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BENEISH M-SCORE AS FRAUD INDICATOR: COMPARATIVE ANALYSIS FOR CROATIAN AND GERMAN COMPANIES

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Abstract

The main purpose of this paper is to determine trends and differences in financial statement frauds between Croatian and German observed companies. Fraud in the financial statement was measured using the M-score model and the research period was from 2018 to 2023. The research sample consisted of 29 companies included in the DAX (German stock market index) and 31 companies listed on Croatian stock market in the observed period. According to research results, the M-score can be used as a tool for fraud detection in both observed markets, and different users of financial statements can use this model to detect potential manipulations in financial statements. Results show that, in the whole observed period, most German companies were classified as non-manipulators, and the results were stable throughout the observed period. For the Croatian sample, number of companies classified as non-manipulators is decreasing, while on the other side, number of those classified as probably or likely manipulated is increasing. Such results indicate the existence of certain differences in fraudulent behavior of listed companies in the two observed countries, and that there are more warning signs and red flags of fraudulent behavior detected on a sample of Croatian companies.

Keywords: *frauds, fraud detection, M-score*

1. INTRODUCTION

The reputation and credibility of the accounting profession have been threatened by scandals such as Enron, WorldCom, Parmalat, and others, which revealed fraudulent financial reporting. Preventing and detecting frauds in financial statements has become one of the tasks of financial and accounting forensics, and one of the main models used for fraud detection is the Beneish

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model. The primary task of this model is to detect potential manipulations in financial statements. However, similar to other detection models (F-score, Z-score), the Beneish model is not certain in diagnosing these scenarios because it only assumes and suspects that, depending on the indicator obtained, business entities could probably manipulate information in financial statements. Thus, the M-score indicates potential issues in certain companies, and discrepancies and large differences in results should be further investigated. This model serves as a valuable tool for investigators and other users of financial statements, aiding them in making informed business decisions rather than being a guarantee of reliability.

This paper aims to use the Beneish model to investigate the probability and frequency of potential manipulations in the financial statements of business entities in two European countries, Germany and Croatia, from 2018 to 2023. We chose these two countries due to fact that they have same legal systems but differences in the level of economic development. On one side, German economy is the strongest in the EU while Croatia is economy which passed through transition and still lags behind developed EU countries. This research should answer the following questions: Is there any suspicion of potential frauds in the financial statements of the selected companies, and are there differences in potential manipulations between the two observed countries? Also, this research tried to detect trends in potential fraudulent behavior in a six-years period for companies included in the analysis.

The structure of the paper includes an introduction followed by an analysis of relevant literature. The third part of the paper describes the sample and measurement of variables included in the Beneish model and the model itself. The empirical findings are presented in the fourth part of the paper, while the last part gives the concluding remarks.

2. REVIEW OF PREVIOUS LITERATURE

Business frauds are defined as "frauds committed by individuals against the organizations that employ them" (ACFE, 2022) and represent "the costliest and most common form of financial crime in the world" (ACFE, 2022). According to Zenzerović & Šarjih (2023), "financial statement fraud is traditionally the most expensive type of fraud which costs are very difficult to calculate precisely". Examples of corporate scandals like Enron, WorldCom, and Parmalat highlight the fraudulent behaviors that spurred the development of various fraud detection models and methods. Models such as the Beneish M-score or the Dechow F-score model can be used to detect potential financial statement fraud. The Beneish M-score is used for fraud detection, and Valaskova & Fedorko (2021) emphasize that "the detection of earnings management by the M-score helps protect business partners of an enterprise against fraudulent behavior, especially in the global environment".

The Beneish model is one of the most used statistical models for detecting potential fraud in financial statements. Created and published in 1999 by Professor M. D. Beneish, it appeared in the time of major corporate scandals and the collapse of multinational companies that manipulated their financial statements and led to huge embezzlements, job losses, and ultimately the decrease in public confidence in the accounting profession. The Beneish model, as a fraud detection tool, correctly predicted one of the major corporate and accounting scandals, the Enron collapse. More precisely, the Beneish M-score detected potential fraud in Enron's financial statements since 1997, years before Enron declared bankruptcy in 2001 (Mahama, 2015). Tarjo (2015) and Kamal et al. (2016) applied the Beneish M-score model for detecting financial fraud, concluding that this model is effective for assessing earnings manipulations in financial statements. Mensah et al. (2023) apply the Beneish model to detect fraud in the financial statements of industrial companies in Ghana. Siregar et al. (2023) investigated its applicability to manufacturing companies in Indonesia during the COVID-19 pandemic, and Dimitrijević et al. (2024) applied the Beneish model for fraud detection to a sample of travel agencies in the Republic of Serbia. The Beneish model served as a fraud detection tool for a sample of Hungarian companies, revealing significant levels of accounting manipulations (Fenyves et al., 2023).

