Equilibrium. Quarterly Journal of Economics and Economic Policy
Volume 17 Issue 2 June 2022
p-ISSN 1689-765X, e-ISSN 2353-3293
www.economic-policy.pl

ORIGINAL ARTICLE

Citation: Durana, P., Blazek, R., Machova, V., & Krasnan, M. (2022). The use of Beneish M-scores to reveal creative accounting: evidence from Slovakia. *Equilibrium. Quarterly Journal of Economics and Economic Policy, 17*(2), 481–510. doi: 10.24136/eq.2022.017

Contact to corresponding author: Pavol Durana, pavol.durana@fpedas.uniza.sk

Article history: Received: 25.02.2022; Accepted: 1.06.2022; Published online: 25.06.2022

Pavol Durana
University of Zilina, Slovakia
orcid.org/0000-0001-5975-1958

Roman Blazek
University of Zilina, Slovakia
orcid.org/0000-0002-8054-9540

Veronika Machova
School of Expertness and Valuation
Institute of Technology and Business in Ceske Budejovice, Czechia
orcid.org/0000-0001-5479-6655

Miroslav Krasnan
University of Zilina, Slovakia
orcid.org/0000-0003-3180-7694

The use of Beneish M-scores to reveal creative accounting: evidence from Slovakia

JEL Classification: *M00; M21; M41; M42; P34*

Keywords: *Beneish model; creative accounting; earnings management; ROC curve*

Abstract

Research background: In creative accounting, the primary goal of every enterprise is to increase and strengthen its market position. Over the years, manipulation of financial statements has also reached the territory of Central European countries, including the Slovak Republic. Therefore, an analysis was conducted to identify enterprises that handle accounting. This article focuses specifically on Sector A: agriculture, forestry, and fisheries.
Purpose of the article: The aim of the article was to reveal the creative accounting practices of a sample of enterprises operating in the Slovak business environment in a sector using the Beneish model.

Methods: The Beneish model was used to calculate the manipulation of enterprises' financial statements. Both variants, that is, the 5-parameter model and 8-parameter model, were used for the calculation. The results of these models were plotted using graphs and receiver operating characteristic (ROC) curves.
Findings & value added: Based on the use of both variants of the Beneish model, it was proven that enterprises in the analyzed sector use the possibility of manipulating financial statements. The added value of the article is the detection of the use of creative accounting in a specific sector, which makes the study original in its application and space-time orientation.

Introduction

Creative accounting is a frequently used tool in the field of economic crime and delinquency (Hlawiczka *et al.*, 2021, pp. 27–37). This topic has been practically observed since the second half of the last century, but the largest boom in creative accounting was experienced before the global financial crisis in 2007. The information that came to the surface led to a reassessment of accounting and its regulations (Savova, 2021, pp. 111–122; Lehene, 2021). Several measures have been taken, most of which were prepared and implemented in the bustle of a rapidly changing economic environment, which means that these measures were not as effective as the authorities expected (Kliestik *et al.*, 2020a, pp. 332–345).

The current theory represents a relatively solid pool of knowledge and practices on how to identify creative accounting techniques and which methods should be used to detect them (Khuong *et al.*, 2020, pp. 247–261). It should be noted, however, that on the other hand of the barricade there is an enterprise practice indicating the use of different measures and steps to present the economic results in the best possible way and thus manipulate various accounts in different ways (Setyoputri & Mardijuwono, 2020, pp. 502–512; Pardal *et al*., 2021, pp. 48–51).

Recent research and a growing number of published articles have revealed that this topic is still relevant and of long-term interest, even without the publicizing of major accounting scandals (Figure 1). The citation report shows that knowledge, monitoring, study design, and awareness of creative accounting are increasing every year, and since 2004, there has been a growing trend of publications trying to raise awareness about this phenomenon. The authors' efforts are focused on the development of models that reveal or deal with creative accounting to raise awareness, which may result in better studies, proposals, and measures to prevent illegal manipulation of financial statements and thus decrease the potential financial risks to business partners (Dvorsky *et al.*, 2020, pp. 76–88; Minciu *et al*., 2020; Gasova & Stofkova, 2017). All relevant studies are mostly published in highly developed countries, but the problem of earnings manipulation is

critical in emerging European countries, where the issue of creative accounting has not yet been explored adequately (e.g., Slovakia, the Czech Republic, and Poland), making this problem even more specific in the given economic conditions (Svabova *et al.*, 2020b, pp. 80–90).

Thus, this study aims to reveal the creative accounting practices of a sample of enterprises operating in the Slovak business environment. Despite the fact that this is a one-country study, its results may be applied within the Visegrad countries as well in the context of the realized sectoral research, as these countries were economically interconnected in the past and have very similar formulas of economic behavior even under the current conditions (Valaskova *et al.*, 2020b, pp. 101–119). The research sample consisted of enterprises operating in the agriculture, forestry, and fishing sectors (statistical classification NACE A) from 2015 to 2018. The study focuses on the critical sector of our unique national environment, which was floundering in scandals in the analyzed period. Thus, a number of enterprises with a high probability of earnings manipulation may be found in this sector. The size and period were chosen intentionally to indicate that external factors play an important role and may motivate an enterprise to use manipulative techniques.

The comparison of the Beneish models (Beneish, 1999, pp. 24–36) and the application of the modified Jones model (Dechow *et al.*, 1995, pp. 193–225) helps detect earnings management practices and identify the use of creative accounting in a specific sector, which makes the study original in its application and space-time orientation. The analysis is completed using a graphical representation (radar graphs), where the resulting scores of the Beneish and modified Jones models are assessed in individual years. The construction of ROC (Receiver operating characteristic) curves illustrates which of the models can better explain the probability of occurrence of creative accounting in the analyzed industry.

The paper is divided as follows: first, the literature review section summarizes the most important and relevant studies published in this field to declare the importance and topicality of the issue. The Materials and Methods section specifies the methods and models used to depict earnings manipulation practices in a sample of enterprises. The Results and Discussion section provides crucial findings and discusses them in the context of other international studies.

Literature review

The literature review covers the research incentives devoted to this topic. Creative accounting and earnings management are global phenomena. These studies focus on a better understanding of the reasons enterprises use this tool to adjust financial statements. This may be due to the financial health of the enterprise and financial indebtedness (Xu *et al.*, 2021, pp. 22–38; Dima & Vasilache, 2016, pp. 127–143; Valaskova *et al.*, 2021b, pp. 639–659), policy uncertainty (Yung & Root, 2019, pp. 255–267), staying in the market (Gavurova *et al.*, 2020, pp. 557–569; Vatamanescu *et al.,* 2021; Ngo, 2021, pp. 60–63), or business prosperity, where managers seek different ways to meet their revenue while meeting the goals set by business management (Wang *et al.*, 2021; Stofko & Stofkova, 2014). The system of rewarding managers based on adherence to the goals set by business owners, who reward their managers based on corporate governance, has also been described in Mayberry *et al.* (2021, pp. 2723–2757) and Cumming *et al.* (2021, pp. 775–813). Goel and Kapoor (2021) find that gender diversity affects the adjustment of financial statements; for example, in enterprises in which women have fewer attempts at excellent accounting than in enterprises with men. The change in the names of enterprises may be the reason for this manipulation. This was pointed out by Devos *et al.* (2021). They claim that changing the name of the enterprise may lead to the loss of a large portion of its customers and, as a result, they rely more on creative accounting to stay in business.

There are dozens of appropriate models for disclosing creative accounting, but the Beneish Model is used worldwide. The results of this model for successful business detection are very good, as evidenced by the study of Shakouri *et al*. (2021, pp. 39–48), where the result of successful detection was at the level of 73%, which was also confirmed by the McFadden coefficient. It is possible to use the Beneish 5-element model or Beneish 8-element model. This study compared them, and the authors were inspired by the article created by Wiszniowski (2020, pp. 9218–9222). This study exposes accounting fraud using both Beneish models. The study found that the 5-parameter model is better than the 8-parameter model in Polish conditions. Sabau *et al.* (2021) used the Beneish element score and investigated its impact on the Romanian environment. The sample of 66 enterprises confirms the significant influence of the GMI, AQI, DEPI, and TATA on the final M-score. The results of the present study also required the use of the modified Jones model, which was required to construct the ROC curves. Garfatta (2021, pp. 189–199) and Goncalves *et al.* (2021) have confirmed its quality.

