

## SELECTING INDICATORS OF PREDICTING FRAUD RISK. CASE STUDY FOR ROMANIAN BUSINESS ENVIRONMENT

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**Abstract:** The act of fraud has been practiced since ancient times and manifests itself in different ways. The aim of the study is to apply the Beneish score on Romanian firms and to identify which indicators are sensitive to the state of fraud. The sample was selected from the Bucharest Stock Exchange and consists of 66 companies traded on the main market for the years 2016-2021. The collected data were analyzed year-by-year and cross-sectional methods (panel data) using manually collected information extracted from financial statements downloaded from the Bucharest Stock Exchange. Based on this data, the Beneish score was calculated and then statistical tests were performed. Using the obtained results from the Beneish Score calculation, we were able to divide the companies into two groups. The obtained scores, clearly underlines the two states: fraud and non-fraud. The ones in the fraud state have a decreased score, while the companies with no likelihood of fraud risk have lower scores. To further investigate our results, we identified sensitive items in both states such as DSRI (Days Sales Receivable Index) and GMI (Gross Margin Index). In conclusion, several theories or hypotheses are offered to explain the underlying motivations for fraud appearance. Romanian companies listed on regulated markets can be classified into risk groups in terms of fraudulent financial statements by applying the Beneish score. The results of the present study are in the interests of the policy makers, management team, business analyst and as well for the general use.

**Keywords:** fraud, Beneish, fraud triangle theory, Romanian company

**JEL classification:** G17, G40

### 1. Introduction

The act of fraud has been practiced since ancient times, and manifests itself in various ways. The first definition of it was stated in the Code of Hammurabi, about 1800 years before the new era (Halilbegovic et al. 2020). According to the Oxford dictionary, the notion of fraud is defined as the act of deceiving parties' interests in order to obtain money or other property illegally. The notion of fraud, according to the explanatory dictionary of the Romanian language is defined as the act "of deceit, an act of bad faith committed by someone, usually to achieve a material profit by taking advantage of another person's rights, or theft." According to the International Standards on Auditing (ISA), financial fraud is defined as "an intentional act committed by one or more individuals at senior management level, persons charged with governance, employees or third parties, involving the use of deception to obtain an unfair or illegal advantage".

With the process of liberalization of developing economies, a number of manipulations of financial statements have emerged and have also occurred with some regularity. With digitization, fraud has become a global phenomenon. In developing economies, there has been a major increase in fraud

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within companies. According to Ibrahim et al. (2013) between corporate taxpayers and tax authorities there is an ongoing "war". Currently, actions taken by companies to manipulate financial statements continue and managers and accountants have become increasingly creative in resorting to different methods.

Fraudulent actions are either detected or undetected (Mohammad et al.2020). In regard of lack of the capabilities of not detecting the fraudulent actions, specialists have developed and are constantly improving models that can help identify the presence of financial fraud.

Several models exist in the literature to identify the presence of financial fraud: the Beneish model (Beneish 1999), the Dechow-Dichev model (Dechow and Dichev 2002), the Piotroski model (Piotroski 2002), the Lev-Thiagarajan model (Lev and Thiagarajan 1993), the Vladu model (Vladu et al. 2016), Robu and Robu (2013), the Hasan score (Hasan et al. 2017).

Through this study, we contribute to the literature by validating the existing model theory in the literature. It is important to note that the results may vary depending on the sample size, larger or smaller, the field of activity for which it is applied and, last but not least, the size of the company (small, medium or large).

The bibliometric analysis aims to provide an overview of existing publications on the topics of interest. By means of a well-founded bibliometric analysis we can quantify the current state of knowledge in our field of research. In this sense we want to perform a bibliometric analysis by using a set of scientific materials downloaded from the Web of Science and Scopus platforms. The main objective of the bibliometric analysis is to provide an overview of existing studies regarding financial fraud theory, fraud theories and the Beneish model allowing us to identify the most valuable articles, institutions, sources, countries and authors. Bibliometric analysis can provide the basis of current studies in the research field and the detection of emerging trends in future research.

For the purpose of our study, we have developed some research questions, which we aim to answer:

Research question 1: *Can bibliometric analysis lay the foundation for qualitative research?*

Research question 2: *Can Romanian listed companies be classified into two groups: with probability of fraud risk, or without?*

Research question 3: *Which indicators may have a significant impact on the probability of fraud risk in the two groups?*

In order to answer to the first research question, we first conduct a bibliometric analysis. Through bibliometric analysis, we can quantify the current state of knowledge. The main objective of this analysis is to study the trend of research in the field of interest. The database that was the basis of the bibliometric analysis was first selected according to several criteria: the first search criterion returned for the 4 keywords a total of 75,245 publications in the period 1996-2022, then the results were refined by applying the following filters, only articles, open access, in English, in the field of finance, financial management and econometrics, excluding part of the articles, resulting in a total of 43,548 articles; then in the second stage of refinement, according to Alshater et al. (2021) Caputo et al. (2021) and Khan et al. (2020), to confirm the accuracy of the research, the refinement concerns strictly articles related to the economic field. The final sample was left with a total of 35,578 items.

