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# APPLICATION OF CA SCORE MODEL ON ENTERPRISES IN BOSNIA AND HERZEGOVINA

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Review paper

**Abstract:** The Ca score model was tested on a sample of 392 small and medium-sized enterprises (SMEs) of various activities in Bosnia and Herzegovina. After mathematical calculations, the companies from the sample were divided into two groups: companies in the first group had business continuity in 2017 and 2018, and those that failed to operate, i.e. had a forced blocking of transaction accounts with commercial banks for more than 30 days. The data for the research were taken from the companies' financial reports for 2016. Financial reports were taken from the state agency FIA. The scientific methods also used were the methods of analysis and synthesis, the comparative method, as well as the general method of the cognitive process. It was established that in transition countries, such as Bosnia and Herzegovina like, the tested CA score model is not fully adequate, and the reasons are found in the specificities of the transition countries. Slowness in the execution of financial obligations, untruthful presentation of balance positions, inconsistent and delayed implementation of legal obligations to exclude bad economic participants from economic flows are some of the specifics that reduce the predictive ability of the model for assessing business impairment.

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## 1. Introduction

Over the past decades, many researchers have contributed to the study of predicting the financial failure of companies. They were encouraged by interest groups, company owners, investors, banks, suppliers, business partners of the company, and everyone else who wanted to protect their interests. The academic community first studied large companies, and over time the subject of interest expanded to include SMEs, often the backbone of economic bases. Some of the fundamental

research and studies are presented below of the possible failure of companies, as well as some recent trends and modifications, which have contributed to the development of this scientific field. When we look at the research conducted by researchers around the world, we will notice that they all focused only on the regions where they live and work. The developed countries of the world have better methodologies, access to statistical data processing, as well as other advantages, and numerous studies have been conducted in developed countries. Numerous models have been developed for predicting business failures of small and medium-sized enterprises. However, small and less developed markets have their own characteristics that set them apart from rich countries. Legal regulation, standards of living, transition from socialism to capitalism are just some of the characteristics. Insufficient research in transition countries on the topic of predicting business failure of small and medium-sized enterprises is recognized as a research problem. The subject of the research is financial indicators taken from the annual financial reports of small and medium-sized enterprises in transition countries. Financial indicators are independent variables, and business failure, reflected in insolvency, is a dependent variable. This raises the question of whether the business failure prediction models used in developed countries are suitable for small and medium-sized enterprises in transition countries? With the aim to identify the strongest predictors of financial failure of small and medium-sized enterprises in Bosnia and Herzegovina, this study proposes the following hypothesis:

*H: The Ca score model for predicting insolvency is, with limitations, applicable to the operations of SMEs in countries in transition.*

This research consists of four parts. In the first part, previous research by authors worldwide, the methodology and limitations of the research are listed. The second part includes a description of the Ca score model and its application in Bosnia and Herzegovina. The third part presents the research results. The fourth part discusses the results. This section provides explanations for why the model demonstrates different predictive power compared to developed markets. The final part presents conclusions, summarizing the research findings and providing recommendations for further research.

### 1.1. An overview of previous research

The first model for assessing the company's creditworthiness was created by Beaver (1966). He observed the financial reports and determined through analysis that there are three financial indicators that predict the failure of the company. These financial indicators are: the cash flow to total assets ratio, the net income to total debt ratio, and the cash flow to total debt ratio. After Beaver, the era of finding financial indicators that predict bankruptcy or the inability to fulfill business obligations began.

The next author to identify a connection between company bankruptcy and financial indicators derived from financial statements was Edmister (1972). He used three-year financial statements and calculated the averages for each ratio, and compared them with the previous three-year average.

The well-known research carried out by Altman (1977) remains one of the most successful models for predicting the bankruptcy of companies. For the first time in history, Altman used discriminant analysis to select those financial indicators that best predict the bankruptcy of a company. The strength of the model was manifested in the 96.2% success rate of predicting bankruptcy within one year. The model was later adapted for several variants, different business activities and company sizes. Finally, in 2008, he included non-financial parameters in the model, such as company size or ownership structure.

Ohlson (1980) achieved similar predictive power, using regression analysis for the first time to develop a model predicting company financial failure. He created three models. The first model predicted business failure within one year with a probability of 96.12%, the second model predicted failure within two years with a probability of 95.55%, while the third model predicted failure within three years with a probability of 92.34%.

The next significant step forward was made by Kralicek in a quick test. The novelty that he introduced into the research was related to the evaluation of financial indicators on a scale from 1 to 5. He believed that financial failure should be viewed in terms of the riskiness of financing, liquidity, profitability and economy (Salkić, 2013).

