sabato 2005, pp. 5). It was found that the following three financial indicators best predict financial failure of the company: cash flow /total assets, net income /total debt and cash flow /total debt.

Altman's model (1968) or Z-score model is one of the best known quantitative models for assessing the financial position of a company. The initial sample is composed of 66 corporations with 33 companies in each of two groups. The first group consisted of companies that went bankrupt, while the second group consisted of companies that performed well.

After the initial groups were defined and companies selected, balance sheet and income statement data were collected. Because of a large number of variables found to be significant indicators of corporate problems in past studies, a list of 22 potentially helpful variables (ratios) was compiled for evaluation. From this lists five variables were selected, which were identified as important in the prediction of corporate bankruptcy, as follows: working capital/total assets, retained earnings/total assets, earnings before interest and taxes/total assets, market value equity/ book value of total liabilities, sales/total assets (adapted from Altman 2000, pp. 7-12).

Edmister (1972) in his study used a sample of small and medium enterprises (SMEs) and their financial statements in the period 1954-1969. He analyzed 19 financial indicators and, using multivariate discriminant analysis, developed a model to predict small businesses defaults (adapted from Altman & Sabato 2005, pp. 2). Compared to earlier studies, Edmister in his research introduces the following new elements: use of three-year indicator average, use of three-year trend of indicators and the relationship between indicators of enterprises and an average indicator of business activity (Zenzerović & Peruško 2006, pp. 15).

Altman, Haldeman and Narayanan (1977) created ZETA model, which is considered successful in predicting the bankruptcy of companies up to five years prior to failure. ZETA model proved to be precise in classifying companies one year prior the bankruptcy (96.2%) to five years prior the bankruptcy (70%).

The study sample consisted of 53 bankrupt companies and 58 successful ones. During the research 27 financial indicators were analyzed, but the model included the following seven: return on assets measured by the earnings before interest and taxes/total assets, stability of earnings, earnings before interest and taxes/total interest payments, cumulative profitability measured by company's retained earnings/total assets, liquidity measured by working capital/total assets, capitalization measured by common equity/total capital, and size measured by company's total assets (adapted from Altman 2000, pp. 31-43).

Ohlson (1980) used logistic regression to develop models for predicting company's bankruptcy. Ohlson chose nine independent variables, which he thought should be useful for predicting bankruptcy, and tested them on a sample of industrial enterprises in the period 1970-1976. The sample consisted of 105 companies that went bankrupt and 2,058 companies that performed successfully. The research resulted in three performance models for predicting bankruptcy. Model 1 predicts bankruptcy within the first year, Model 2 within the second year, provided that bankruptcy was not initiated in the first year, while Model 3 is derived for predicting bankruptcy within a period of two years. The precision of the above models can be considered satisfactory. Model 1 accurately predicts bankruptcy in 96.12% of the cases, Model 2 in 95.55%, while the accuracy of the Model 3 is 92.84%. Ohlson considered that the main determinants for predicting bankruptcy are: size, financial structure measured by the indicator of indebtedness, performance indicators that include the ratio of net profit and total assets and /or the ratio of cash flow from business operations and total liabilities, and finally liquidity ratios (ratio of working capital and total assets or the same indicator combined with the ratio of short-term liabilities and current assets) (adapted from Zenzerović & Peruško 2006, pp. 14-15).

It is important to note that the studies from the United States dominate in the professional literature that deals with the prediction of enterprises' insolvency. The studies used American companies as a sample. "To be used in other parts of the world, these models should be tested and where possible they should adapt to the realities of each country or bank" (Minussi et al. 2006, pp. 78). It is also evident that these models were developed during the 70s and 80s of the last century. Since then, the way of doing business and the market has changed significantly and new industries have emerged. It is thus logical to assume that there is likely a need for modification of the models so that they can be applied successfully in today's business environment. In this regard it would be desirable, in order to improve credit risk management in BiH banks, to establish the possibility for using some of the existing

models for determining the creditworthiness of companies in BiH.