For the next two research questions, we calculate the Beneish score, which helps us to divide the societies into the two groups. For this purpose, we used a representative sample of 66 companies listed on the Bucharest Stock Exchange for the period 2016-2021. The results of our study show that a majority percentage of firms in Romania can be classified into two groups (with probability and without probability of fraud risk).

The main objective of our study is to validate the predictive accuracy of the Beneish model. In contrast to previous studies, which were based solely on the application of the model, we want in this study to consider the concomitant effects of both states on the indicators in the composition of the score.

The paper is structured as it follows: the Literature Review in the first section, where we have approached the existing researches, regarding of financial fraud and its evaluation models. In the second

chapter, the Research Methodology was detailed. The section describes the techniques used, variables and data. Further, Results and Discussions, on the results of applying the M-Beneish fraud risk measurement model were issued. In the end, within the conclusions, we have outlined the main findings of the paper. The limitations of the research aimed to constitute future research directions on the researched topic.

## 2. Literature review

The literature states that fraud is perpetrated by applying various techniques to manipulate the results, depending on the expected outcome. Accounting manipulation is applied by those who draw up financial statements, who have different ways of thinking and perceiving things, and can give rise to different ways of applying accounting manipulation.

According to Wells (2011) and Abdullahi et al.( 2015), Robu & Robu (2013) , "fraud" is defined in several ways, but the most suggestive definition is that fraud is committed to make a profit. Financial fraud is committed as a result of a series of intentional acts in order to obtain an unfair, illegal gain or advantage. It is an act undertaken with the intent to deceive others, often ending in significant financial loss (Achim and Borlea 2020).

Financial fraud can occur in different business sectors. Thus, it can be seen that the responsibility to raise red flags is distributed to the company's management, the personnel in charge of corporate governance (Bilgin et al. 2017). Externally, auditors should also apply sufficient audit tests to be sure that financial statements are free from errors or financial manipulation. Therefore, the responsibility is not only assigned to management or the auditor, but is distributed fairly (Johnes 2010).

Thus, in order to present a positive image, pressure is put on managers to cosmeticize results in order to remain attractive to stakeholders (MacCarthy 2017).

The current economic and technological context is considered to be complex, uncertain due to the impossibility of identifying interdependencies between elements of financial statements (Alazard & Separ 2001). Studies by researchers Robu(2013), Beneish (1999), Dechow-Dichev (2001), Mantone (2013), Piotroski (2000),Lev-Thiagarajan(1993),Vladu(2017) are among the seminal works that have highlighted the importance of fraud detection using financial statements. By consulting the literature in the field, we were able to identify analytical models that allow us to catch financial fraud hidden in financial statements and define these models.

The authors Robu and Robu (2013) have made a classification of Romanian firms listed on the BSE into risk groups on fraudulent reporting based on indicators proposed by Beneish (1999). The sample that formed the basis of the study consisted of 64 companies; 27 companies with fraud risk and 37 without fraud risk were identified. In the article "Financial statement fraud detection model using financial ratios", an analysis of financial ratios was carried out, with which fraud can be identified. The sample that was used in the study consisted of 40 companies whose financial statements were classified as fraudulent and 125 companies with non-fraudulent financial statements. The conclusion of the research was that "red flags" signals can also be identified with the help of financial statements (Kanapickienė & Grundienė, 2015).

In the same vein, the authors Hawariah Dalnial et al. (2014) identified in their article "Financial accountability: detecting fraudulent firms", which is 130 companies divided into 65 companies with fraudulent behaviors and 65 companies with honest behaviors, significant differences between the results of financial indicators of fraudulent and non-fraudulent companies. This amount was spent in the period 2000-2011 on Malaysian Public Listed Firms

In their study Erdoğan and Erdoğan (2020) used the Beneish model to examine fraudulent companies at the Istanbul Stock Exchange the sample consists of 30 financially manipulated information in the period 2016 and 2017. After identifying fraudulent companies, they obtain a positive relationship between fraudulent financial information and asset quality index and public, administrative and selling expenses.

Until recent studies, no researcher has applied the unmodified Beneish score to companies listed on the Bucharest Stock Exchange. There are studies in the literature that address a similar idea, but they apply the adjusted Beneish score. The modified score is also applied by the researcher Robu (2013) Herawati, (2015) We believe that it is important to apply the original score to lay the foundation for a thorough research decision. In future research, we propose to develop a specific score to measure the occurrence of financial fraud in Romania

According to some researchers (Wang et al., 2021, 2021, 2022), covering a wide field of research for finds the solution in bibliometric analysis, this being the most suitable for revealing keywords and future research directions, and this way the better. more effective at showing the evolution and relationships between articles and a particular topic or journal by analyzing the relevant literature. Researchers (Wang et al., 2021, 2021, 2022: Xu et al., 2021) research from a holistic perspective. Bibliometric analysis has the advantage of highlighting the current state of research and development trends. Thus, a well-founded bibliometric analysis can lead to future research directions that would further develop the investigated research field (Wang et al., 2022).

In their study entitled "Mapping of financial technology (FinTech) Research: A bibliometric analysis" Ahmi et al (1967) adopted a bibliometric analysis based on data obtained from Scopus and WOS database. Based on the keywords used, which are related to FinTech in the article title, the study manages to obtain 486 documents for further analysis. Various tools were used, such as Microsoft Excel to perform frequency analyses, VOSviewer for data visualization, and Harzing's Publish or Perish for metrics and citation analyses. This study reports results using standard bibliometric indicators such as publication year, document type, source type, source title, languages, domain, keyword analysis, geographic distribution, authors, active institutions, and citation analysis.