The use of modern technological solutions made the way for researchers easier. In Italy, research was conducted on a sample of 505 companies, using two modern techniques - discriminant analysis and logical regression. The research results show that the probability of the impossibility of fulfilling the obligation is as high as 95% when using the first method, and slightly higher when using the second method (D'Amato, Mastrolia, 2023). In Poland, multiple district analysis and logistic regression were applied to predict the bankruptcy of companies in the tourism sector during the Covid-19 pandemic. The results did not show a great predictive power of the model due to the huge crisis of that sector during the pandemic (Wieprow, Gawlik, 2021). In Morocco, research was conducted on 669 companies using the discriminant analysis technique. The model proved to be partially acceptable, and the indicators that best predict the failure of the company are inventory turnover, liquidity, return on capital and management innovation (Meskini, 2022). Several techniques were tested in India to predict corporate bankruptcy. The best models were the support vector model and the artificial neural network, superior in terms of their prediction accuracy compared to the simple binomial logit model. Also, prognostic results are better for one year, while they are more unstable for longer terms (Sehgal at al, 2021). After a large amount of

research in Germany, which used some of the most common techniques - multiple discriminant analysis, logical regression or the technique of neural networks, the researchers tried to find the answer which of the mentioned techniques is better. The result showed that they have random prognostic power (Tillmanns, Kraft, 2021). In Great Britain, the authors examined the random forest technique, alongside other other statistical methods (Sermpinis at al, 2023) for UK companies that had business problems from 1997-2015. They came to the conclusion that the first fifth grade is significantly better in predicting failure, but that there are no big differences in cases of crisis. An interesting study was conducted in Great Britain (Jones, 2023). The author has systematically laid out all the methods that have been used to predict the bad management of companies over the past 35 years. He expressed the view that statistical and informatics methods are significantly more advanced than conventional prognostic methods, but that, nevertheless, they should be taken with caution.

Research in Montenegro was conducted (Lakić et al, 2024) was conducted on 100 medium and large enterprises, of which 30 went bankrupt, and 70 continued to operate. A regression analysis was used, and it was determined that the existing models cannot be reliably applied on Montenegrin market. In Serbia, research was conducted on 103 companies (Stanišić et al, 2013). The authors developed tree models using the method of neural networks, regression analysis, and decision trees and compared them with Altman's Z-score. They found that the first mentioned model can be used to predict financial failure. Using the Mann-Whitney test, a researcher from Serbia (Kušter, 2023) came to the conclusion that financial indicators can be used with great certainty in this country as well. Bogdan et al (2023) used all companies in Croatia, bankrupt and healthy, as a sample. They used multiple discriminant analysis and regression analysis. They found that the first method can be used with a probability of 73.7%, and the second with a probability of 76.3%. In Slovenia, research was conducted on the possibility of applying Altman's model to Slovenian companies. The authors (Dolinšek and Kovač, 2024) determined that the tested model can be used with a probability of success in forecasting as well as in the region, where, in similar research, it was found to be slightly more than 70%. In Bosnia and Herzegovina, using the example of Republika Srpska, the possibility of using binary linear regression was tested. The authors (Mujkić, Poljašević, 2023) found that the mentioned model can be used with a probability of 82.9% for bankrupt companies and 80% for healthy companies.

The aforementioned researches in the world and the region were related to different groups of companies, but, according to the knowledge so far, no systematic researches have been done on small and medium-sized companies. For this reason, the necessity of finding an appropriate model that will be used with adequate probability to predict the failure of small and medium-sized enterprises in transition countries was determined.

### 1.2. Sample and methodology

The financial reports of the observed companies were obtained from the state agency for financial, statistical and IT data processing - FIA. From the total number of large, small, and medium-sized enterprises, 3,500 companies belonging to the Zenica-Doboj Canton were selected. The sample was stratified. A group of companies operating in a single region, central Bosnia, was observed in order to gain as much reliability as possible. The classification was not made according to the company's activity. Further selection was made in such a way that the sample included companies meeting at least two of the following three conditions: the total revenue is above two million convertible marks, the total assets are worth more than one million convertible marks and companies that employ more than 10 workers. Thus, 392 companies were found in the sample. These companies were divided into two groups: those whose transaction accounts had been blocked due to financial problems and inability to pay business obligations, for more than 30 days and "healthy" companies.

Of the mentioned number, 70 companies belonged to the first group of companies, while the rest belonged to the second group. Financial problems were recorded in 2017 and 2018, while the financial reports used to predict these problems were from 2016.