One of the best known and most widely used credit risk models which is based on accounting data is the Altman Z-score model. In Croatia, Serbia and BiH researches were already done in order to determine the possibility for using Altman's model to determine the creditworthiness of domestic companies.

The studies conducted in Croatia showed that the implementation of Altman's Z-model in Croatian economic environment is not adequate, and that the security of enterprise bankruptcy prediction is significantly lower than in the U.S.A. (Škeljo, 2000, according to Zenzerović & Peruško 2009, pp. 350).

The research conducted in Serbia tested the application of Altman's original Z-score model, Z'-score model developed for companies that are not listed on the stock exchange and Z''-score model, developed for the emerging markets, on a sample of companies that represent the Serbian capital market. The above mentioned models were tested over a period of 2006-2009. The sample consisted of 44 companies, which are companies that entered the basket Belex15 during September 2010 and Belexline, excluding companies from the financial sector. The results of precision testing of Altman's models indicated that these models, which are designed for developed capital markets, cannot be successfully applied for the prediction of bankruptcy of enterprises in transition economies (adapted from Muminović et al. 2011, pp. 9-10).

The research into testing the possibility for using Altman's original Z-score and the revised Z'-score for the analysis of business enterprises in the Federation of BiH was conducted on a sample of 40 companies, all clients of one commercial bank in BiH. Companies were divided into two groups: companies that regularly pay credit obligations and companies with repayment delays longer than 90 days. The selected companies had sales income less than BAM 3 million and employed less than 20 people on average, so they were small and medium enterprises. The research found that the Z-model and revised Z'-model do not have the appropriate level of accuracy assessment to determine the creditworthiness of companies in the Federation of BiH (Salkić 2011, pp. 334-335).

In this paper, we aim to test the applicability of Kralicek DF indicator, without the intention to compare it with other credit models presented. Kralicek DF indicator is not so well known scoring model which was, unlike Altman's model, developed in Europe. Peter Kralicek developed a model on a sample of companies from German-speaking countries. Similar to Altman's model, Kralicek DF indicator contains several key indicators and each of them has a corresponding ponder. The assumption is that the financial indicators of unsuccessful companies, which have problems in business and are not able to regularly pay obligations, are different from indicators of financially successful and solid companies.

The research into the possibility of predicting creditworthiness of companies by using Kralicek model has been implemented in Croatia. The result of this research showed that the simple application of the model is not suited to companies that operate under transition conditions. (Deverić, 2002, according to Zenzerović & Peruško 2009, pp. 350).

Similar research has been conducted in Serbia. The study was carried out to evaluate the ability to predict business problems of domestic companies by applying Kralicek DF indicators. Four industrial companies were used as a sample and their business activities in four consecutive years were analyzed. The study concluded that the usage of the model

created in the developed market economies, despite the specifics of business legal entities in transition economy, enables a successful assessment of the existence of business problems in the functioning of selected companies (Jakovčević & Andrašić 2011, pp. 191).

Another study which tested the possibility for using Kralicek DF indicator was conducted in Serbia. The study was conducted on a sample of 30 local companies and their financial indicators for the years 2009 and 2010. In this study, the authors analyzed the business performance of the mentioned companies using several models: Kralicek Quick Test, EMS Model, Kralicek DF Indicator and Growth Equilibrium Model. The results obtained were twofold: namely, certain models pointed to problems in company operations, while on the other hand, the indicators calculated by using different models for the same company indicated good performance of the company (Vuković & Mijić 2012, pp. 222).

To our knowledge, testing the usage of Kralicek DF indicator to determine the creditworthiness of companies in Bosnia and Herzegovina has not been conducted so far. In this paper we will present the basic aspects of Kralicek DF indicator and we will test the possibility for its application to determine the creditworthiness of companies in BiH.

2. KRALICEK DF INDICATOR

While assessing performance indicators attention should be paid to the economic environment in which the company operates so that their interpretation would be better. Altman Z-score indicator was made on a sample that included U.S. companies. Taking into account the differences between the U.S. and European economic environment, such model would be difficult to apply on European companies. That is why Kralicek developed a model for assessing business crisis in a company based on balance sheets and profit and loss account of German, Swiss and Austrian companies.