To achieve the research objective, the following hypotheses are considered, in addition to the previous mentioned research questions presented above:

Hypothesis 1: *The Beneish model can predict the manipulation of financial statements for Bucharest Stock Exchange listed companies.*

Hypothesis 2: *The Beneish model has a predictive ability and is able to divide the companies into two groups: a group with high fraud risk a group with low fraud risk.*

Following the review of the literature mentioned above, we will further present the research methodology for practical evidence of the application of the score.

### **3. Methods and data**

#### **3.1 Bibliometric methodology**

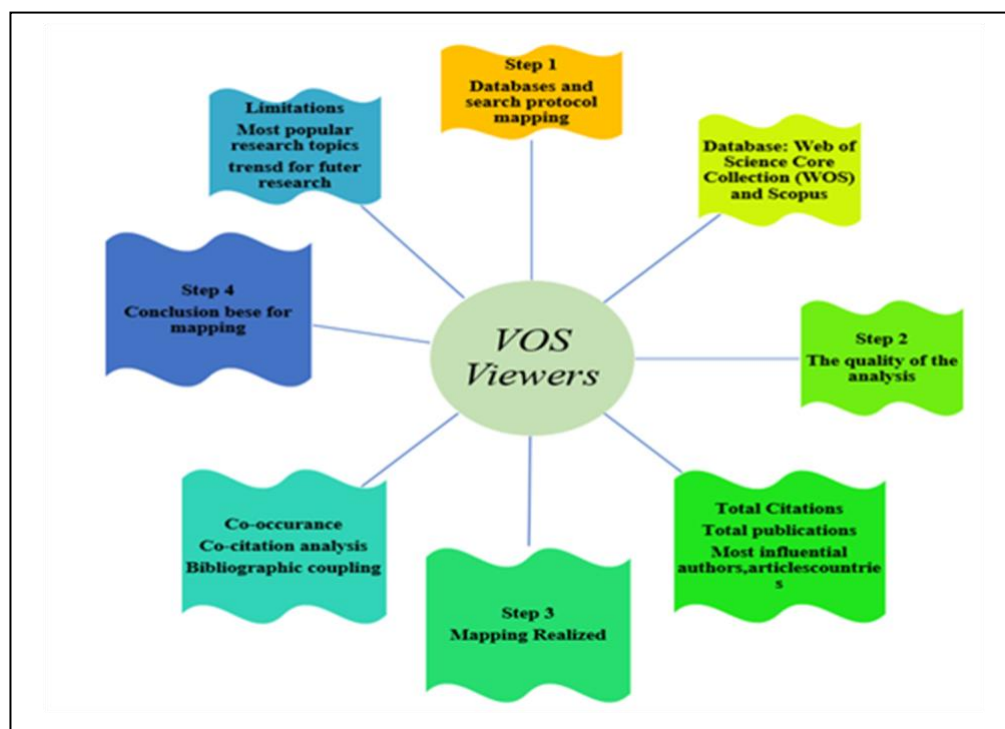
In order to provide a comprehensive review of the knowledge on handling financial statements in correlation with developments in the bibliometric research field (Alshater et al., 2021; Anuar et al., 2022; Dabic et al., 2020), we conducted a database search following known review protocols. Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) protocol, recently revised by Page et al. (2021), we followed the data extraction that we used in the bibliometric analysis. Data were extracted from the Web of Science and Scopus databases. The guide also provides a diagram that we use in this study. (Figure 1).

According to Caputo et al., (2021) and Raghuram et al., (2019), the WOS and Scopus databases present the highest quality publications being a trusted source of highly rated journals. The database selection started on September 1, 2022 and ended on October 30, 2022, it is very important the accuracy of the criteria in terms of bibliometric analysis (Alshater et al., 2021), which prompted us in our searches to lump all possible words associated with fraud, earning management, Beneish and creative accounting. The key words according to which the selection was made, should be found in the abstract, title or in the content of the articles. The first search criterion returned for the 4 key words a total of 75,245 publications during the period 1996-2022, then the results were refined by applying the following filters, only articles, with open access, in English, in the field of finance, financial management and econometrics, excluding a part of the articles, resulting in a total of 43,548 articles, then in the second



refinement according to Alshater et al. (2021) Caputo et al. (2021) and Khan et al. (2020), to confirm the accuracy of the research, the refinement was subjective, i.e. only papers strictly related to economics. The sample remained with a total of 35,578 articles. Moreover, in the term checking step, some of the common terms such as author, study, research, article, year, date, paper, etc. were deselected.

**Figure 1: Research methodology in bibliometric analysis**



Source: created by the author.