### 1.3. Limitations of the research

A challenge encountered during this research was related to the verification of companies that had banked transaction accounts during 2017 and 2018, that is, they had problems in fulfilling financial obligations. Specifically, the Central Bank of Bosnia and Hercegovina publishes monthly reports on insolvent companies. Each company had to be manually checked against the register of insolvent companies, introducing a potential for error. The possibility of error is greater because the report changes every month, so a check had to be made in 24 monthly reports of the Central Bank. However, the checks were carried out twice. Considering the sample size, as well as double checking, the negative impact on the research was minimized.

## 2. Ca score model

The Ca score model is used to predict the bankruptcy of a company. It was developed by Jean Legault of the University of Quebec in Montreal. The model uses stepwise multiple discriminant analysis. it was created specifically for small businesses, but it must be noted that the same in Canada have total assets between one and twenty million dollars.

### 2.1. Ca score model - indicators

If the result is less than -0.3, it is considered that the company will have significant financial problems within one year, including possible bankruptcy. Ca score formula consists of

$A_1 = 4.59313 * (Capital/Assets)$

$A_2 = 4.5080 * (EBIT/Assets)$

$A_3 = 0.3936 * (Income/Assets)$

$Ca\ score = -2.7616 + A_1 + A_2 + A_3$ (1)

It must be pointed out that the second indicator was "EBIT + costs of financing" in relation to "Total assets". The revised second ratio don't have the cost of financing, which was later established when using the model, and which makes this calculation more stringent. Since these are small companies, the information "Share capital" was later replaced by the term "Capital" because small companies, as a rule, aren't registered as stock exchange companies.

## 3. Research results

After applying the Ca score model to the sample, the following results were obtained:

- Among the 70 blocked companies, 28 were misclassified. The probability of correctly assessing blocked companies is presented in Table 1 (column 5, row 2).;
- Among the 322 unblocked SMEs, 106 were misclassified. The probability of correctly assessing "healthy" companies is shown in Table 1 (column 5, row 3).

The overall reliability of the model is reported in Table 1, column 5, row 4.

**Table 1: Assessment of acceptability of the Ca score model**

| Ordinal number | Number of enterprisese | Number of correctly rated companies | Number of incorrectly rated companies | Total probability |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| 2 | 70 „Failed" enterprises | 41 | 28 | 60% |
| 3 | 322 „Healthy" enterprises | 217 | 106 | 67,19% |
| 4 | Total number of enterprises | 258 | 134 | 64,82% |

*Source:* Author's calculations

A small advantage was observed when predicting failure in the "healthy" company. However, we cannot talk about a big difference compared to the total number of observed companies.

## 4. Discussion

The first factor explaining the weak predictive power of the Ca score model on SMEs in region, and countries in transition in general, is the weak development of the economy and the weak regulation of the market. A characteristic of all countries in transition is certainly a lower volume of business in most industries, so this model can hardly be applied. As can be seen in the financial indicators used in this model, the basic indicators are total assets, earnings before taxes and interest, total income, and capital. Treated SMEs do not have financially high listed items, which affects the obtained results. Additionally, this claim is supported by the difference in the characteristics of SMEs in the region compared to those in the developed West. In the country where this model was developed, the group of SMEs includes companies with revenues from 1 to 20 million dollars, while in this research a sample of SMEs was used, in which a small number of enterprises had revenues greater than 5 million KM. Please note that the sample included all companies from the stratum that met the set criteria of SMEs.

Another problem that limited the possibility of using the Ca score model is the level of the gray economy in the market of Bosnia and Herzegovina, and "creative accounting", a term that has been used to describe improper, illegal accounting recording of financial changes in the company. The reasons for the high gray economy can be found in several facts. One of them is the low level of East European morals. Namely, numerous studies show that tax morale is high in e.g. Scandinavian countries, Germany, but very low in the countries of Southeast Europe. In addition, an insufficiently organized system of control by the state favors the development of the gray economy. Business entities, due to low productivity, are only profitable in the zone of non-payment of tax obligations. On the other hand, high tax bases make it difficult for companies to work. Even companies that previously operated completely legally, after entering the crisis in 2008, transferred their jobs to the informal sector. There are also other, perhaps less important reasons, but which nevertheless lead to the shadow economy are the difficulties arising from the complicated bureaucratic apparatus, so it is easier for companies to resort to unregistered financial flows. Škarić-Jovanović (2011) states that there is more "creative accounting" in countries in transition than in market economies, because cash flows are not clearly defined or sufficiently controlled, a large part of economic activities takes place in the so-called gray zone, and managers are insufficiently competent.

Sometimes managers are motivated to show higher incomes than the real ones in the following ways: prematurely reporting incomes, reporting non-existent

incomes, overestimating earned incomes and including non-business incomes in operating incomes.