Following the example of Altman's aggregate indicator, Kralicek also separated "healthy" from "unhealthy" companies and on the basis of multivariate discrimination analysis he developed the model for the identification of the crisis of a company (adapted from Žager et al. 2008, pp. 272).

Kralicek developed the following model (Zenzerović & Peruško 2006, pp. 17):

$$DF = 1.5X_1 + 0.08X_2 + 10X_3 + 5X_4 + 0.3X_5 + 0.1X_6$$

where DF is Kralicek indicator, and other parameters are:

X_1 = net cash flow/total liabilities,

X_2 = total assets/total liabilities,

X_3 = earnings before interest and taxes (EBIT) total assets,

X_4 = earnings before interest and taxes (EBIT)/total revenues,

X_5 = inventories/total revenues,

X_6 = operating income/total assets.

The assessment of the financial stability of company shall be based on the comparison of the calculated Kralicek indicator for a particular company with marginal values shown in Table 2.1.

Table 2.1. Values of Kralicek DF indicator with the assessment of financial stability

Values of Kralicek DF indicator	Financial stability
> 3.0	excellent
> 2.2	very good
> 1.5	good
> 1.0	moderate
> 0.3	bed
≤ 0.3	start of insolvency
≤ 0.0	moderate insolvency
≤ -1.0	pronounced insolvency

Source: Žager et al. 2008, pp. 273

Therefore, the calculated Kralicek DF indicator of a company may be above a certain quantitative threshold (the company has good financial stability), in the central zone (the company has moderate financial stability) and below the lower threshold (the company has bad financial stability and it is faced with the problem of insolvency).

3. ESTABLISHING CREDITWORTHINESS OF SMALL AND MEDIUM ENTERPRISES IN BOSNIA AND HERZEGOWINA BY USING KRALICEK DF INDICATOR

3.1. Methodology

Bearing in mind that loans to legal entities in BiH make up a significant portion of bank assets and that nonperforming loans recorded an upward trend, it would be desirable to explore the possibility of using the existing credit models to determine the creditworthiness of companies.

Therefore, the aim of this paper is to investigate the possibility of determining the creditworthiness of SMEs in BiH by using Kralicek DF indicators. The intention is to test the applicability of Kralicek model, one of the few models developed in Europe, in banks in BiH when determining creditworthiness of companies.

The initial hypothesis of the paper is that Kralicek DF indicator, the credit model created for companies operating in developed countries, is not appropriately precise for determining the creditworthiness of companies in BiH, operating under conditions of transition economies. A SME credit portfolio in one commercial bank was used as the database. The bank operates on the entire territory of BiH (Federation of BiH, Republic of Srpska and Brčko District). The bank continuously achieved good business results so that it can be concluded that the quality of the credit policy of the bank is at a satisfactory level. Using the expert sample the author singled out 40 companies, which are divided into two groups:

- "healthy" companies: clients who are regular in repayment of credit obligations or with delays up to 30 days;
- "bad" companies: customers who are late with the settlement of obligations to the bank longer than 90 days.

The reason for mentioned classification is the definition of a default according to Basel, in which default is considered to have occurred when the obligor is past due more than 90 days on any credit obligation (Basel II *The New Basel Capital Accord*).

The selected companies have sales revenue of less than BAM 5 million and employ less than 30 people on average, so they are classified as SMEs. Namely, according to the Basel Agreement, SMEs are defined as companies with sales of less than EUR 50 million (adapted from Altman & Sabato 2005, pp. 3). Banks in BiH also classify companies based on annual revenue. Having regard to the BiH economic reality, the limit for such classification is significantly lower than the Basel prescribed and it is BAM 5 million of sales revenue.

Thus, companies with revenue of less than BAM 5 million are classified as SMEs, while companies with revenues exceeding BAM 5 million are classified as large, corporate enterprises.[1]

The companies represented in the sample are in different branches of business: the sample includes enterprises dealing with the provision of services as well as enterprises dealing with manufacture and sale. Considering the politically conditioned division of the banking market in BiH, sample included companies that do business in Federation of BiH, Republic of Srpska, and Brčko District.