The approaches of academics also reworked the Beneish model or used new methods to increase detection power. These studies analyzed creative accounting using panel data regression models (Bansal & Kumar, 2021, pp. 194–216), one-dimensional analysis, or panel regression (Kim *et al*., 2021, pp. 27–48). Logistic regression was performed as described by Purba *et al.* (2021). The least-squares method was used by Ismael and Kamel (2021), Bhutta *et al*. (2021), and Chakroun *et al*. (2022, pp. 331–362). Bansal and Ali (2021, pp. 559–572) supplemented the analysis with a one-dimensional and two-dimensional portfolio of methodology and cross-sectional Fama-MacBeth regression. Svabova *et al*. (2020a, pp. 485–508) modified Beneish M-score to create their own model for identification of fraudulent behavior. The authors designed their models based on their origin, using discriminant analysis and financial reports from 2009 to 2018. The test sample for the origin and the new model included 1,900 Slovak enterprises. The coverage of both models was 32.7% for manipulating behavior and 38.4% for non-manipulating behavior.

The authors also investigate the paths between creative accounting, as determined by the Beneish model, and bankruptcy. Valaskova *et al*. (2021a, pp. 167–184) applied two models based on discriminant analysis. They combined the earnings management model (Beneish M-score) with the bankruptcy model (Altman's Z-score). The authors disclosed significant bonds between these financial situations based on a sample of 11,105 business units from the Visegad Group. Enterprises in financial distress, or "the enterprises of the uncertain zone" tend to manipulate earnings. Srebro *et al*. (2021) ran these models for agricultural enterprises in Serbia. The results were supported by the Z'-score model and the Z-score probability calculation of financial distress in the period 2015–2019. The results confirm that many bankruptcies reflect signals of purposeful managerial manipulation. Pavlovič *et al*. (2019, pp. 254–272) also investigated the earnings management phenomenon in agriculture in the context of the age of the board of directors, revealing no mutual interconnection between the analyzed factors. Agribusiness is typical of low earnings quality reporting (extreme level of accruals), which is why accrual-based earnings management is more typical in this sector (Trejo-Pech *et al*., 2016, pp. 89–118; Stofkova *et al.*, 2016). Dadayan *et al*. (2020) also confirmed that business activities in agriculture are risky, and the growth of production and financial stability depends on how subjects overcome economic risks. The importance of the agricultural sector in the specific conditions of Slovakia is highlighted in the studies by Valaskova *et al*. (2020a) or Blazek *et al*. (2020).

Rossi *et al*. (2020, pp. 37–52) found the opposite dependence. The Beneish M-score was calculated to be related to the Altman Z-score and Pi-

otroski F-score. The findings note, based on the case study, that financial instability predicts bankruptcy but simultaneously excludes the management of earnings at the same time. Kovalova and Frajtova Michalikova (2020) and Hrosova (2021) evaluated the same issue in the aforementioned studies. They prefer the CFEBT model to the Z-score because it was constructed for Slovak and Czech conditions. Papik and Papikova (2021, pp. 185–201) compared the classification ability of financial ratios to the financial variables of the Beneish model, and the decision tree to the random forest. This was considered an unintentional financial error. The level of quality in the detection of accounting errors was proven based on 400 items from 80 enterprises.

Recent research has concentrated on the causes of creative accounting, the link between manipulation and bankruptcy, and the general selection of appropriate detection models. This study compares the adequacy of the 5-parameter Beneish model and its extension in an agri-sector to set the preference for revealing creative accounting quickly and reliably. The research applied this methodology to different sectors affected by the manipulation of earnings in a similar emerging economy.

Research method

The dataset of the analyzed businesses was generated using the Amadeus financial database created by Bureau van Dijk. The sample consists of enterprises operating in the agriculture, forestry, and fishing sectors. As indicated in the introduction section, the selection of enterprises was purposeful, as there is a high presumption of adjustments in the financial statements for this sector of the economy (based on the official EU reports, this sector in Slovakia is affected by lasting problems with tax fraud and financial affairs). Patton (2004) confirmed that dedicated sampling should be used to identify and select information-rich cases to make the most efficient use of limited cases.

The sample of enterprises was subject to criteria for achieving more relevant results (to avoid the selection of enterprises according to their size, legal form, or years of operation). Table 1 presents the financial criteria.

Enterprises were selected based on the NACE and financial criteria. A total of 46 enterprises met the financial criteria analyzed. The Beneish model was used for the analysis. This model can be compiled into five indicators (DSRI, GMI, AQI, SGI, DEPI), or as a more complex model, which includes much more data from financial statements, as it consists of eight indicators. In the case of the 8-parameter Beneish model, SGAI, LVGI, and

TATA indicators were added to the aforementioned indicators. These indicators form a sophisticated model that can identify enterprises that have manipulated their financial statements. Although these models are widely used to detect the probability of manipulation of financial statements, they cannot detect the manipulating companies (their detection should be accompanied by the application of additional models and techniques). Moreover, Beneish M-score models are probabilistic models and their ability to detect earnings manipulation is not 100% accurate (Herawati, 2015, pp. 924–930). It should also be mentioned that the most accurate results were achieved when applied to a sample of public company data.

The main definition of the relationship is based on the following equations:

5 parameter Beneish model

$$M = -6.065 + 0.823 \cdot DSRI + 0.906 \cdot GMI + \\ +0.593 \cdot AQI + 0.717 \cdot SGI + 0.107 \cdot DEPI \quad (1)$$

8 parameter Beneish model

$$M = -4.84 + 0.92 \cdot DSRI + 0.528 \cdot GMI + \\ +0.404 \cdot AQI + 0.892 \cdot SGI + 0.115 \cdot DEPI - \\ - 0.172 \cdot SGAI + 4.679 \cdot TATA - 0.327 \cdot LVGI \quad (2)$$

where:

M	Beneish manipulation score;
DSRI	Days´sales in a receivable index;
GMI	Gross margin index;
AQI	Asset quality index;
SGI	Sales growth index;
DEPI	Depreciation index;
SGAI	Sales and general and administrative expenses index;
LVGI	Leverage index;
TATA	Total accruals to total assets.

The classification rule of these models was set by Beneish at -2.22, which is the limit between manipulation and nonmanipulation. If the resulting M-score is below this value, it means that there were no manipulations of the financial statements in the accounting period; the Beneish model

does not assume manipulative interventions. However, if the M-score is higher than -2.22, probable manipulations in the accounting records for the given accounting period are indicated. Each element in the model has its own rules for indicating the possible risk of fraud, the so-called fraud indicator (Mantone, 2013).

Table 2 lists the limit values for individual indicators. When these limit values are exceeded, it indicates that there are problem issues with the analyzed parameter. As can be seen in Table 2, the manipulation indicators of the individual indicators of the Beneish model offer a better specification of the problem of manipulation of accounting data. Each of these indicators is characterized by a formula consisting of various pieces of informational data that may have been manipulated.