Paolone et al. (2015) examined the impact of the financial crisis on earnings management on a sample of Italian companies. Results revealed that earnings management, measured by the Beneish model, decreased during the crisis period. Valaskova & Fedorko (2021) performed a cross-country study investigating the fraudulent behavior of selected countries of the Visegrad grouping. Results showed a difference in the number of potential fraudulent companies in Slovakia and Czech Republic. Blazek et al. (2020) also concluded that many Slovak companies tend to manipulate financial statements. From 2010 to 2013, a large research was performed on a sample of 84,000 Asian companies. Results showed that 34% of analyzed companies were detected as potential manipulators (Hasan et al., 2017). Bartulović (2024) investigated fraudulent behavior on a sample of Croatian large companies from 2017 to 2022. According to the results, there were large oscillations in the M-score, and fraud risk was the highest in 2020. The mentioned examples are just some of the many in the literature that show the significance and possibilities of the Beneish model when analyzing financial statements, especially those where manipulative actions are suspected. Based on the aforementioned factors, we believe the Beneish M-score can serve as an effective tool for detecting potential fraud among selected Croatian and German companies. Furthermore, we assume that Croatian companies will be more vulnerable to fraud and that the M-score will indicate greater fraud risks on a sample of Croatian companies.

3. RESEARCH DESIGN

The first part of this chapter describes the research sample, while the research variables and the Beneish model are described in the second part of this chapter.

3.1. Sample description

The research sample comprised the largest German and Croatian companies listed on national stock exchanges. The initial sample covered the 40 largest companies from Germany and Croatia, known as „blue chip“ companies, that are included in stock market indexes or had the largest market capitalization at the beginning of the observed period. It should be pointed out how financial institutions were excluded from the analysis since those institutions are characterized by certain specificities related to preparation and publication of financial reports. After excluding financial institutions and those companies with missing data on variables required for calculating the Beneish M-score, the final sample included 29 companies incorporated in the DAX index (German stock market index) and 31 companies listed on the Croatian capital market.

Companies included in Croatian sample were either part of CROBEX (Croatian stock market index) or included by criteria of market capitalization. As already stated, companies that provide financial and insurance services (financial institutions) as well as those companies for which the necessary data for the calculation of the Beneish model were not available were excluded from the sample. Research period covered years from 2018 to 2023. Financial information for each business entity was collected from the companies' financial reports available on their websites. In cases where financial reports were not published on the company's websites (the case of a few Croatian companies), the reports were downloaded from the Zagreb Stock Exchange website.

3.2. Research variables description

Forensic investigations use different methods and techniques to locate red flags and potential fraud areas. Along with the Dechow F-score model (Dechow et al., 2011), the Beneish M-score model (Beneish, 1999) is often used for fraud detection. Prof. M. D. Beneish from the Kelley School of Business at Indiana University has developed this model. Siregar et al. (2023) emphasize that the „Beneish ratio is a technique used to analyze financial statements detecting whether there is or there is no fraud in financial statements“. The Beneish model is based primarily on information

published in the company's financial statements, and it has two versions; one is a version with eight variables and the other with five variables.

In this paper, we used a version of the model with eight variables, which has the following form:

$$M = -4.84 + 0.92 \cdot \text{DSRI} + 0.528 \cdot \text{GMI} + 0.404 \cdot \text{AQI} + 0.892 \cdot \text{SGI} + 0.115 \cdot \text{DEPI} - 0.172 \cdot \text{SGAI} + 4.679 \cdot \text{TATA} - 0.327 \cdot \text{LVGI} \quad (1)$$

The first step in calculating Beneish M-score is to determine each of the eight input parameters, and the formulas required for their calculation are presented in Table 1.