Table 3.1. The values of financial indicators for non-default companies (in BAM)

PL Company	Net Cash Flow	Total Assets	EBIT	Inventories	Total liabilities	Total revenues
PL Company 1	43,000	824,000	37,000	99,000	498,000	676,000
PL Company 2	713,000	3,829,000	644,000	401,000	2,154,000	4,699,000
PL Company 3	33,000	330,000	31,000	31,000	213,000	1,331,000
PL Company 4	107,000	724,000	112,000	212,000	310,000	1,749,000
PL Company 5	-32,000	3,038,000	37,000	408,000	1,153,000	2,507,000
PL Company 6	586,000	1,140,000	651,000	702,000	175,000	1,736,000
PL Company 7	897,000	3,436,000	44,000	229,000	1,367,000	3,162,000
PL Company 8	789,000	2,609,000	621,000	513,000	405,000	4,220,000
PL Company 9	301,000	2,649,000	302,000	773,000	605,000	4,215,000
PL Company 10	1,000	1,651,000	-43,000	252,000	1,129,000	3,014,000
PL Company 11	91,000	1,699,000	6,000	198,000	1,467,000	2,642,000
PL Company 12	94,000	568,000	78,000	249,000	412,000	2,030,000
PL Company 13	245,000	2,783,000	163,000	50,000	656,000	3,296,000
PL Company 14	64,000	715,000	-26,000	242,000	278,000	1,460,000
PL Company 15	59,000	733,000	42,000	155,000	374,000	606,000
PL Company 16	461,000	2,529,000	94,000	30,000	806,000	2,205,000
PL Company 17	13,000	224,000	3,000	27,000	164,000	411,000
PL Company 18	17,000	571,000	8,000	287,000	514,000	506,000
PL Company 19	154,000	1,396,000	140,000	363,000	732,000	2,994,000
PL Company 20	116,000	1,193,000	108,000	164,000	811,000	1,521,000

Source: author's research

When calculating the ratios, we used the official financial statements (balance sheet and income statement) of the debtor at the time of approving loan applications. Delays in the settlement of credit obligations occurred in the period of 12 months after loan approval, so in accordance with the requirements of the Basel Agreement the possibility of predicting default for a period of one year is considered.

3.2. Calculation of Kralicek DF indicators for companies in BiH

Based on the official balance sheet and income statement of companies that regularly pay their credit obligations, we selected financial data and calculated the parameter included in Kralicek DF indicator. They are presented in Table 3.1.

Based on these indicators, Kralicek model had values shown in Table 3.2.

Table 3.2. Values of Kralicek DF indicator for non-default companies (in BAM)

PL Company	X1	X2	X3	X4	X5	X6	DF Indicator
PL Company 1	0.09	1.65	0.04	0.05	0.15	0.82	1.11
PL Company 2	0.33	1.78	0.17	0.14	0.09	1.23	3.15
PL Company 3	0.15	1.55	0.09	0.02	0.02	4.03	1.82
PL Company 4	0.35	2.34	0.15	0.06	0.12	2.42	2.85
PL Company 5	-0.03	2.63	0.01	0.01	0.16	0.83	0.50
PL Company 6	3.35	6.51	0.57	0.38	0.40	1.52	13.40
PL Company 7	0.66	2.51	0.01	0.01	0.07	0.92	1.50
PL Company 8	1.95	6.44	0.24	0.15	0.12	1.62	6.75
PL Company 9	0.50	4.38	0.11	0.07	0.18	1.59	2.81
PL Company 10	0.00	1.46	-0.03	-0.01	0.08	1.83	-0.01
PL Company 11	0.06	1.16	0.00	0.00	0.07	1.56	0.41
PL Company 12	0.23	1.38	0.14	0.04	0.12	3.57	2.41
PL Company 13	0.37	4.24	0.06	0.05	0.02	1.18	1.86
PL Company 14	0.23	2.57	-0.04	-0.02	0.17	2.04	0.35
PL Company 15	0.16	1.96	0.06	0.07	0.26	0.83	1.47
PL Company 16	0.57	3.14	0.04	0.04	0.01	0.87	1.79
PL Company 17	0.08	1.37	0.01	0.01	0.07	1.83	0.60
PL Company 18	0.03	1.11	0.01	0.02	0.57	0.89	0.62
PL Company 19	0.21	1.91	0.10	0.05	0.12	2.14	1.96
PL Company 20	0.14	1.47	0.09	0.07	0.11	1.27	1.75