Therefore, the power of these models must be determined. Therefore, ROC curve analysis was used. However, the modified Jones model was used as another model to obtain relevant results. This model was used to reveal creative accounting through discretionary accruals. Valaskova *et al.* (2019, pp. 3922–3931), Kliestik *et al.* (2020b, pp. 371–400), Kliestik *et al.* (2021, pp. 1452–1470), and Gregova *et al.* (2021, pp. 221–244) classified this model as the best for the detection of creative accounting in the Slovak Republic. The modified Jones model is a model improved by Dechow *et al.* (1995, pp. 193–225), which extends the original Jones model by changing sales, meaning that this model understands more data that appears in the financial statements of enterprises. The relationship that applies to the modified Jones model is captured using the following formula (3):

$$\frac{NDA_{it}}{A_{\mathrm{it}-1}} = \alpha_0 \frac{1}{A_{\mathrm{it}-1}} + \alpha_1 \frac{\Delta REV_{it} - \Delta REC_{it}}{A_{it-1}} + \alpha_2 \frac{PPE_{it}}{A_{it-1}} + \varepsilon_{it} \tag{3}$$

where:

NDA_{it}	non-discretionary accrual in a year t;
TA_{it}	total accrual in a year t;
A_{it-1}	total assets in a year t-1;
ΔREV_{it}	annual change in revenue in year t
ΔREC_{it}	annual change in receivables in year t.
PPE_{it}	long-term tangible assets in a year t;
α_0, α_1, α_2	coefficients;
ε_{it}	prediction error.

Using the above-mentioned models, an analysis was created using ROC curves to show which among the 5-member Beneish model or the 8-member Beneish model, is better, more accurate, and provides more reliable information.

Results

The 5-parameters Beneish model was computed first, followed by the 8-parameters.

5-parameter Beneish model

The 5-parameters Beneish model, which is easier to quantify, was the first to be used. The Beneish M-score was calculated for selected 46 enterprises from sector A — agriculture, forestry, and fishing. The required data were fitted to Equation (1). Table 3 shows the number of enterprises that committed manipulations based on the Beneish M-score calculation.

The number of enterprises that handle them has varied over the years. In 2016, 42 enterprises tried to manipulate, which is more than 91% of all monitored enterprises; thus, only 9% of the enterprises did not commit manipulation. In 2017, the number of handling enterprises had decreased. Compared to 2016, 21% fewer enterprises were handled, representing 33 enterprises, and 225% more enterprises avoided manipulating financial statements (i.e., 13 enterprises). In 2018, however, the number of handling enterprises increased by 27% to 42 enterprises. This amounted to a 69% decrease in enterprises that did not commit fraud. The results indicate that, on average, up to 85% of the total number of monitored enterprises in a given sector are manipulated with their financial statements.

Figure 2 shows the development of the resulting Beneish M-scores for individual enterprises in individual years. It can be seen, that some enterprises were not engaged in any manipulation over the years. In addition, the resulting M-score shows that some enterprises manipulate their financial statements every year, resulting in values above the manipulation limit (red line) in each monitored year.

8-parameter Beneish model

After analyzing the 5-member Beneish model, an 8-member Beneish model was applied. Various Beneish M-score values were obtained, as evidenced by the number of enterprises that resorted to manipulation and

those that did not. Table 4 shows the division of enterprises into manipulative and non-manipulative enterprises.

Figure 3 presents the values of the Beneish M-score that were not too far from the manipulation limit (red line) except for one enterprise in 2018. According to the initial calculations, this one did not commit manipulation. The final M-score was far from any manipulation. Other enterprises have moved around the limits of manipulation. This means that enterprises were trying to use more sophisticated handling strategies, as proven by the smaller deviations from the handling limit.

Figures 4, 5, and 6 compare the Beneish 5 and Beneish 8 parameter models. Figure 5 shows a comparison of the two models for 2018. There were no significant changes in the number of enterprise number 30. It may be noted that the informative values of the Beneish 5 and Beneish 8 models for 2018 were the same; therefore, both models were almost identical.

However, the change occurred, as can be seen in the next monitoring periods, specifically in 2017 and 2016. In 2017, the color distribution did not change, and it is evident that the difference in the resulting M-score value was different for the Beneish 5 and Beneish 8 models. While the M-score values for Beneish 5 are around the manipulation threshold, except for the results for enterprises 14, 20, 22, and 44, the remaining values suggest that the monitored enterprises should not approach the manipulation of their accounts. However, this statement is refuted by the values of the Beneish 8 model, where a high number of enterprises that committed manipulations in the given period can be observed as the resulting M-score values are above the manipulation limit.

Similar to 2017, 2016 again revealed the gap between the monitored results of both models. The resulting M-score values for the Beneish 5 model show that almost no enterprise has committed manipulation. The M-score of the Beneish 8 model offers a different conclusion. As is evident, the Beneish 8 model assessed most enterprises as manipulative, which is declared by the distance of the individual peaks from the manipulation limit.

Two simple variants of the Beneish model were compared using this simple graphical representation. In most cases, the five-parameter model offers a final M-score around the manipulation boundary. However, the second variant, the 8-parameter Beneish model, shows that using a larger amount of information from financial statements can produce different results. This was proven by the different M-score values for each variant. This finding was verified using ROC curves that show which of the models captured the manipulative behavior of enterprises more accurately; therefore, these models should be used for the detection of manipulation in enterprises.

To compare these two models based on ROC curves, the results of another detection model are required to reveal potential creative accounting practices. Therefore, the modified Jones model was computed. Enterprises were classified as manipulative or non-manipulative based on calculated discretionary accruals. This division is presented in Table 5.

Figure 7 shows enterprises that manipulated their accounts (yellow) and enterprises that did not manipulate their accounts (green) based on discretionary accruals of the modified Jones model.

To evaluate the results of the ROC curves, it was necessary to divide the data into four groups that capture certain situations. These groups included true negatives, false negatives, false positives, and true positives.

Based on the classification of enterprises into these groups, it is possible to calculate the overall accuracy, sensitivity, and specificity of the model. Using the determined sensitivity and specificity values, it was possible to construct ROC curves and evaluate their accuracy using the area under the curve (AUC). This value is always in the range of 0 to 1, but the relevant results range from 0.5. Table 6 shows the AUC values and associated test quality.

Evaluation of the combination of Beneish 5 models and the modified Jones model

Based on the analysis of all graphs and AUC curves, the best predictive ability was obtained by comparing the Beneish M-score and modified Jones model adjusted to numerical values 0 and 1. Negative is represented by the number 0 and positive is represented by the number 1. This was also confirmed by the results, which showed more favorable values for this option, as they have a much better classification capability. Table 7 was compiled based on these findings.

Following the outputs of the matrix of changes, the number of enterprises that were correctly classified as manipulating their financial statements changed during the reporting period. In 2016, 37 enterprises were correctly identified, representing approximately 80% of all the enterprises. In 2017, 32 enterprises were correctly classified, representing approximately 70% of the enterprises analyzed in that year. In 2018, approximately 85% of the enterprises were correctly identified (39 enterprises). It can be said that enterprises used manipulation practices due to the possibilities and gaps in legislation and the ingenuity of their accountants and managers, as evidenced by the high values of correctly classified enterprises in the reference periods. The resulting calculations for all indicators in the monitored periods are listed in Table 8.

The results of the graphical representation of the ROC curves are shown in Figures 8, 9, and 10.

Evaluation of the combination of Beneish 8 models and the modified Jones model

The same analysis was performed for the Beneish model, which contains eight parameters, in combination with the modified Jones model, which remained unchanged. The matrix of changes (Table 9) captured the results obtained for a given combination of models.

Based on the results shown in Table 10, it was found that in 2016, approximately 87% of enterprises that manipulated their accounting data were correctly identified, representing 39 enterprises. This year, there was also a result that captured one enterprise that was identified as incorrectly positive. In 2017, 42 enterprises were correctly identified, representing approximately 91% of the total monitored enterprises. In 2018, 80% of enterprises were correctly identified, representing 37 enterprises. The resulting calculation of all the values obtained is presented in Table 10.

All information was graphically captured by ROC curves (Figures 11, 12, and 13).

It may be seen that the 5-parameter Beneish model showed similar results to the 8-parameter Beneish model in some cases. However, it did not reach such convincing values as in the 8-parameter Beneish model. For comparison purposes, 2017 was a crucial year. The value of 96.60% of the AUC of the 8-parameter Beneish may be considered the most differential. This led to the finding that the 8-parameter Beneish model is better for revealing creative accounting in enterprises.