Table 1 Measurement of the variables included in Beneish model

M-score element	Measurement
Days' sales in a receivable index (DSRI)	$(\text{Receivables}_t / \text{Sales}_t) / (\text{Receivables}_{t-1} / \text{Sales}_{t-1})$
Gross margin index (GMI)	$(\text{Gross profit}_{t-1} / \text{Sales}_{t-1}) / (\text{Gross profit}_t / \text{Sales}_t)$
Asset quality index (AQI)	$1 - ((\text{CA}_t + \text{PPE}_t) / \text{TA}_t) / 1 - ((\text{CA}_{t-1} + \text{PPE}_{t-1}) / \text{TA}_{t-1})$
Sales growth index (SGI)	$\text{Sales}_t / \text{Sales}_{t-1}$
Depreciation index (DEPI)	$(\text{Depr}_{t-1} / (\text{Depr}_{t-1} + \text{PPE}_{t-1})) / (\text{Depr}_t / (\text{Depr}_t + \text{PPE}_t))$
Sales and general and administrative expenses index (SGAI)	$((\text{COGS}_t + \text{GA}_t) / \text{Sales}_t) / ((\text{COGS}_{t-1} + \text{GA}_{t-1}) / \text{Sales}_{t-1})$
Leverage index (LVGI)	$(\text{LTD}_t + \text{CL}_t) / \text{TA}_t / (\text{LTD}_{t-1} + \text{CL}_{t-1}) / \text{TA}_{t-1}$
Total accruals to total assets (TATA)	$\text{Working capital} - \text{Cash} - \text{Depr} / \text{Total assets}$

Where: Where: CA- Current assets; PPE - Property, plant, and equipment, TA - Total assets, COGS - Cost of goods sold, GA - General expenses, LTD - Long-term debt, CL - Current liabilities, Depr - Depreciation
Source: Beneish, 1999.

As previously mentioned, all variables included in the Beneish M-score are calculated based on data from financial statements, and data for two succeeding years are required for variable calculation. When the individual components of the M-score are calculated, the final score is measured, and the possibility of fraud behavior for the observed company is determined. The potential fraudulent behavior is assessed based on the following critical values. When the calculated M-score is greater than -1.78, it indicates a potential for fraud, necessitating further forensic investigations. Furthermore, when the calculated M-score is below -2.22, it can be concluded that there are no fraud indications, while results between -2.22 and -1.78 indicate a "grey zone" and potential fraud in financial statements. For example, the calculated M-score, which amounts to -3.4, indicates a low probability of fraud in financial statements, while the M-score, which amounts to 1.5, signals potential fraud issues.

However, when applying the Beneish M-score, one should consider certain model's limitations. One of the main limitations is that the model was developed on a sample of US companies whose reports are based on American accounting standards. As a result, certain issues may arise when applying the model to financial statements prepared in accordance with International Financial Reporting Standards (Belak, 2011). Another limitation is that the model will be unsuccessful when financial statements are manipulated several years in a row. Also, this model is developed as a fraud detection tool, and making more specific conclusions on fraudulent activities of certain companies requires more detailed forensic analysis.

4. RESULTS

This chapter presents the results of the research conducted. The first part of the research presents the results of the Beneish analysis for German and Croatian companies, which is then followed by a comparative analysis.

4.1. Results of Beneish analysis on a sample of German companies

Table 2 presents the results of applying the Beneish M-score on 29 German companies included in the DAX from 2018 to 2023. All the companies included in the analysis were, according to calculated M-score, classified in one of three groups: unlikely manipulated, probably manipulated or likely manipulated. According to the results, most companies in the whole observed period were classified in the group of unlikely manipulated companies, meaning that their obtained M-score is below -2.22. On the other hand, the percentage of companies classified as probably manipulated is moving from 17.24% (5 companies) in 2021 to 24.14% (7 companies) in 2019 and 2020. Number of likely manipulated companies (with an M-score above -1.78) was the highest in 2022 when four companies (13.79%) were classified as likely manipulated.

Table 2 Presentation of the results of Beneish model for German companies

Year	UM (unlikely manipulated)		PM (probably manipulated)		LM (likely manipulated)	
	Number of companies	%	Number of companies	%	Number of companies	%
2018	20	68.97%	6	20.69%	3	10.34%
2019	19	65.52%	7	24.14%	3	10.34%
2020	21	72.41%	7	24.14%	1	3.45%
2021	21	72.41%	5	17.24%	3	10.34%
2022	18	62.07%	7	24.14%	4	13.79%
2023	20	68.97%	7	24.14%	2	6.90%

Source: Author's work

In order to get a better insight in movements of the M-score on a sample of German companies', the results are presented in Figure 1.