Source: author's research

The results of Kralicek DF indicator for non-default companies are the following:

- According to Kralicek model, the limit for the start of company's insolvency is 0.3. It can be concluded that out of 20 non-default companies only one was classified under the mentioned zone, which is 5.00%;
- A number of 14 companies was classified in a safe zone with values above 1.0, i.e. 70%;
- Only 12 companies without default were classified as good, financially stable companies (DF >1.5), which is 60%.

Indicators and financial indicators of the default companies are shown in Table 3.3.

Table 3.4 shows the calculated values of Kralicek DF indicator for default companies, i.e. that are due with the settlement of credit obligations to the bank more than 90 days.

The results of Kralicek DF indicator for default companies are the following:

- One out of 20 default companies was classified as company with starting insolvency (DF ≤ 0.3). This means that only 5% of default companies were identified as potentially problematic in obligations repayment;
- Eleven enterprises were classified as companies with medium or good financial stability (DF >1.0), which means 55%,
- For 4 companies the calculated Kralicek DF indicator was higher than 3, so that 20% of "bad" companies were classified as companies with excellent financial stability.

Table 3.3. Values of financial indicators of the default companies (in BAM)

NPL Company	Net Cash Flow	Total Assets	EBIT	Inventories	Total Liabilities	Total Revenues
NPL Company 1	36,000	675,000	-18,000	327,000	604,000	736,000
NPL Company 2	154,000	850,000	136,000	188,000	715,000	416,000
NPL Company 3	2,000	141,000	3,000	24,000	137,000	80,000
NPL Company 4	1,000	1,345,000	7,000	130,000	917,000	705,000
NPL Company 5	5,000	88,000	5,000	46,000	73,000	64,000
NPL Company 6	12,000	174,000	9,000	0	136,000	444,000
NPL Company 7	27,000	242,000	7,000	70,000	192,000	132,000
NPL Company 8	-184,000	1,254,000	16,000	467,000	1,410,000	3,050,000
NPL Company 9	45,000	603,000	5,000	7,000	450,000	556,000
NPL Company 10	11,000	106,000	4,000	54,000	101,000	514,000
NPL Company 11	4,000	40,000	4,000	0	29,000	49,000
NPL Company 12	38,000	1,800,000	18,000	240,000	1,250,000	600,000
NPL Company 13	27,000	104,000	30,000	0	71,000	229,000
NPL Company 14	103,000	2,641,000	52,000	253,000	2,083,000	3,663,000
NPL Company 15	433,000	1,911,000	208,000	108,000	848,000	1,086,000
NPL Company 16	19,000	631,000	10,000	72,000	468,000	279,000
NPL Company 17	123,000	490,000	133,000	15,000	287,000	681,000
NPL Company 18	131,000	3,712,000	56,000	21,000	671,000	636,000
NPL Company 19	1,000	807,000	30,000	381,000	620,000	1,511,000
NPL Company 20	8,000	211,000	17,000	82,000	178,000	163,000