Discussion

The results of the investigation are discussed in the recent studies and approaches related to the use of Beneish models, the choice of a specific sector and period of detection, and the contrast model for evaluation of the power of detection.

Wiszniowski (2020, pp. 9218–9222) employed a similar detection method. This study focuses only on enterprises that are known to manage earnings. However, the research provided the opposite conclusion, that the 8-parameter Beneish model is better and more accurate. A Polish study also used a small sample of enterprises. The threshold value (-2.22) of the overall score was the same in both studies. It was not a one-sector study, as

the sample consisted of 10 enterprises from the production, food, agriculture, financial services, construction services, and "new technology" sectors. Legal status was also broad: public limited companies, private limited companies, companies owned by natural persons, and state-owned companies. The difference in results may be caused by the use of a very small sample, including various legal statuses and sectors. However, a significant reason for the different findings is the different use of thresholds for variable values in the Beneish model. Table 11 lists the limits used in this Polish investigation. This study used the unequal values of the handling indicators from Table 2.

Timofte *et al.* (2021, pp. 296–312) focused on creative accounting in northeastern Romania, which is associated with many tax evasion crimes. An equal assessment of Beneish models was planned, but not with the same approach as in this investigation. They preferred the Beneish model and its 5-parameter version for 30 enterprises. Preferences were made because of circumstances without an empirical assessment. The 8-parameter Beneish model was intended, but finally, the lack of data availability from the Ministry of Public Finance led to the selection of a 5-parameter model.

The results of the preference of the 8-parameter Beneish model were empirically proven for a selected sector. Bilan and Jurickova (2021) used the Beneish model in a Slovak environment in a specific sector. They disclosed the use of earnings management in the processing and production of food products and assessed the power of the Beneish model. They did not prefer the modified Jones model and argued that its origin was not in Central European countries. However, the CFEBT model is recommended because it was created in this region, and may provide a better solution for detecting creative accounting.

Valaskova and Fedorko (2021) analyzed the Slovak and Czech enterprises for the same period. The existence of manipulation was also disclosed but in different sectors. Creative accounting occurred during transport and storage (NACE H). These studies reflected the status of the Slovak economy during the same period, which supported the manipulation of earnings. In addition, the investigation provides specific macroeconomic impacts that influence not only sector H, but also sectors such as agriculture, forestry, and fisheries. Table 12 summarizes the relevant factors for the Slovak enterprises in 2016, 2017, and 2018. Some elements support the existence of creative accounting in the Slovak business environment.

The preference of Beneish models was assessed using the modified Jones model. This adequacy was chosen based on previous research on creative accounting in emerging European markets. Aghghaleh *et al.* (2016, pp. 57–65) also used the modified Jones model. They performed a longitu-

dinal paired study from 2001 to 2014 in Malaysia. The modified Jones model matched the Beneish M-score. The sensitivity of predicting fraud cases was 73.17%, compared to 69.51%. Therefore, there is very close detection power between the models used. These results were also confirmed in this short-term investigation by the high sensitivity values of both models (Tables 8 and 10) for the entire analyzed period of 2016–2018.

Thus, the methodology of comparing the results of Beneish models using the modified Jones model is adequate, even in a short period of time, as declared in this study. The reduction in the period of disclosing manipulators improves the importance of this exploration. The period of 2016–2017 was very open for Slovak enterprises to apply creative accounting, and the 8-parameter Beneish model is appropriate for revealing creative accounting for enterprises in a specific sector. However, following the empirical evidence provided, this model is also very sensitive to the detection of non-manipulative ones.

Conclusions

The aim of the article was to reveal the creative accounting practices of a sample of enterprises operating in the Slovak business environment in aselected sector using the Beneish model. Creative accounting practices were identified, and better and more accurate detection power was determined using the 8-parameter Beneish model. This conclusion was based on the contrary results of the modified Jones model and captured ROC curves. Therefore, the 8-parameter model demonstrated excellent AUC values. This version of the Beneish model is recommended for revealing creative accounting in Central European countries.

The practical implications of these findings may be observed by fiscal authorities to monitor the level and risk of creative accounting not only in Slovakia, but this approach may be applied in a whole region of countries. Auditors may use the methodology as the first step of investigation before in-depth analysis of the specific enterprise and due diligence phase.

The limitations of this study are as follows. The Beneish models were used for a single sector and a small sample of 46 enterprises. However, a more in-depth analysis would require direct contact with the employees (managers) of the enterprises concerned, who would be willing to explain the various economic operations to better determine whether the enterprise manipulates its accounting records, as not every use of creative accounting is linked with a crime.

Future research may focus on confirming the results of the analysis of sector A using Beneish models. The results of this study can be compared with the industry in V4 countries. This analysis also focuses on the entire economy of the Slovak Republic and compares these results with those of V4 countries. In addition, further models may be added to obtain a comprehensive view of creative accounting.

References

Aghghaleh, S. F., Mohamed, Z. M., & Rahmat, M. M. (2016). Detecting financial statement frauds in Malaysia: comparing the abilities of Beneish and Dechow Models. *Asian Journal of Accounting & Governance*, *7*, 57–65. doi: 10.17576/AJAG-2016-07-05.

Bansal, M., & Ali, A. (2021). Differential impact of earnings management on the accrual anomaly. *Journal of Asset Management*, *22*(7), 559–572. doi: 10.1057/s41260-021-00243-z.

Bansal, M., & Kumar, V. (2021). Forcing responsibility? Examining earnings management induced by mandatory corporate social responsibility: evidence from India. *Review of Accounting and Finance*, *20*(2), 194–216. doi: 10.1108/RAF-06-2020-0151.

Beneish, M. D. (1999). The detection of earnings manipulation. *Financial Analysts Journal*, *55*(5), 24–36. doi: 10.2469/faj.v55.n5.2296.

Bhutta, U. S., AlHares, A., Shahab, Y., & Tariq, A. (2021). The jinx of real earnings management: evidence from inefficient investments and debt maturity structure in Pakistan. *Journal of Accounting in Emerging Economies*, *12*(2), 405–432. doi: 10.1108/JAEE-03-2021-0079.

Bilan, Y., & Jurickova, V. (2021). Detection of earnings management by different models. *SHS Web of Conferences*, *92*, 02005. doi: 10.1051/shsconf/20219202005.

Blazek, R., Durana, P., & Valaskova, K. (2020). Creative accounting as an apparatus for reporting profits in agribusiness. *Journal of Risk and Financial Management, 13*(11), 261. doi: 10.3390/jrfm13110261.

Chakroun, S., Ben Amar, A., & Ben Amar, A. (2022). Earnings management, financial performance and the moderating effect of corporate social responsibility: evidence from France. *Management Research Review*, *45*(3), 331–362. doi: 10.1108/MRR-02-2021-0126.

Cumming, D., Tingle QC, B. C., & Zhan, F. (2021). For whom (and for when) is the firm governed? The effect of changes in corporate fiduciary duties on tax strategies and earnings management. *European Financial Management*, *27*(5), 775–813. doi: 10.1111/eufm.12332.

Dadayan, E., Storozheva, A., & Letyagina, E. (2020). Impact of economic risks on the financial stability of agricultural enterprises. *Web of Conferences, 161*: 01065. doi: 10.1051/e3sconf/202016101065.

Dechow, P. M., Sloan, R. G., & Sweeney, A. P. (1995). Detecting earnings management. *Accounting Review*, *70*(2), 193–225.

Devos, E., Huang, J., & Zhou, F. (2021). The effects of corporate name changes on firm information environment and earnings management. *International Review of Financial Analysis*, *77*, 101849. doi: 10.1016/j.irfa.2021.101849.

Dima, A. M., & Vasilache, S. (2016). Credit risk modeling for companies default prediction using neural networks. *Romanian Journal for Economic Forecasting*, *19*(3), 127–143.