### 3.2 Data

In this study we selected 81 companies listed on the BSE. To construct the sample, we have set the base ground on two perspectives. In the first perspective we have selected the type of company. The financial institutions and companies that had only a point of business in Romania, not headquarters, were eliminated. In the second perspective we selected only companies that had a constant listing, because the lack of data can lead to bias the research. With the application of the two perspectives the sample was filtered down to a total of 66 companies for the period 2016-2021. In the following, the Beneish score was calculated. The score for each company was calculated and then it was reported to the benchmark value of -2.22 so that the selected sample can be divided into the two categories: with probability of fraud risk and without probability of fraud risk. In the group with probability of fraud risk we have a number of 45 companies analyzed and for the group without probability of fraud risk we have a number of 21 companies. In both cases the data were in panel form over a period of 6 years (2016-2021). (Safta et al. 2020)

The steps that have been followed to carry out the study are the following:

- \*Centralization of data from financial statements downloaded from the Bucharest Stock Exchange (BSE);
- \*Calculation of the eight variables and finally the Beneish score;
- \*Segmentation of companies into two groups (the first group is the one that contains companies with no probability of fraud risk and the second group is the one that contains companies that are with probability of fraud risk. The groups were selected according to the result of the Beneish score;
- \*Application of the statistical model;

\* The statistical testing is carried out in the identified states with the help of the Beneish score, in order to identify the indicators of sensitivity to the state without fraud risk and to the state with fraud risk.

Variables

Using the M-Beneish (1999) model it is possible to identify the presence or absence of fraud risk in the analyzed companies. The score was calculated using the information contained in the financial statements. The Beneish score is considered the dependent variable, the components of the Beneish score are the independent variables.

The M-Beneish equation is as follows:

$$M = -4.84 + 0.92 * DSRI + 0.528 * GMI + 0.404 * AQI + 0.892 * SGI + 0.115 * DEPI - 0.172 * SGAI + 4.679 * TATA - 0.327 * LVGI \text{ (Beneish, 1999). (1)}$$

The reference value is -2.22. Any score higher than this will indicate an increased likelihood of data manipulation.

**Table 1: The independent variables**

Variables	Explanation	Calculation formula
<b>Days' Sales in Receivables Index (DSRI)</b>	This indicator should have a linear trajectory, if there are no major changes in terms of external lending. The value greater than 1 indicates that the number of receivables is higher in year t than in t-1. This could signal the presence of manipulated income (Mahama, 2015)	$DSRI = \frac{\text{Net Receivables}_t}{\text{Sales}_t} / \frac{\text{Net Receivables}_{t-1}}{\text{Sales}_{t-1}}$
<b>Gross Margin Index (GMI)</b>	It was constructed by Beneish (1999) to detect irregularities in financial statements by measuring the ratio of a company's previous year's gross margin to the current year's gross margin (Beinesh 1999). Declining gross margin from one year to the next may indicate manipulation of the financial statements. A GMI score greater than 1 is an important red flag for any auditor and accountant (Robu&Robu, 2013).	$GMI = \frac{\text{Gross margin}_{t-1}}{\text{Sales}_{t-1}} / \frac{\text{Gross margin}_t}{\text{Sales}_t}$

<p><b>Asset quality index (AQI)</b></p>	<p>A value greater than 1 of the AQI variable can signal the presence of financial fraud. The cases where AQI has a higher value is when the accounting professional uses asset/asset revaluation techniques, research and development costs, advertising are capitalized as intangible assets (Ibadin and Ehigie, 2019). A high value of the variable indicates the presence of creative accounting/fraud through the use of excessive capitalization of expenses (Ibadin and Ehigie, 2019).</p>	$AQI = \frac{\text{Fixed assets}_t - \text{Net tangible fixed assets}_t}{\text{Total assets}_t} / \frac{\text{Fixed assets}_{t-1} - \text{Net tangible fixed assets}_{t-1}}{\text{Total assets}_{t-1}}$
<p><b>Sales Growth Index - SGI</b></p>	<p>In the situation where the index has a high value, then it may be about the manipulation of financial statements (Mahama, 2015).</p>	$SGI = \frac{\text{Sales}_t}{\text{Sales}_{t-1}}$
<p><b>Depreciation Index (DEPI)</b></p>	<p>Depreciation index is the ratio of depreciation expenses to gross value (Mahama, 2015). A value greater than 1 of this index indicates that the rate of asset depreciation has slowed (Beneish, 1999). Thus, "red flags" could be raised when revenues are increasing and depreciation expenses are decreasing (Ibadin and Ehigie, 2019).</p>	$DEPI = \frac{\text{Value adjustments expenses}_{t-1}}{\frac{\text{Value adjustments expenses}_{t-1} + \text{Tangible fixed assets}_{t-1}}{\text{Value adjustments expenses}_t + \text{Tangible fixed assets}_t}}$
<p><b>Sales, General, and Administrative Expenses Index (SGAI)</b></p>	<p>The index could include a number of incentives or bonuses for managers.</p>	$SGAI = \frac{\frac{\text{General management expenses}_t}{\text{Sales}_t}}{\frac{\text{General management expenses}_{t-1}}{\text{Sales}_{t-1}}}$
<p><b>Leverage Index (LVGI)</b></p>	<p>A value greater than 1 may suggest the possibility that the enterprise is involved in financial fraud (Ibadin and Ehigie, 2019).</p>	$LVGI = \frac{\text{Total debts}_t}{\text{Total liabilities}_t} / \frac{\text{Total debts}_{t-1}}{\text{Total liabilities}_{t-1}}$
<p><b>Total Accruals to Total Assets Index (TATA)</b></p>	<p>The alarm signal in the case of this index can be raised if the degree of commitments increases as a share of total assets. Also, an increase in income or a decrease in expenses, in accrual accounting, indicates the presence of a manipulation of financial information (Aghghaleh, 2016).</p>	$TATA = \frac{\text{Net outcome of exercise}_t - \text{Cash flows from exploitation activities}_t}{\text{Total assets}_t}$

Source: own processing.