Source: author's research

Table 3.4. Values of Kralicek DF indicator for default companies

NPL Company	X1	X2	X3	X4	X5	X6	DF Indicator
NPL Company 1	0.06	1.12	-0.03	-0.02	0.44	1.09	0.03
NPL Company 2	0.22	1.19	0.16	0.33	0.45	0.49	3.84
NPL Company 3	0.01	1.03	0.02	0.04	0.30	0.57	0.65
NPL Company 4	0.00	1.47	0.01	0.01	0.18	0.52	0.33
NPL Company 5	0.07	1.21	0.06	0.08	0.72	0.73	1.45
NPL Company 6	0.09	1.28	0.05	0.02	0.00	2.55	1.11
NPL Company 7	0.14	1.26	0.03	0.05	0.53	0.55	1.08
NPL Company 8	-0.13	0.89	0.01	0.01	0.15	2.43	0.32
NPL Company 9	0.10	1.34	0.01	0.01	0.01	0.92	0.48
NPL Company 10	0.11	1.05	0.04	0.01	0.11	4.85	1.18
NPL Company 11	0.14	1.38	0.10	0.08	0.00	1.23	1.85
NPL Company 12	0.03	1.44	0.01	0.03	0.40	0.33	0.56
NPL Company 13	0.38	1.46	0.29	0.13	0.00	2.20	4.45
NPL Company 14	0.05	1.27	0.02	0.01	0.07	1.39	0.60
NPL Company 15	0.51	2.25	0.11	0.19	0.10	0.57	3.08
NPL Company 16	0.04	1.35	0.02	0.04	0.26	0.44	0.63
NPL Company 17	0.43	1.71	0.27	0.20	0.02	1.39	4.62
NPL Company 18	0.20	5.53	0.02	0.09	0.03	0.17	1.35
NPL Company 19	0.00	1.30	0.04	0.02	0.25	1.87	0.84
NPL Company 20	0.04	1.19	0.08	0.10	0.50	0.77	1.72

Source: author's research

3.3. Errors in the classification of enterprises and the prediction accuracy of Kralicek DF indicator

The errors made by Kralicek DF indicator while classifying the companies were calculated and presented in the paper. Table 3.5. shows the types of model errors. Type I error is the number of default companies that the DF indicator incorrectly classified as companies with stable business. Type II error indicates an error in the classification of non-default companies that the DF indicator classified as the companies with poor financial stability. The third column shows the calculated average of actual errors of Type I and II. The fourth column shows the average accuracy of model estimation which is calculated as the difference between number one and the average error of Type I and II. These values were calculated for two thresholds of Kralicek DF indicator as follows:

- DF ≤ 0.3: the limit that, according to Kralicek, indicates the beginning of company's insolvency;
- DF > 1.0: companies with good financial stability.

Based on the presented results, we can establish the following:

- Kralicek DF indicator has a very good result in the assessment of non-default companies, since it correctly classified 19 out of 20 "healthy" companies;
- DF indicator is not at all reliable when classifying default companies since it incorrectly classified 95% of the companies (19 out of 20);
- Model accuracy testing with two threshold values determined the average percentage error of 50% for DF ≤ 0.3 and 42.50% for DF > 1.0;
- The average accuracy of model assessment of 50% and 57.50% confirms the thesis that Kralicek DF indicator does not have the adequate precision in determining the creditworthiness of companies in BiH.

CONCLUSIONS AND RECOMMENDATIONS

The growing complexity of doing business in the banking sector, large number of banking products, as well as the need for rapid decision-making by management all emphasize the importance of high quality data and indicators that would serve for making decisions on the approval or rejection of a potential loan placement. Therefore, it is extremely important for bank to improve the decision-making process in credit business, especially when lending to legal entities. This would contribute to the achievement of bank's good business results and strengthen its market position.

In BiH, banks do business under conditions of strong competition, in the underdeveloped economic environment and without proper economic activities of the state. The business of the banking sector has certainly been affected by the global financial and economic crisis, which has inevitably left its mark on the entire BiH economic system.

The effect of the recession on banks' business activities in BiH is evident from the data on the annual growth of loans which in the 2008

Table 3.5. Errors in the classification of enterprises and the prediction accuracy of Kralicek DF indicator

Model type	Type I error	Type II error	The calculated average of errors	The average accuracy of model estimation
DF ≤ 0,3	95.00%	5.00%	50.00%	50.00%
DF > 1,0	55.00%	30.00%	42.50%	57.50%

Source: research by author

was 22.4%, while the same indicator for the next year was -3.2%. At the same time, with the decline of credit placement, a significant upward trend is evident in non-performing assets of banks, meaning loans overdue more than 90 days, whose percentage in 2008 amounted to 2.2%, while in 2011 this percentage was 8.8%.