Dvorsky, J., Petrakova, Z., & Fialova, V. (2020). Perception of business risks by entrepreneurs according to experience with the business failure. *International Journal of Entrepreneurial Knowledge*, *8*(1), 76–88. doi: 10.37335/ijek.v8i 1.104.

Gavurova, B., Cepel, M., Belas, J., & Dvorsky, J. (2020). Strategic management in SMEs and its significance for enhancing the competitiveness in the V4 countries - a comparative analysis. *Management & Marketing. Challenges for the Knowledge Society*, *15*(4), 557–569. doi: 10.2478/mmcks-2020-0032.

Garfatta, R. (2021). Corporate social responsibility and earnings management: evidence from Saudi Arabia after mandatory IFRS adoption. *Journal of Asian Finance, Economics and Business*, *8*(9), 189–199. doi: 10.13106/jafeb.2021.vo l8.no9.0189.

Gasova, K., & Stofkova, J. (2017). Cluster cooperation in globalised world. In T., Kliestik (Ed.). *Globalization and its socio-economic consequences. 17th international scientific conference on globalization and its socio-economic consequences*. Zilina: University of Zilina, 479–486.

Goel, S., & Kapoor, N. (2021). Is earnings management related to board independence and gender diversity? Sector-wise evidence from India. *International Journal of Disclosure and Governance*. Advance online publication. doi: 10.1057/s41310-021-00130-4.

Goncalves, T., Gaio, C., & Ferro, A. (2021). Corporate social responsibility and earnings management: moderating impact of economic cycles and financial performance. *Sustainability*, *13*(17), 9969. doi: 10.3390/su13179969.

Gregova, E., Smrcka, L., Michalkova, L., & Svabova, L. (2021). Impact of tax benefits and earnings management on capital structures across V4 countries. *Acta Polytechnica Hungarica*, *18*(3), 221–244. doi: 10.12700/APH.18.3.2021 .3.12.

Herawati, N. (2015). Application of Benesih M-score models and data mining to detect financial fraud. *Procedia – Social nd Behavioral Sciences, 211*, 924–930. doi: 10.1016/j.sbspro.2015.11.122.

Hlawiczka, R., Blazek, R., Santoro, G., & Zanellato, G. (2021). Comparison of the terms creative accounting, earnings management, and fraudulent accounting through bibliographic analysis. *Ekonomicko–manazerske spektrum*, *15*(2), 27–37. doi: 10.26552/ems.2021.2.27–37.

Hrosova, L. (2021). Ways of detection of creative accounting in a global economy. *SHS Web of Conferences*, *129*, 03012. doi: 10.1051/shsconf/202112903012.

Ismael, H. R., & Kamel, H. (2021). Internal audit quality and earnings management: evidence from the UK. *Managerial Auditing Journal*, *36*(7), 951–978. doi: 10.1108/MAJ-09-2020-2830.

Khuong, N. V., Liem, N. T., & Minh, M. T. H. (2020). Earnings management and cash holdings: evidence from energy firms in Vietnam. *Journal of International Studies*, *13*(1), 247–261. doi: 10.14254/2071-8330.2020/13-1/16.

Kim, K. S., Lee, J. H., & Park, Y. W. (2021). Acquiring firms' earnings management in stock-for-stock mergers within Korean business groups. *Managerial Finance*, *48*(1), 27–48. doi: 10.1108/MF-05-2020-0262.

Kliestik, T., Belas, J., Valaskova, K., Nica, E., & Durana, P. (2021). Earnings management in V4 countries: the evidence of earnings smoothing and inflating. *Economic Research-Ekonomska Istraživanja*, *34*(1), 1452–1470. doi: 10.1080/1331677X.2020.1831944.

Kliestik, T., Nica, E., Suler, P., & Valaskova, K. (2020a). Innovations in the company's earning management: the case for the Czech Republic and Slovakia. *Marketing and Management of Innovations*, *18*(3), 332–345. doi: 10.21272/mmi.2020.3-24.

Kliestik, T., Valaskova, K., Nica, E., Kovacova, M., & Lazaroiu, G. (2020b). Advanced methods of earnings management: monotonic trends and change-points under spotlight in the Visegrad countries. *Oeconomia Copernicana*, *11*(2), 371–400. doi: 10.24136/oc.2020.016.

Kovalova, E., & Michalikova, K. F. (2020). The creative accounting in determining the bankruptcy of business corporation. *SHS Web of Conferences*, *74*, 01017. doi: 10.1051/shsconf/20207401017.

Lehene, C. F. (2021). Is control still an important managerial function? An examination of structural and control process factors in strategic alliances. *Management & Marketing. Challenges for the Knowledge Society*, *16*(4), 316–333. doi: 10.2478/mmcks-2021-0019.

Mantone, S. P. (2013). *Using analytics to detect possible fraud: tools and techniques*. New Jersey: John Wiley and Sons.

Minciu, M., Berar, F. A., & Dobrea, R. C. (2020). New decision systems in the VUCA world. *Management & Marketing. Challenges for the Knowledge Society*, *15*(2), 236–254. doi: 10.2478/mmcks-2020-0015.

Mayberry, M., Park, H. J., & Xu, T. (2021). Risk-taking incentives and earnings management: new evidence. *Contemporary Accounting Research*, *38*(4), 2723–2757. doi: 10.1111/1911-3846.12704.

Ngo, Q-H. (2021). The impact of market orientation on small businesses' performance in Vietnam: the mediating effects of the management accounting system. *Entrepreneurial Business and Economics Review, 9*(3), 59–72. doi: 10.15678/EBER.2021.090304.

Papik, M., & Papikova, L. (2021). Application of selected data mining techniques in unintentional accounting error detection. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *16*(1), 185–201. doi: 10.24136/eq.2021.007.

Pardal, P., Hurnyak, I., & Kordonska, A. (2021). Zombie business strategies: the case of Ukraine. *Entrepreneurial Business and Economics Review, 9*(1), 47–59. doi: 10.15678/EBER.2021.090103.

Patton, M. Q. (2014). *Qualitative research & evaluation methods: integrating theory and practice*. London: Sage publications.

Pavlovič, V., Knezevic, G., & Bojicic, R. (2019). Does board of director´s age impact earnings management in agriculture? Case of Serbian agricultural sector. *Custos e Agronegocio on Line, 15*(1), 254–272.

Purba, G. K., Fransisca, C., & Joshi, P. L. (2021). Analyzing earnings management preferences from business strategies. *Journal of Financial Reporting and Accounting*. Advance online publication. doi: 10.1108/JFRA-04-2021-0103.

Rossi, M., Festa, G., Kolte, A., & Shams, R. (2020). The strange case of the Jet Airways bankruptcy: a financial structure analysis. *Journal of Operational Risk*, *15*(4), 37–52. doi: 10.21314/JOP.2020.245.

Sabau, 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. doi: 10.339 0/risks9060116.

Savova, K. (2021). Differences in application of accounting standards – current aspects. *Ekonomicko-manazerske spektrum*, *15*(1), 111–122. doi: 10.26552/ems .2021.1.111-122.

Setyoputri, L. S., & Mardijuwono, A. W. (2020). The impact of firm attributes on earnings management. *Polish Journal of Management Studies*, *22*(1), 502–512. doi: 10.17512/pjms.2020.22.1.32.

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. doi: 10.22075/IJNAA.2021.4793.

Srebro, B., Mavrenski, B., Bogojevic Arsic, V., Knezevic, S., Milasinovic, M., & Travica, J. (2021). Bankruptcy risk prediction in ensuring the sustainable operation of agriculture companies. *Sustainability*, *13*(14), 7712. doi: 10.3390/su13 147712.

Stofko, S., & StofkovA, J. (2014). Survey of utilization of the e-learning in university education. In L. G. Chova, A. L., Martinez & I. C., Torres (Eds.). *Eduelearn 14 proceedings.* IATED, 1993–1999.

Stofkova, J., Stofkova, Z., & Stofko, S. (2016). Increasing the quality of the educational process through implementation of practice requirements in the university study program. In L. G., Chova, A. L., Martinez & I. C. Torres (Eds.). *Edulearn 16: 8th international conference on education and new learning technologies (EDULEARN)*. Valencia: IATED, 1548–1554.