**Table 2: Descriptive statistics of the main variables**

Variables	Fraud	Average	Std.Dev.	Min	Max	Observations
<b>BENEISH</b>	No risk	-4.068	4.7234	-58.971	-2.221	232
	With risk	3.0489	16.5048	-2.199	123.206	146
<b>DSRI</b>	No risk	1.1623	1.3467	0.23	17.84	232
	With risk	2.8177	10.6713	0.06	103.6	146
<b>GMI</b>	No risk	-0.7715	8.6009	-105.08	17.4	232
	With risk	4.9322	22.8148	-8.46	235.61	146
<b>AQI</b>	No risk	1.0057	1.0281	-4.39	9.69	232
	With risk	3.8066	17.9901	0	206.82	146
<b>SGI</b>	No risk	1.0019	0.3396	-0.73	2.11	232
	With risk	1.0693	0.35838	0.08	2.17	146
<b>DEPI</b>	No risk	1.0822	0.6395	0.01	7.72	232
	With risk	2.4780	12.2186	0.01	144.01	146
<b>SGAI</b>	No risk	1.2799	2.3054	0.36	33.95	232
	With risk	1.1814	1.0973	0.15	12.31	146
<b>LVGI</b>	No risk	0.9456	0.4118	0	3.05	232
	With risk	0.9393	0.6672	0	5.25	146
<b>TATA</b>	No risk	-0.0888	0.1491	-1.2	0.44	232
	With risk	-0.01226	0.1927	-1.2	1.2	146

Source: own processing

**Table 3: Descriptive statistics of the main variables**

	Beneish	DSRI	GMI	AQI	SGI	DEPI	SGAI	LVGI	TATA
<b>BENEISH</b>	1								
<b>DSRI</b>	-0.2703***	1							
<b>GMI</b>	0.9189***	0.0273	1						
<b>AQI</b>	0.0957	-0.1319***	0.0523	1					
<b>SGI</b>	-0.0378	-0.5130***	-0.2227***	0.0180	1				

<b>DEPI</b>	0.0421	-0.1431**	-0.0095	-0.0318	0.0993	1			
<b>SGAI</b>	-0.0125**	0.2898***	0.0148	0.0099	-0.2677***	-0.0394	1		
<b>LVGI</b>	-0.0381**	0.0911	0.0543	0.0118	-0.1179	-0.0457	-0.1094	1	
<b>TATA</b>	0.1536**	-0.3689***	-0.0269	0.0032	0.2078***	0.0305	0.0166	-0.1595***	1

Source: own processing

Note: \* p < 0,1, \*\* p < 0,05 and \*\*\* p < 0,01.

**Table 4: Fraud risk probability state variable correlation matrix**

	<b>Beneish</b>	<b>DSRI</b>	<b>GMI</b>	<b>AQI</b>	<b>SGI</b>	<b>DEPI</b>	<b>SGAI</b>	<b>LVGI</b>	<b>TATA</b>
<b>BENEISH</b>	1								
<b>DSRI</b>	0.5521***	1							
<b>GMI</b>	0.6927***	-0.0273	1						
<b>AQI</b>	0.3698***	-0.0294	-0.0438	1					
<b>SGI</b>	0.0586	-0.3070***	0.2376***	0.1627***	1				
<b>DEPI</b>	0.0356	-0.0248	-0.0253	-0.0237	-0.1594	1			
<b>SGAI</b>	0.1763**	0.4387**	-0.0719	-0.0276	-0.4249***	0.0191	1		
<b>LVGI</b>	0.0262	0.2697**	-0.0876	-0.1067	-0.0281	-0.1282	-0.0061	1	
<b>TATA</b>	-0.0740	0.1644***	-0.0165	-0.3495***	-0.0846	-0.0262	0.0195	-0.1698***	1

Source: own processing

Note: \* p < 0,1, \*\* p < 0,05 and \*\*\* p < 0,01.

We can see that in both groups there are Beneish score items that are statistically significant at a 1% significance level, such as DSRI, GMI, SGAI, but we can also identify Beneish score items that are not significant in both groups.

In Table 5 we find the correlation matrix for the group with no likelihood of fraud risk. For these regressions the tests were performed using the random effect test because the significance coefficient of the model is less than 0.05. For each individual model the random effect was applied, in each test which we have performed. The models presented in Table 5, have Beneish score as dependent variable. Model 1 has Beneish score as dependent variable and DSRI as independent variable. For this model, it can be seen that the independent variable is statistically significant but negative. Model 2 has GMI as the independent variable, after testing it can be seen that this variable is also statistically significant. For model 3 we have AQI as independent variable. After testing its relationship with the dependent variable, we have seen that it is the case of an insignificant relationship. In case of model 4, we have SGI as independent variable and for model 5 we have DEPI as independent variable. Model 6 uses SGAI as the independent variable and model 7 has LVGI as the independent variable, as for the independent variables forming model 4,5,6,7, none of the variables is statistically significant. It can be seen that model 8, has statistically significant independent variable. In terms of testing all independent variables with the dependent variable, it can be seen in model 9, that statistically significant and positive are the indicators GMI, SGAI and TATA, and statistically significant and negative are DSRI and LVGI.