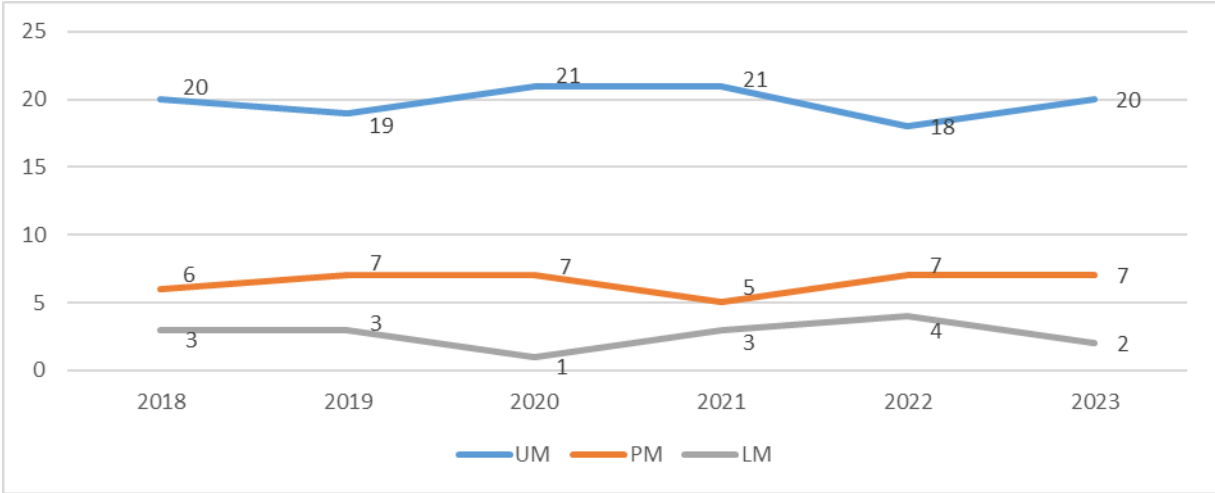


Figure 1 German companies classified in three categories of manipulation (UM: unlikely manipulated, PM: probably manipulated, LM: likely manipulated)

Source: Author's work

It can be seen that the M-score is relatively stable throughout the whole observation period and does not indicate significant oscillations. It should be emphasized that even the COVID years did not affect the increase in the number of companies classified into groups probably manipulated and likely manipulated. Thus, it can be concluded that analysis performed on a sample of German companies included in the DAX index showed how a relatively small proportion

of companies were classified as likely manipulated. It speaks in favor of the reliability and quality of financial reports of analyzed German companies and sends a message to all users of financial statements that they can rely on the information that such reports provide.

4.2. Results of Beneish analysis on a sample of Croatian companies

Table 3 presents the results of the Beneish analysis conducted for 31 Croatian companies in a six-year cycle. The obtained results detect a decrease in the number of companies classified in the group of unlikely manipulated and an increase in the number of those classified in the groups of probably manipulated and likely manipulated. More precisely, the number of companies marked as unlikely manipulated reached 67.74% in the first year of analysis, while in the last year, this number decreased to 32.26% or 10 companies from the sample.

Table 3 Presentation of the results of Beneish model for Croatian companies

Year	UM (unlikely manipulated)		PM (probably manipulated)		LM (likely manipulated)	
	Number of companies	%	Number of companies	%	Number of companies	%
2018	21	67.74%	5	16.13%	5	16.13%
2019	20	64.52%	4	12.90%	7	22.58%
2020	20	64.52%	3	9.68%	8	25.81%
2021	18	58.06%	4	12.90%	9	29.03%
2022	13	41.94%	7	22.58%	11	35.48%
2023	10	32.26%	12	38.71%	9	29.03%

Source: Author's work

Figure 2 also shows negative trends in the movement of the Beneish M-score on the sample of Croatian companies. The number of companies classified as non-manipulators decreased in the observed period, while those classified as potential manipulators increased. This increase in the number of companies that potentially started manipulating financial statements raises a red flag and signals all users to be more careful when making their business decisions.