Svabova, L., Kramarova, K., Chutka, J., & Strakova, L. (2020a). Detecting earnings manipulation and fraudulent financial reporting in Slovakia. *Oeconomia Copernicana*, *11*(3), 485–508. doi: 10.24136/oc.2020.020.

Svabova, L., Valaskova, K., Durana, P., & Kliestik, T. (2020b). Dependency analysis between various profit measures and corporate total assets for Visegrad group's business entities. *Organizacija*, *53*(1), 80–90. doi: 10.2478/orga-2020-0006.

Timofte, C. C., Socoliuc, M., Grosu, V., & Coca, D.-A. (2021). Fiscal and accounting fraud risk detection using beneish model. A Romanian case study. *International Journal of Business and Society*, *22*(1), 296-312. doi: 10.33736/ijbs.3176.2021.

Trejo-Pech, C. J. O., Weldon, R. N., & Gunderson, M. A. (2016). Earnings management through specific accruals and discretionary expenses: evidence from US agribusiness firms. *Canadian Journal of Agricultural Economics-Revenue Canadienne D Agroeconomie, 64*(1), 89–118. doi: 10.1111/cjag.12063.

Valaskova, K., & Fedorko, R. (2021). Detection of earnings management by different models. *SHS Web of Conferences*, *92*, 02064. doi: 10.1051/shsconf/20219202064.

Valaskova, K., Androniceanu, A-M., Zvarikova, K., & Olah, J. (2021a). Bonds between earnings management and corporate financial stability in the context of the competitive ability of enterprises. *Journal of Competitiveness*, *13*(4), 167–184. doi: 10.7441/joc.2021.04.10.

Valaskova, K., Durana, P., Adamko, P., & Jaros, J. (2020a). Financial compass for Slovak enterprises: modelling economic stability of agricultural entities. *Journal of Risk and Financial Management, 13*(5), 92. doi: 10.3390/jrfm13050092.

Valaskova, K., Gavurova, B., Durana, P., & Kovacova, M. (2020b). Alter ego only four times? The case study of business profits in the Visegrad Group. *E&M Economics and Management*, *23*(3), 101–119. doi: 10.15240/tul/001/2020-3-007.

Valaskova, K., Kliestik, T., & Gajdosikova, D. (2021b). Distinctive determinants of financial indebtedness: evidence from Slovak and Czech enterprises. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *16*(3), 639–659. doi: 10.24136/eq.2021.023.

Valaskova, K., Kliestik, T., & Kovacova, M. (2019). Assessment of selected models of earnings management in economic conditions of Slovakia. In *Proceedings of the 33rd international business information management association conference IBIMA 2019*. Granada: IBIMA, 3922–3931.

Vatamanescu, M., Dabija, D. C., Gazzola, P., Cegarra-Navarro, J. G., & Buzzi, T. (2021). Before and after the outbreak of Covid-19: linking fashion companies´ corporate social responsibility approach to consumers´ demand for sustainable products. *Journal of Cleaner Production, 327*, 129465. doi: 10.1016/j.jclepro.2021.129465.

Wang, Y., Wang, F., & Liu, S. (2021). The influence of executive compensation gap on earnings management from the perspective of media supervision: evidence from China. *Discrete Dynamics in Nature and Society*, *2021*, 3203759. doi: 10.1155/2021/3203759.

Wiszniowski, E. (2020). Accuracy of the Beneish Model as applied to polish enterprises known to manipulate financial reports. In *Proceedings of the 35th International business information management association conference IBIMA 2020.* Sevilla: IBIMA, 9218–9222.

Xu, C., Zhang, H., Hao, J., & Guo, L. (2021). Real earnings management in bankrupt firms. *Journal of Corporate Accounting and Finance*, *32*(2), 22–38. doi: 10.1002/jcaf.22483.

Yung, K., & Root, A. (2019). Policy uncertainty and earnings management: international evidence. *Journal of Business Research*, *100*, 255–267. doi: 10.1016/j.jbusres.2019.03.058.

Acknowledgements

This research was financially supported by the Slovak Research and Development Agency - Grant Vega 1/0121/20: Research of transfer pricing system as a tool to measure the performance of national and multinational companies in the context of earnings management in conditions of the Slovak Republic and V4 countries.

Annex

Table 1. Selection criteria of analyzed enterprises

Criterion	Value (in EUR)
Minimal value of total assets	3,000,000
Minimal value of sales	2,000,000
Minimal value of net income	100,000

Table 2. Values of handling indicators

	DSRI	GMI	AQI	SGI	DEPI	SGAI	LVGI	TATA
Fraud indicator	≥ 1.46	≥ 1.19	≥ 1.25	≥ 1.61	≥ 1.077	≥ 1.041	≥ 1.111	≥ 0.031

Table 3. Results of business analysis through the Beneish model

	2018	2017	2016
Over the limit value	42	33	42
Below the limit value	4	13	4

Table 4. Results of business analysis through the Beneish model

	2018	2017	2016
Over the limit value	40	44	43
Below the limit value	6	2	3

Table 5. Results of business analysis using the Modified Jones model

	2018	2017	2016
Over the limit value	43	44	41
Below the limit value	3	2	5

Table 6. Table of test values and qualities for AUC

AUC value	Test quality
0.9 – 1	Excellent
0.8 – 0.9	Very good
0.7 – 0.8	Good
0.6 – 07	Sufficient
0.5 – 0.6	Insuffficient

Table 7. Matrix of changes in the monitored years

Jones 2018 Beneish (5) 2018		**Predicted group**		
		Negative (0)	**Positive (1)**	
Real group	**Negative (0)**	0	4	4
	Positive (1)	3	39	42
		3	43	46
Jones 2017 Beneish (5) 2017		**Predicted group**		
		Negative (0)	**Positive (1)**	
Real group	**Negative (0)**	1	12	13
	Positive (1)	1	32	33
		2	44	46
Jones 2016 Beneish (5) 2016		**Predicted group**		
		Negative (0)	**Positive (1)**	
Real group	**Negative (0)**	0	4	4
	Positive (1)	5	37	42
		5	41	46

Table 8. Classification of parameters to assess the success of models

	Jones 2018 Beneish 2018	**Jones 2017 Beneish 2017**	**Jones 2016 Beneish 2016**
Overall accuracy	84.78%	71.74%	80.43%
Sensitivity	90.70%	72.73%	90.24%
Specificity	0.00%	7.69%	0.00%
False positive	6.98%	2.27%	12.20%
False negative	100%	92.31%	100%
AUC	64.90%	38.50%	54.80%

Table 9. Matrix of changes in the monitored years

Jones 2018 Beneish 2018 (8)			**Predicted group**	
		Negative (0)	**Positive (1)**	
Real group	**Negative (0)**	0	6	6
	Positive (1)	3	37	40
		3	43	46
Jones 2017 Beneish 2017 (8)			**Predicted group**	
		Negative (0)	**Positive (1)**	
Real group	**Negative (0)**	0	2	2
	Positive (1)	2	42	44
		2	44	46
Jones 2016 Beneish 2016 (8)			**Predicted group**	
		Negative (0)	**Positive (1)**	
Real group	**Negative (0)**	1	2	3
	Positive (1)	4	39	43
		5	41	46

Table 10. Classification of parameters to assess the success of models

	Jones 2018 Beneish 2018	**Jones 2017 Beneish 2017**	**Jones 2016 Beneish 2016**
Overall accuracy	80.43%	91.30%	86.96%
Sensitivity	86.05%	95.45%	95.12%
Specificity	0.00%	0.00%	33.33%
False positive	6.98%	4.55%	9.76%
False negative	100%	100%	66.67%
AUC	59.60%	96.60%	44.20%

Table 11. Tresholds for variable values in Beneish model

Marker	DSRI	GMI	AQI	SGI	DEPI	SGAI	LVGI	TATA
Manipulators	1.412	1.159	1.228	1.581	1.072	1.107	1.124	0.049
Non-manipulators	1.030	1.017	1.031	1.133	1.007	1.085	1.033	0.015

Source: own processing according to Wiszniowski (2020).