**Table 5: Fraud risk probability state variable correlation matrix**

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6	MODEL 7	MODEL 8	MODEL 9
<b>DSRI</b>	-0.9261***								-0.9293***
<b>GMI</b>		0.5004***							0.5136***
<b>AQI</b>			0.42180						0.0522
<b>SGI</b>				-0.8024					0.3947
<b>DEPI</b>					-0.52298				0.0633
<b>SGAI</b>						-0.02975			0.1072***
<b>LVGI</b>							0.1064		-0.5128***
<b>TATA</b>								4.7594**	2.1161***
<b>NR OBS</b>	232	232	232	232	232	232	232	232	232
<b>R2 WITHIN</b>	0.0563	0.8522	0.0073	0.0322	0.0048	0.0006	0.0001	0.0155	0.9364
<b>R2 BETWEEN</b>	0.0962	0.8648	0.0082	0.0779	0.0033	0.0000	0.0203	0.0563	0.9602
<b>R2 OVERALL</b>	0.0731	0.8443	0.0092	0.0014	0.0018	0.0002	0.0014	0.0236	0.9428
<b>WALD CH2(1)</b>	17.10	1293.36	1.98	0.78	0.50	0.05	0.02	5.23	3673.02
<b>PROB &gt; CH2</b>	0.000	0.000	0.1597	0.3773	0.4778	0.8241	0.8969	0.022	0.000

Source: own processing

Note: \* p < 0,1, \*\* p < 0,05 and \*\*\* p < 0,01.

Regarding the probability of fraud risk, the test was also performed with random effect, which can be seen in Table 6. We test each model individually. Model 1 has Beneish score as dependent variable and DSRI as independent variable, for this model it can be seen that the independent variable is statistically significant. Model 2 has GMI as the independent variable, after testing it can be seen that this variable is also statistically significant. For model 3 we have as independent variable AQI, following the test of its relationship with the dependent variable it is significant. For model 4 we have SGI as independent variable, for model 5 we have DEPI as independent variable. Model 6 uses SGAI as the independent variable and model 7 has LVGI as the independent variable. As for the independent variables forming model 4,5,6,7,8 none of the variables is statistically significant. In terms of testing all the independent variables with the dependent variable, it can be seen in model 9, that statistically significant and positive are the indicators DSRI, GMI, AQI, DEPI and statistically significant and negative are SGAI, TATA and LVGI.

We can see that in both states the DSRI, GMI indicators are statistically significant when we test the indicators in turn, this suggests that we have a share of sensitive indicators in both groups.

The DSRI and GMI indicators, can be associated with bifurcated accounts in the accounts, as they indicate both the occurrence of fraud and the absence of fraud. An increase in DSRI is the result of a change in lending policy, which leads to a boost in sales, but unusual increases in receivables relative to sales also suggest a fluctuation in revenue. GMI is the ratio of gross margin in year t-1 to gross margin in year t. When GMI is greater than 1, gross margins deteriorate. Clearly, deteriorating gross margin is a negative signal about a company's prospects and may be a sign of poor management. this could cause managers (who are often under pressure to budget) to manipulate profits.

Our results are similar with those of Li and Zaitas (2018) who focus in their study on identifying information contained in financial statements that indicate profit manipulation. They indicated that companies with high Asset quality index have a good platform for profit manipulation and managers of these companies are more motivated to manage profits. On the same note, Rahimian and Heidari (2019), conducting their research, find that the ratio of sales to total assets and equity to total assets are two fraud sensitive financial indices. Similarly, Shirazi and Mehrdad (2018) in their study focused on the topic of "Investigating the relationship between business strategy and fraudulent financial reporting", revealed through their results that management strategy influences fraud in financial statements

This section provides an overview of the results on the applicability of the Beneish M-Score model to the regulated market. In this regard, the research had two research hypotheses "The Beneish model can predict the manipulation of financial statements for BSE listed companies. And The Beneish model has a predictive ability and divides companies into the two groups. Based on the results, it was concluded that the Beneish model can indeed be applied to BSE listed companies that are part of the regulated market and with the help of the score can be divided into two groups and the research hypotheses are validated.

**Table 6: Beneish Regression Result and Components with random effect (probability of fraud risk)**

	MODEL 1	MODEL 2	MODEL 3	MODEL 4	MODEL 5	MODEL 6	MODEL 7	MODEL 8	MODEL 9
<b>DSRI</b>	0.85704***								0.9364***
<b>GMI</b>		0.5002***							0.5218***
<b>AQI</b>			0.3351***						0.3762***
<b>SGI</b>				4.26059					0.2575
<b>DEPI</b>					0.0451				0.1032***
<b>SGAI</b>						1.8793			-0.3759**
<b>LVGI</b>							1.1923		-0.5831**
<b>TATA</b>								-4.3202	-1.6594***
<b>NR OBS</b>	146	146	146	146	146	146	146	146	146
<b>R2 WITHIN</b>	0.3701	0.5732	0.0022	0.0144	0.0022	0.0001	0.0218	0.0045	0.9797
<b>R2 BETWEEN</b>	0.1590	0.2843	0.4422	0.0156	0.0002	0.0427	0.0488	0.1113	0.9926
<b>R2 OVERALL</b>	0.3048	0.4798	0.1367	0.0034	0.0013	0.0311	0.0007	0.0055	0.9851
<b>WALD CHI2(1)</b>	64.80	142.93	21.95	1.2	0.17	2.15	0.37	0.37	9049.96
<b>PROB &gt; CHI2</b>	0.000	0.000	0.000	0.2739	0.6813	0.0.1423	0.5443	0.5439	0.000

Source: own processing

Note: \* p < 0,1, \*\* p < 0,05 and \*\*\* p < 0,01.