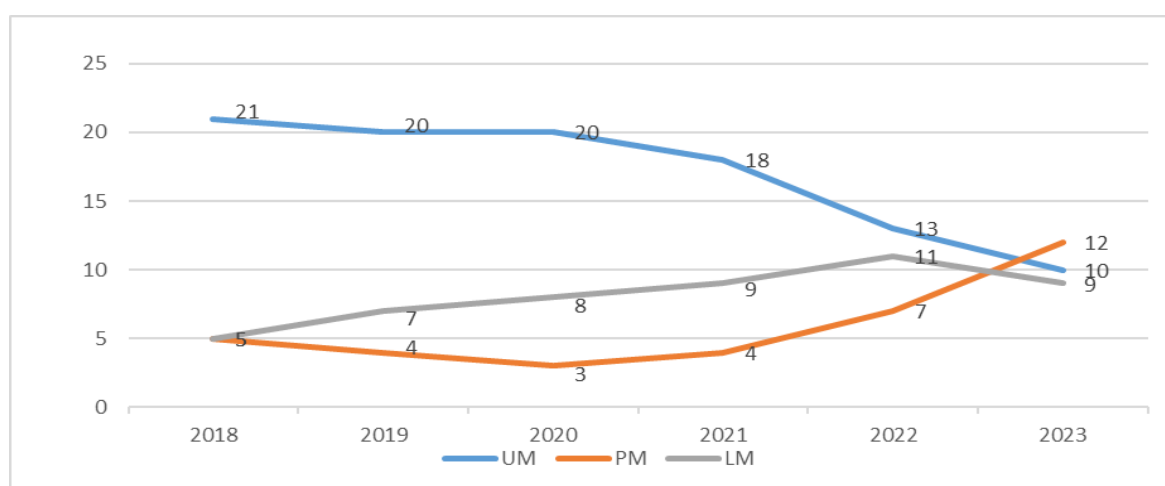


Figure 2 Croatian companies classified in three categories of manipulation (UM: unlikely manipulated, PM: probably manipulated, LM: likely manipulated)

Source: Author's work

Such trends in the M-score may be explained partially by the impact of the COVID-19 pandemic and the weak resilience of Croatian companies to unexpected crisis events that have increased their propensity for fraudulent behavior. Also, as noted by Pervan et al. (2024), tax reforms may

impact earnings management practices, and because tax reform from 2020 introduced a lower income tax rate (from 12% to 10%) from January 1, 2021, this could give impetus to companies for moving income in upcoming years.

4.3. Comparative analysis of the Beneish M-score

This chapter brings a comparative analysis of companies included in this research. As previously mentioned, the Beneish M-score was calculated for 29 German and 31 Croatian companies. The following table presents calculated values for the M-score variables. When analyzing mean values of the calculated M-score in the observed period, conclusions slightly differ from those obtained by detailed classification of companies in three categories of manipulation. When observing the mean M-score value for Croatian companies, the potential fraudulent behavior of companies included in the analysis is detected only in 2022 and 2023. More precisely, the M-score amounted to -2.0424 for 2022. and -2.1128, which classifies analyzed companies in the grey zone or as probably manipulated. For the German sample, there was no sign of manipulation in any of the observed periods since calculated M-score values were below -2.22 in the whole observed period.

When looking at the standard deviation of the M-score variable, the Croatian sample has a greater dispersion of data, which could influence the analysis results. To obtain more robust results, we tested the statistical significance of detected differences using an independent samples t-test. However, the obtained results did not indicate statistical differences in the M-score values (p -value > 0.005) among the two observed countries. Finally, we can conclude that there are no significant differences in the M-score variable, a sign of potentially fraudulent behavior, among German and Croatian companies included in the analysis.

Table 4 Statistical values of M-score indicators for the observed countries in the six-year period

		2018	2019	2020	2021	2022	2023
Minimum	Germany	-3.1219	-3.8502	-3.0459	-16.0091	-3.3101	-3.4869
	Croatia	-4.5659	-3.8160	-7.2364	-6.9565	-3.7665	-3.2432
Maximum	Germany	-1.5924	-0.5592	-1.5068	-1.1619	-1.3931	0.4938
	Croatia	-0.9814	2.5815	-0.5427	-0.7591	0.1017	-0.5559
Median	Germany	-2.3602	-2.4145	-2.6571	-2.5128	-2.3293	-2.5524
	Croatia	-2.5334	-2.4825	-2.5205	-2.4280	-2.1281	-2.1211
Mean	Germany	-2.3757	-2.4013	-2.5255	-2.8662	-2.3293	-2.4049
	Croatia	-2.5749	-2.3402	-2.7015	-2.4188	-2.0424	-2.1128
Standard deviation	Germany	0.42199	0.6539	0.4075	2.5612	0.4707	0.6954
	Croatia	0.79193	1.1933	1.3169	1.1715	1.0159	0.5861