Table 12. Macroeconomic factors for Slovak enterprises

Factor	2018	2017	2016
Factor 1	corruption	corruption	corruption
Factor 2	tax rates	bureaucracy	bureaucracy
Factor 3	tax regulations	tax rates	tax rates
Factor 4	low educated labour force	restrictive labour regulations	restrictive labour regulations
Factor 5	access to finance	tax regulations	tax regulations

Source: own processing according to Valaskova & Fedorko (2021).

Figure 1. Citation report of creative accounting (Web of Science)

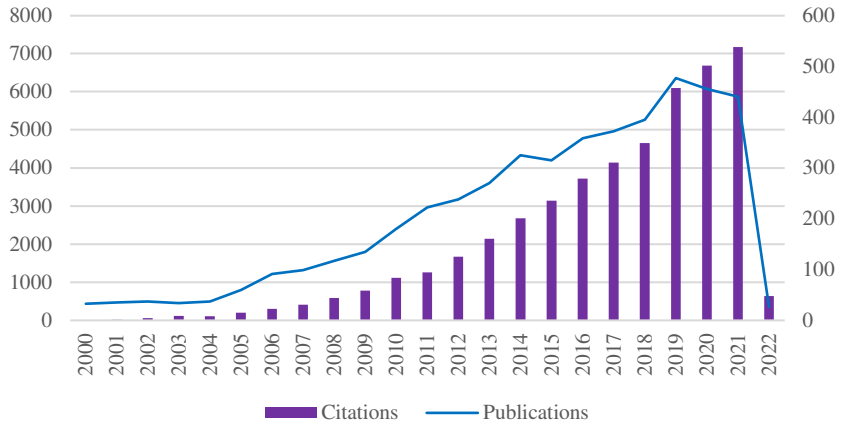

Figure 2. Development of M-score values for the 5-parameter Beneish model

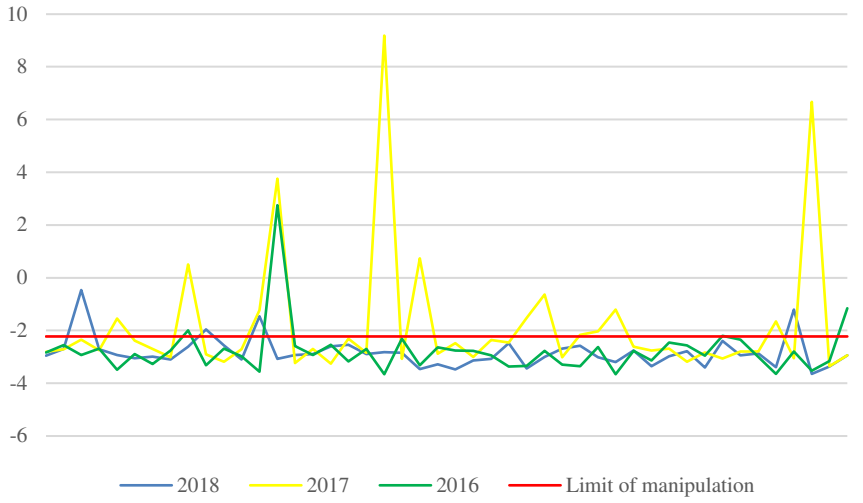

Figure 3. Development of M-score values for 8-parameter Beneish model

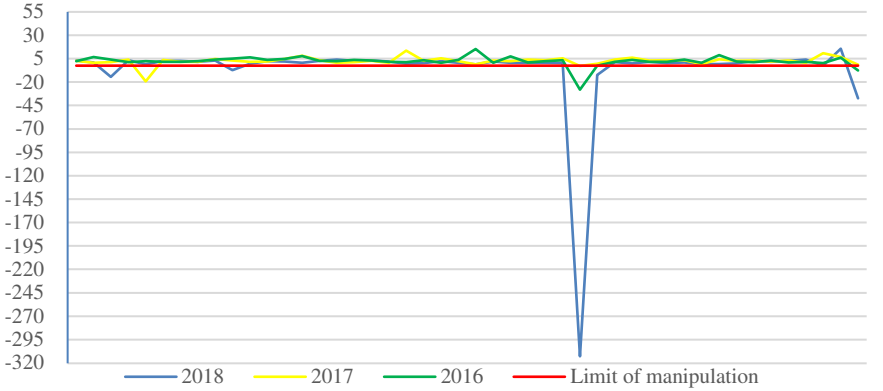

Figure 4. Comparison of Beneish 5 and Beneish 8 models in 2018

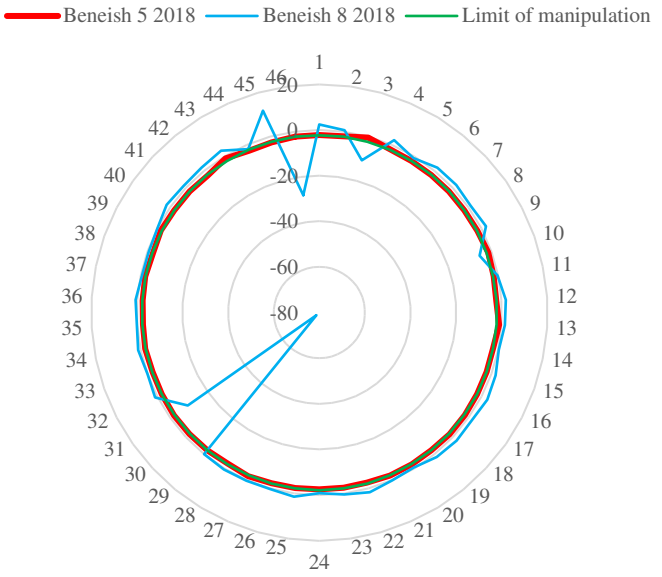

Figure 5. Comparison of Beneish 5 and Beneish 8 models in 2017