## 5. Conclusions

In conclusion, several theories or hypotheses are offered to explain the motivations behind co-professional fraud. However, it is fair to say that no hypothesis has received overwhelming empirical support that refutes reasonable alternative explanations. Some of the simplistic explanations end up raising more questions than providing convincing answers.

Through the bibliometric study, we have answered research question 1, as it presents us with a holistic picture of the structure of the research on the link between for security and the Beneish model, providing a comprehensive assessment of the literature on this topic over the past quarter century.

By applying the Beneish score, we succeed in answering research question two, by affirming the fact that Romanian companies listed on regulated markets can be classified into two classes of risk groups, in terms of fraudulent and non-fraudulent financial statements.

With the statistical processing, we came to the conclusion that the calibration of our data is very important, because the existing models in the specialized literature are not generally applicable.

The models from the literature are not generally applicable, because each sample has its specific characteristics, the samples can differ both in size and characteristics, such as the type of company, the type of financial situation, the country of origin of the company.

Based on the results of the bibliometric analysis, the most popular topics, challenges and directions for the future research was discussed, confirming that the research area of financial fraud is of increasing interest to both academia and business. This bibliometric study provides a holistic visual picture of the intellectual structure of knowledge related to financial fraud, providing a comprehensive picture of this topic. Indices like DSRI, GMI, SGAI, help us to draw the difference between companies with fraud risk and companies without fraud risk. The contribution of this paper consists in the fact that, through the bibliometric analysis carried out, the foundations of a qualitative research can be laid, this helping us to answer the first research question. The element of novelty brought by our work compared



to the other existing research in the specialized literature is the mapping of the relationship between the indicators of the financial fraud identification models. In terms of the novelty of this research, it is the identification of the elements that have a direct influence on the Benish school, and in terms of as for the bibliometric part, the clarification of the papers that suggest the relationship between the Benish score and financial fraud.

A first, limitation of this study is the size of the sample, but we would like to extend the sample to all companies listed on the Bucharest Stock Exchange in order to analyse all companies listed on the Bucharest Stock Exchange. Even the object of activity of the analyzed companies can be considered as another limitation. The companies analyzed belong to various sectors, and this could be the second improvement that could be added to the thesis: the selection of all listed companies and the calculation of indices for each sector of activity.

The second limitation of the study may be the limitation of searches from only two sources (Web of Science and Scopus) and the use of only one bibliometric analysis software.

Improvement is a constant, and for each study carried out, another research opportunity may arise. The more we research, the more we realize we know less. We aim to remove these limitations by expanding the database, both in forming a larger sample and downloading data from both the BSE and the Thomson Reuters Eikon platform and selecting articles for bibliometric analysis from several international databases.

### Supplementary information

The article does not contain additional files.

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### References

- Achim, M. V., & Borlea, S. N. (2017). Ghid pentru analiza-diagnostic a stării financiare. Risoprint.
- Achim, M. V., & Borlea, S. N. (2020). Economic and Financial Crime: Corruption, shadow economy, and money laundering (Vol. 20). *Springer Nature*.
- Ahmi, A., Tapa, A., & Hamzah, A. H. (1967). Mapping of financial technology (FinTech) Research: A bibliometric analysis. *Globalization*, 2, 2008.
- Alazard, C., & Separi, S. (2001). *Contrôle de gestion*, Paris, Dunod.
- Abdullahi, R., and N. Mansor. (2015) Concomitant Debacle of Fraud Incidences in the Nigeria Public Sector: Understanding the Power of Fraud Triangle Theory. *International Journal of Academic Research in Business and Social Sciences* 5 (9): 241–255.
- Alshater, M. M., Atayah, O. F., & Khan, A. (2021). What do we know about business and economics research during COVID-19: A bibliometric review. *Economic Research-Ekonomska Istraživanja*, 35(1), 1884-1912.
- Anuar, A., Marwan, N. F., Smith, J., Siriyanun, S., & Sharif, A. (2022). Bibliometric analysis of immigration and environmental degradation: evidence from past decades. *Environmental Science and Pollution Research*, 1-13.
- Beneish, M. D. (1999). The detection of earnings manipulation. *Financial Analysts Journal*, 55(5), 24-36.
- Bilgin, M. H., Gozgor, G., & Lau, C. K. M. (2017). Institutions and gravity model: The role of political economy and corporate governance. *Eurasian Business Review*, 7, 421-436.
- Caputo, A., Pizzi, S., Pellegrini, M. M., & Dabić, M. (2021). Digitalization and business models: Where are we going? A science map of the field. *Journal of Business Research*, 123, 489-501.