Source: Author's work

Table 5 provides descriptive statistics for the eight variables used in the Beneish model. For the German sample, the number of observations for each variable is 174 (29 companies multiplied by 6 observed years), and for Croatian companies, it amounts to 186 observations (31 business entities times 6 years). From the presented data and considering control measures for the variables, it can be concluded that the obtained results do not indicate the possibility of manipulation. The unique control measure for the variables DSRI, GMI, AQI, and SGI is 1.08. For the German sample, all the results for these variables are below the threshold value. As for the Croatian sample, results for variables AQI and SGI slightly exceed the control value of 1.08. The critical value for the variables DEPI, SGAI, and LVGI is 1.00, and the obtained results for both countries are around this value and do not indicate significant deviations. Variable TATA has a threshold value of 0.02, and in the case of both analyzed samples, the calculated values are below, meaning there is no signal of manipulation on this variable.

Table 5 Descriptive statistics of variables that form Beneish model for a six-year period

		DSRI	GMI	AQI	SGI	DEPI	SGAI	LVGI	TATA
G E R	Min	0.0848	-24.5339	0.2570	0.5739	0.5112	0.4934	0.2843	-0.4685
	Max	1.8841	7.2906	3.4001	1.7918	1.9114	2.2737	2.1985	0.2576
	Mean	0.9930	0.8921	1.0391	1.0649	1.0359	0.9973	1.0102	-0.0033
	Med	0.9799	1.0103	0.9839	1.0532	1.0184	0.9865	0.9948	-0.0085
	SD	0.1816	2.0038	0.3382	0.1608	0.1712	0.1703	0.1534	0.0846
C R O	Min	0.1999	-4.5082	0.2105	0.2337	0.3567	0.2925	0.5009	-0.7483
	Max	3.6403	1.9415	10.6982	3.1083	3.0982	3.6672	2.3278	0.2763
	Mean	1.0630	0.9615	1.1468	1.1534	0.9944	1.0040	1.0151	-0.0239
	Med	0.9970	1.0038	1.0023	1.0843	0.9769	0.9854	0.9892	-0.0217
	SD	0.4475	0.4915	0.9329	0.4156	0.2399	0.2754	0.2309	0.1546

Source: Author's work

When interpreting the M-score as a whole or its specific components, one should consider that the Beneish M-score model is used for detecting potential fraud, and any more specific conclusions require a more detailed forensic analysis.

5. CONCLUSIONS

In this paper, the authors used the Beneish model to detect potentially fraudulent behaviour on a sample of selected German and Croatian companies. Besides the Dechow F-score model, the Beneish model is one of the most common tools used in forensic analysis, and its purpose is to recognize the possibility of manipulations in financial statements. The model consists of 8 (wider version) or 5 (shorter version of the model) variables. In this research, we used the version with eight variables. After identifying the individual parameters of the model, the final M-score was calculated, and the results were compared to critical values. Ultimately, a conclusion was drawn regarding potential manipulations in the financial statements of selected companies in Germany and Croatia.

Based on the research findings, we can conclude that the analysis conducted using the Beneish M-score model shows notable differences in the potential for financial statement manipulation between the German and Croatian companies analyzed. In the sample of Croatian companies, there was a higher incidence of potential financial statement manipulation compared to the German counterparts. The M-score for these Croatian companies exceeded the threshold value in both 2022 and 2023, indicating that they were likely manipulated during these years. However, these differences were not statistically significant, leading us to conclude that there are no major differences in the calculated M-score values between the German and Croatian companies included in this analysis.

This study has several limitations, with the primary one being that it is based on a relatively small sample from only two countries. To achieve more generalized and robust results, future research should consider using larger data sets. Additionally, expanding the research to include more countries in Central and Eastern Europe would provide better insights into the potential fraudulent behavior of companies operating in these regions. Despite the continuous improvement in fraud detection tools and techniques, Omeir et al. (2023) note that the rising number of fraud cases highlights the need for further investigations and enhancements in fraud detection models.

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