A particular issue is that many business entities have operated, for years without paying their obligations or paying them with a significant delay, yet bankruptcy proceedings are rarely initiated against them.. The process of filing and conducting bankruptcy should take place very quickly, however, in reality, this happens very slowly. According to the Indikator portal, in the last 14 years, 1,550 companies in the Federation of Bosnia and Herzegovina and 1,050 companies in the Republika Srpska, or 2,600 in Bosnia and Herzegovina, have gone bankrupt, which is an average of 185 companies per year. Only every fiftieth company undergoes a reorganization, while the rest of the companies go directly into the liquidation process. During 2018, 150 bankruptcy proceedings were opened in the Federation of Bosnia and Herzegovina, and a total of 103 in the Republika Srpska. However, it is believed that around 30,000 companies meet the requirements for starting bankruptcy. About 50% of utility companies meet the requirements for bankruptcy. However, as these "unhealthy" companies flows, which remain involved in economic flows create problems for companies with healthy foundations, which makes it even more difficult to diagnose financial problems.

By testing the Ca score model on SMEs in Bosnia and Herzegovina, we came to the conclusion that the model can only be applied with a probability of 64.82% in this market, which is modest, thus confirming the hypothesis. The reasons for this are primarily in the market circumstances, mentioned above. SMEs in countries in transition, which includes Bosnia and Herzegovina, have their own special characteristics, created under the influence of the markets in which they operate, which limits the forecasting power of the model for evaluating the company's financial condition, such as the Ca score model, in these markets.

According to the mentioned research, we observe that the models for predicting business disruptions, which are used for forecasting financial problems of large companies in the rich economies of the world are not fully suitable for predicting the insolvency of SMEs. Small and medium enterprises have their own characteristics, e.g. in the relationship between owners and managers, which make them more flexible but also more vulnerable. When we place such a small and medium-sized enterprise in the environment of transition countries, flexibility and vulnerability are additionally emphasized, and models for predicting business failure are less reliable.

Research that have been carried out so far in the world have provided theoretical frameworks for determining creditworthiness, predicting business disruptions, bankruptcies and non-fulfillment of obligations towards banks, for the developed countries of the world. Considering the specifics of SME business in certain regions, legislation and market development, there is a need to determine the acceptability of models previously developed by scientists, as well as their

simultaneous applications, for countries in transition, which would reduce the shortcomings that a particular model may have, and thus the possibility of a valid assessment of the company's financial success increased. Researchers around the world, when creating models for assessing the financial performance of both large companies and SMEs, were exclusively concerned with the analysis of markets and regions in which they live and operate, and as far as we know, researchers in countries in transition have not dealt with the creation of a general model for predicting business disruption for transition countries; it is evident that there is an unexplored area within the framework of predicting business failure of SMEs in developing markets. Acknowledging the fact that SMEs in the world have their own characteristics determined by the legislation of individual countries, the business environment, the state of the economy as well as other circumstances, the models that exist in the world are adapted to the markets of the countries where the authors conducted the research. This research covered the causes that lead to the limited possibility of forecasting the financial difficulties of SMEs for countries in transition, as well as the consequences that arise from the untimely and inadequate resolution of this problem.

The legal regulations in the developed countries of the world and countries in transition, as well as the executive implementations, differ significantly, which results in the fact that in countries in transition, long after the failure, even those SMEs that have essentially already experienced significant economic developments are still market participants. failure. The slowness of payments between business entities would already sanction undisciplined business entities by forcing them to declare bankruptcy. It must be noted that the legal regulations in the transition countries are quite regulated, inherited and partially refined in the process of transition from socialism to capitalism, and is still being refined. However, although the laws are continuously updated, the implementation in practice is much slower. Thus, for example, there is a legal obligation for companies to have capital. In the event that the loss exceeds the amount of the capital, such business entities should automatically shut down. However, the fact is that in transition countries there is no automatic shutdown of companies that no longer have capital. They still continue to operate, making failure prediction models less useful. By direct examination of the sample in this research, it was observed that there are such companies. In both entities in Bosnia and Herzegovina, there is a legal obligation to declare bankruptcy, if the company cannot fulfill its obligations to suppliers in 30 days delay. Initiation of bankruptcy proceedings can be initiated by any creditor. It is an obligation for such companies to add the part "in bankruptcy" to the list so that potential business partners have the information to decide for themselves whether to take the risk. However, bankruptcy proceedings are not initiated for years. Business partners find ways to settle obligations through private means, bypassing legal financial flows, which has kept bad companies in the business world for years. It is believed that there are dozens of such companies in Bosnia and Herzegovina.