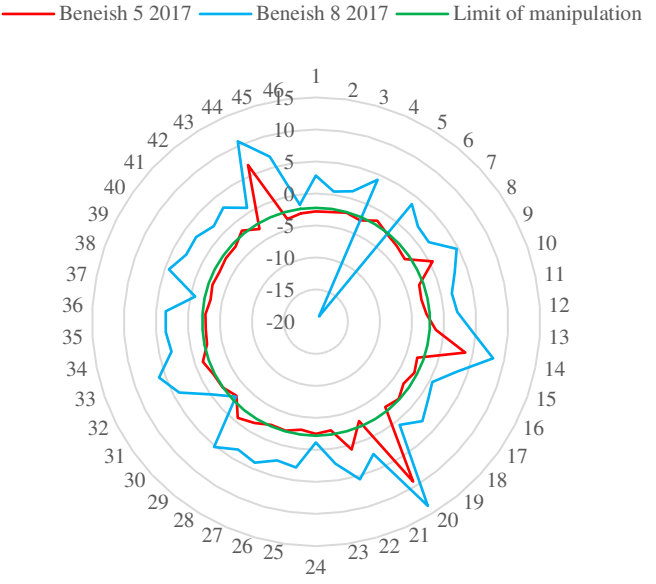

Figure 6. Comparison of Beneish 5 and Beneish 8 models in 2016

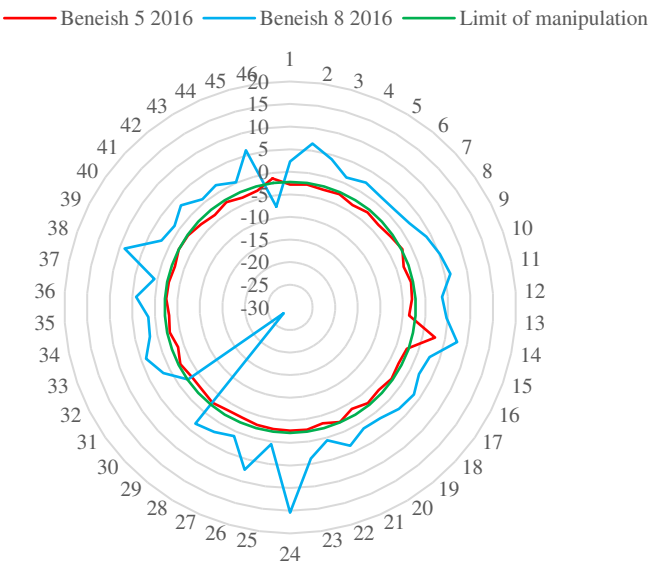

Figure 7. Distribution of handling and non-handling enterprises based on DA

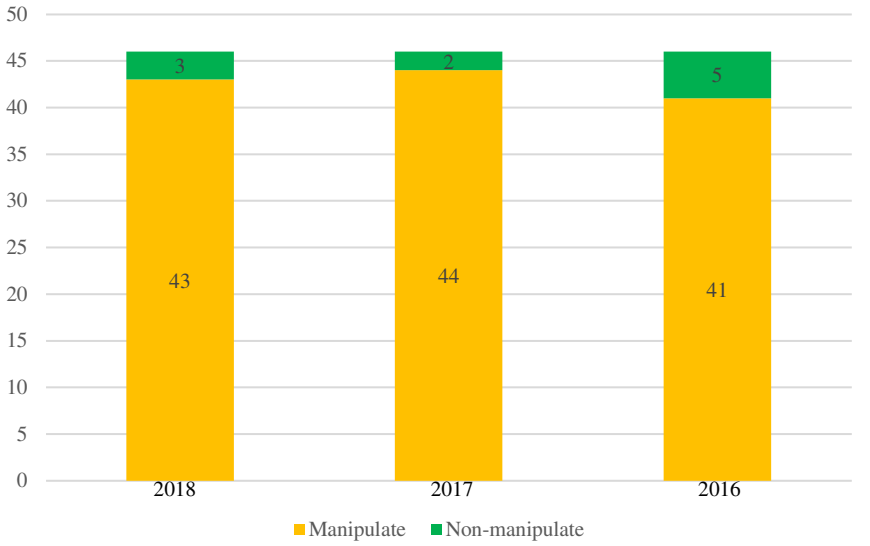

Figure 8. ROC curve in 2018 comapring the Jones and Beneish model (5)

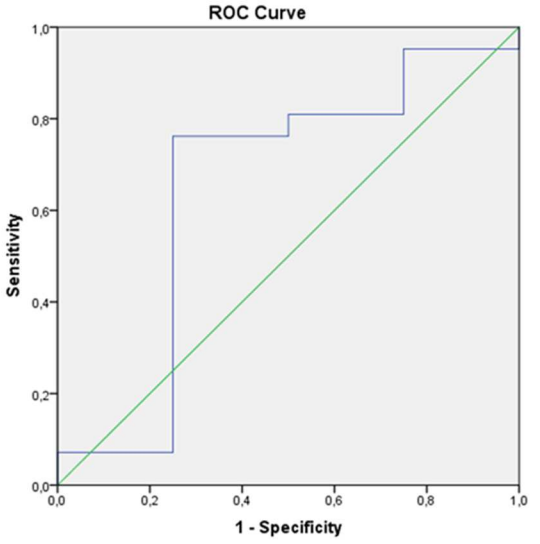

Figure 9. ROC curve in 2017 comapring the Jones and Beneish model (5)

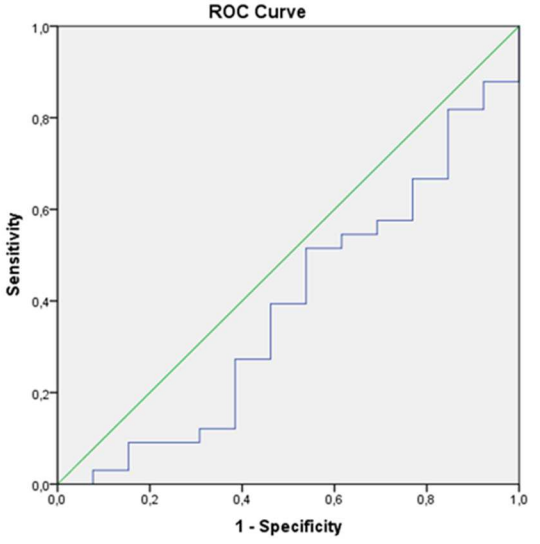

Figure 10. ROC curve in 2016 comapring the Jones and Beneish model (5)

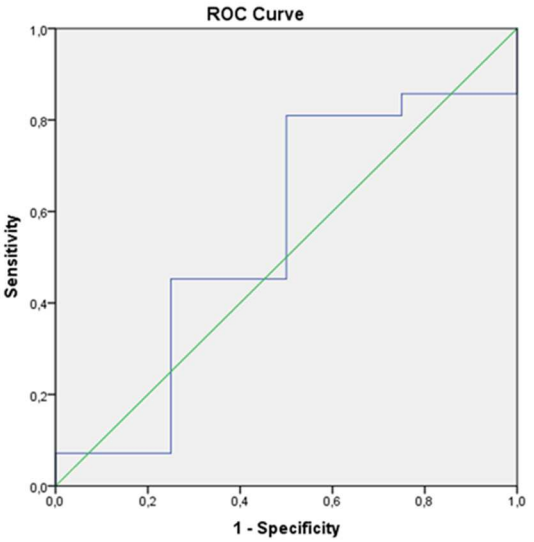

Figure 11. ROC curve in 2018 comapring the Jones and Beneish model (8)

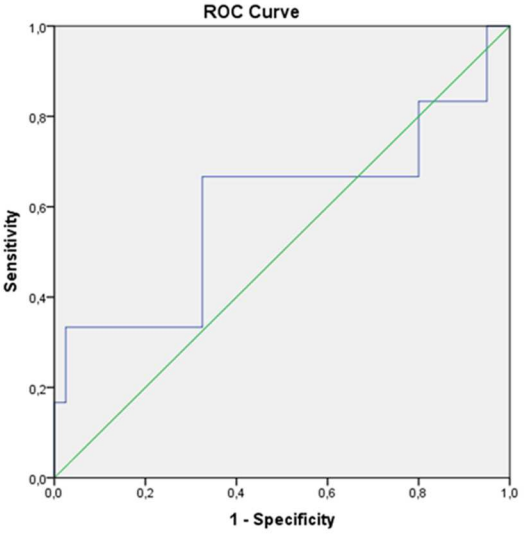

Figure 12. ROC curve in 2017 comapring the Jones and Beneish model (8)

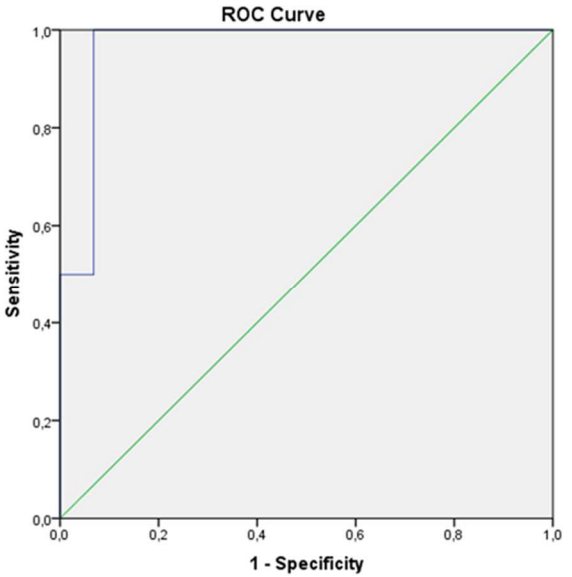

Figure 13. ROC curve in 2016 comapring the Jones and Beneish model (8).