The increase in non-performing assets resulted in a rapid increase in the cost of loss provision expenses in the banks, which further affected the achievement of business results. Bearing in mind that loans constitute the most significant part of the banks' assets and that there is a trend of growth of non-performing loans, it is evident that the credit risk is dominant in the banking business in BiH. Accordingly, the reduction of the credit risk to a level acceptable for the bank is crucial for its survival and successful business.

In order to establish efficient credit risk management, Basel Agreement recommends the usage of credit models and rating systems to assess the creditworthiness of borrowers. Banks may independently develop credit models and rating systems or use external rating models, which on the basis of the financial and qualitative indicators of enterprises' business provide risk assessment of potential placement to that client. This assessment enables risk managers to generate such decisions in lending activities which expose bank to credit risk that is acceptable. Determined scoring or rating of potential debtor's creditworthiness influences the decision whether bank shall grant the requested loan, in what amount and under what conditions. Banks have multiple benefits from the usage of scoring models in the credit decision-making process since they are objective and consistent, they eliminate discriminatory practices, they are relatively simple and easy to interpret and they enable banks to provide higher quality services to customers for faster approval or rejection of their loan application. During the development, implementation and usage of scoring models, one should keep in mind that practical experience has shown that the models need to be adjusted to the type and size of assessed companies, as well as to specific countries or regions in which companies do business.

Accordingly, in this paper we tested the possibility of using Kralicek DF indicator to evaluate the creditworthiness of SMEs in BiH. The results show that the percentage of Type I error for the marginal value of DF ≤ 0.3 is 95%, which means that the model recognized only one out of 20 "bad" company as potentially problematic. The average accuracy of the model was 50% for DF ≤ 0.3, and 57.50% for DF> 1.0. Based on the presented data it is possible to draw a conclusion that Kralicek DF indicator does not have an adequate level of accuracy of the credit rating of BiH companies, which confirms the research hypothesis. This corresponds with the results of a similar study conducted in Croatia (Deverić, 2002), which contested the possibility of model's application to companies operating under transitional conditions. Also, a study conducted in a number of companies in Serbia shows that the results obtained by implementing the model should be taken with caution since their inaccuracy in evaluating the performance of the company is evident (Vuković & Mijić 2012, pp. 222).

Bearing in mind the significant participation of corporate loan portfolio in total assets of banks, trend of increased participation of non-performing loans in the total loans and the low return on average assets of banks, it would certainly be necessary to improve the credit decision-making process of the banks operating in BiH. However, to our knowledge, there has not been a serious research in BiH into the usage of the existing credit model for determining the creditworthiness of domestic enterprises, nor has anyone developed a model based on accounting data of companies

that would determine their creditworthiness, which leaves open space for further research.

Certainly, it is necessary to point out the fact that the survey was conducted using a sample of a limited size containing a relatively small number of debtors of only one bank. In future research it would be desirable, using a larger sample of legal persons, to determine which key financial indicators most importantly predict insolvency of companies in BiH. It would also be desirable to try to modify some of the existing models for predicting bankruptcy under the business conditions in BiH (changing the values of weights or replacing financial indicators in the model) and/or to create a new model for credit rating of companies in Bosnia and Herzegovina.[2]

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[1] Note: According to the Law on Accounting and Auditing of the Federation of BiH definition of small or medium-sized legal entities is:

- small legal entities include companies that meet at least two of the following three conditions: average number of employees is less than 50, average value of business assets at the end of the fiscal year is less than BAM 1,000,000.00, total annual revenue is less than BAM 2,000.000.00;
- medium legal entities include companies that meet at least two of the following three conditions: average number of employees from 50 to 250, average value of business assets at the end of the fiscal year amounts to BAM 1,000,000.00 to 4,000,000.00 and total annual revenue is BAM 2,000,000.00 to 8,000,000.00.

[2] More information about development or modification of credit models in the countries of Eastern Europe can be found in the following sources: Voronova, I. (2012), *Financial Risks: Cases Of Non-Financial Enterprises, Risk Management for the Future - Theory and Cases*, Emblemsvåg, J.