- Dabić, M., Maley, J., Dana, L. P., Novak, I., Pellegrini, M. M., & Caputo, A. (2020). Pathways of SME internationalization: A bibliometric and systematic review. *Small Business Economics*, 55, 705-725.
- Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., & Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. *Journal of Business Research*, 133, 285-296.
- Erdoğan, M., & Erdoğan, E. O. (2020). Financial statement manipulation: a Beneish model application. In *Contemporary Issues in Audit Management and Forensic Accounting* (Vol. 102, pp. 173-188). *Emerald Publishing Limited*.
- Halilbegovic, S., Celebic, N., Cero, E., Buljbasic, E., & Mekic, A. (2020). Application of Beneish M-score model on small and medium enterprises in Federation of Bosnia and Herzegovina. *Eastern Journal of European Studies*, 11(1).
- Khan, A., Hassan, M. K., Paltrinieri, A., Dreassi, A., & Bahoo, S. (2020). A bibliometric review of takaful literature. *International Review of Economics & Finance*, 69, 389-405.
- Li, T., & Zaiats, N. (2017). Corporate governance and firm value at dual class firms. *Review of Financial Economics*.
- Manesh, M. F., Pellegrini, M. M., Marzi, G., & Dabic, M. (2020). Knowledge management in the fourth industrial revolution: Mapping the literature and scoping future avenues. *IEEE Transactions on Engineering Management*, 68(1), 289-300.
- Martyn, J. (2010). Auditors and Fraud—And the end of Watchdogs and Bloodhounds, *The Magazine Financial Auditor*. Bucharest: CAFR, vol. 8, pp. 46–49.
- MacCarthy, J. (2017). Using Altman Z-score and Beneish M-score models to detect financial fraud and corporate failure: A case study of Enron Corporation. *International Journal of Finance and Accounting*, 6(6), 159-166.
- Mahama, M. (2015). Detecting corporate fraud and financial distress using the Altman and Beneish models. *International Journal of Economics, Commerce and Management*, 3(1), 1-18.
- Mantone, P. S. (2013). Using analytics to detect possible fraud: tools and techniques. John Wiley & Sons.
- Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., ... & Moher, D. (2021). The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *International journal of surgery*, 88, 105906.
- Piotroski, J. D. (2000). Value investing: The use of historical financial statement information to separate winners from losers. *Journal of Accounting Research*, 1-41.
- Raghuram, S., Hill, N. S., Gibbs, J. L., & Maruping, L. M. (2019). Virtual work: Bridging research clusters. *Academy of Management Annals*, 13(1), 308-341.
- Rahimian, N. and Haji Heydari, R. (2019). Detection of fraud using the modified model and financial ratios, *Empirical Accounting Research*, 8(3), pp. 47-69.
- Robu, I. B., & Robu, M. A. (2013). Proceduri de audit pentru estimarea riscului de fraudă bazate pe indici de detectare a manipularilor contabile/Audit Procedures for Estimating the Fraud Risk Based on Indexes for Detection of Accounting Manipulation. *Audit Financiar*, 11(10), 3.
- Safta, I. L., Achim, M. V., & Borlea, S. N. (2020). Manipulation of financial statements through the use of creative accounting. Case of Romanian companies. *Studia Universitatis Vasile Goldiș Arad, Seria Științe Economice*, 30(3), 90-107.
- Safta, I. L., Sabău, A. I., & Muntean, N. (2021). Bibliometric analysis of the literature on measuring techniques for manipulating financial statements. *Risks*, 9(7), 123.
- Sabău, A. I., Mare, C., & Safta, I. L. (2021). A statistical model of fraud risk in financial statements. Case for Romania companies. *Risks*, 9(6), 116.
- Shakouri, M. M., Taherabadi, A., Ghanbari, M., & Jamshidinavid, B. (2021). Explaining the Beneish model and providing a comprehensive model of fraudulent financial reporting (FFR). *International Journal of Nonlinear Analysis and Applications*, 12, 39-48

- Shirazi D., M. and Haghgoo M., N. (2018). Investigating the Relationship between Business Strategy and Fraudulent Financial Reporting with Emphasis on the Role of Disclosure Quality, *Accounting Perspective and Management*, 1(1), pp. 60-76
- Salihu, I. A., Obid, S. N. S., & Annuar, H. A. (2013). Measures of corporate tax avoidance: Empirical evidence from an emerging economy. *International Journal of Business and Society*, 14(3), 412.
- Wang, X., Xu, Z., Su, S.-F., & Zhou, W. (2021). A comprehensive bibliometric analysis of uncertain group decision making from 1980 to 2019. *Information Sciences*, 547, 328–353.
- Wang, X., Xu, Z., Qin, Y., & Skare, M. (2021). Service networks for sustainable business: A dynamic evolution analysis over half a century. *Journal of Business Research*, 136, 543–557
- Wang, X., Qin, Y., Xu, Z., & Skare, M. (2022). A look at the focus shift in innovation literature due to Covid-19 pandemic. *Journal of Business Research*, 145, 1–20.
- Xu, Z., Wang, X., Wang, X., & Skare, M. (2021). A comprehensive bibliometric analysis of entrepreneurship and crisis literature published from 1984 to 2020. *Journal of Business Research*, 135, 304–318