The attitude of people in transition countries towards the state, specifically towards the payment of tax obligations, is at a low level. This may be a consequence of inadequate control and sanctioning by tax and state authorities, as well as high corruption. Additionally, the undeveloped awareness of socially responsible actions, and fulfillment of obligations, is a consequence of the remnants of earlier economic systems. The developed "creative accounting" made it possible for SMEs not to show real income, to show expenses that did not actually happen, all in order to reduce the profit as a tax base. The avoidance of tax obligations leads to the fact that among the financial indicators there are those that do not show the real state of a small or medium-sized company, so the calculations that are undertaken to create a precise and high-quality model cannot be carried out to the end. However, one should be careful here as well. The gray market also exists in the countries of the developed West, on a smaller scale, but it still exists. The selfish activities of capital owners are represented to varying degrees. The level of the gray economy implies economic flows that are not covered by legal routes, and mostly refers to the non-disclosure of traffic. The reduction of profits as a result of the desire for lower tax obligations, however, is not the subject of the shadow economy. This activity significantly distorts the relationships between the balance sheet positions, so they are distorted and do not show the true state of the company. Underreported profits signal to potential creditors that the companies are operating at or near the break-even point, and which will not be able to settle their obligations from their operations. Every financial coefficient that measured, either in the numerator or the denominator, the company's profit, showed relationships that essentially do not exist in the company, so such coefficients could not be taken as strong predictors of the company's financial difficulties. Likewise, the property that should be shown as owned by the company, which for various reasons received a lower or higher value, had an impact on the financial indicators, and they on the correctness of the model for assessing business performance of the company.

## 5. Conclusion

The Ca score model was designed in Canada, one of the developed countries with a high standard of living. Small businesses have assets from one to twenty million dollars. Compared to companies in transition countries, this highlights the difference in economic development. In transition countries, companies with these financial strengths would even be classified as large companies. The model was created in an economy where bad business entities are very quickly removed from economic flows, if they are not successful. On the other hand, in transitional, as a rule, less developed countries, the standard of living is significantly lower, tax morale is significantly lower, and the tolerance for delay in fulfilling obligations is high. The paper showed that the percentage of predicting the further work of "healthy" companies is quite modest, with 67.19% probability. The prediction of

bankruptcy of the company is even more modest, it is 60% probability, while the overall reliability of the model is a low 64.82%.

The aforementioned studies show that the models used in developed Western countries are not suitable for predicting the financial failure of small and medium-sized enterprises in transition countries.

Considering the results of similar research in the region, it would be interesting to do research that would include non-financial parameters, such as years of existence of the company, location or credit history of the company. This would provide additional information on the necessary treatment of small and medium-sized enterprises in transition countries. The business partners of those companies would benefit, but the academic community would also have a more complete insight into the relations between companies and other interested parties.

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## PRIMENA CA SCORE MODELA NA PREDUZEĆIMA BOSNE I HERCEGOVINE

***Rezime**: Na uzorku od ukupno 392 malih i srednjih preduzeća različitih delatnosti koja posluju na teritoriji Bosne i Hercegovine, testiran je Ca score model. Posmatrana preduzeća su nakon matematičkih izračuna svrstana u dve grupe: ona koja su imala kontinutet u poslovanju tokom 2017. i 2018. godine, i ona koja su neuspešno poslovala, tj. imala prinudnu blokadu transakcijskih računa kod poslovnih banaka dužu od 30 dana. Podaci koji su se tretirali tokom ovog istraživanje su preuzeti iz finansijskih izveštaja posmatranih preduzeća za 2016. godinu, a koja su pak preuzeta iz državne agencije FIA. Od naučnih metoda, također su korištene i metode analize i sinteze, komparativna metoda, metoda indukcije i dedukcije, kao i opšta metoda spoznajnog procesa. Utvrđeno je da za tržište Bosne i Hercegovine, kao jedne od tranzicijskih zemalja, testirani CA score model nije u potpunosti adekvatan, a razloge nalazimo u specifičnostima tranzicijskih zemalja. Sporost u izvršavanju finansijskih obaveza, neistinito pikazivanje bilansnih pozicija, nedosledno i odloženo sprovođenje zakonskih obaveza isključenja loših privrednih sudionika iz privrednih tokova su neke od specifičnosti kojima se umanjuje prediktivna sposobnost modela za ocenu narušenosti poslovanja.*

***Ključne reči**: finansijski pokazatelji, predviđanje, neuspeh, finansijski izveštaji, Ca score, mala i srednja preduzeća, insolventnost.*