EARNINGS MANAGEMENT DETECTION: PRACTICAL APPLICATION OF BENFORD'S LAW IN BUSINESS PRACTICE

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ABSTRACT.
Background: Benford's Law referring to the frequency distribution of digits in many real-life sources of data states that there is a naturally occurring set of numbers, which can help alert enterprises to possible errors, potential fraud, manipulation practices, or other irregularities. **Aim:** The main aim of this paper was to apply Benford's law to the Slovak conditions, and verify its successful implementation in commercial practice. **Methods:** To identify the manipulation practices, this mathematical principle defining the frequency of occurrence of digits was applied. Benford's law is based on the assumption that the sequences of numbers follow certain formulas that can be predicted. **Sample:** The law is verified in the agricultural sector, which is often connected with financial fraud. *Results:* The outputs of the analysis confirm the relevance of this method usage in the process of the detection of earnings management practices in enterprises. **Conclusions:** Thus, it can be concluded, that researchers and accountants often compare the leading digits of financial transaction data to a Benford curve to spot anomalies that may indicate fraud and discover numerical anomalies. **Implications:** Analysts can use this law to detect certain fluctuations in data that may signal fraudulent reporting.

Keywords: earnings management, earnings manipulation, Bedford's law, financial reports

JEL Classification: G30, M00

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Introduction

The hallmark of a modern company is the distinction between ownership and management, where we classify the owners and investors of the company in the category of ownership, and the area of management is represented by the company's managers. Investors and business owners need to be familiar with the efficiency and activities of a business entity. It is this information that is provided to them by the managers who oversee the company's decisions, and it is difficult to monitor and control all these decisions. Many times, managers make decisions that are largely influenced by their subjective motives.

In order for business owners as well as investors to ensure that these decisions are made by managers for the good of the business and within their requirements, they can review the information in the company's financial statements. Based on these reports, they should be able to assess the company's performance and get a clear picture of the facts. However, the reality shown in them does not always correspond to the actual state. For example, managers can significantly alter results by selecting appropriate accounting techniques, which then mislead investors and owners, and using the practices of earnings management. Earnings management is a new concept that the academic field has only been interested in for the last few decades. While abroad, a large number of academics and authors deal with this issue, in the territory of the Slovak Republic it has been a matter of research in recent years. Earnings management is a topic that should be of interest to many managers, especially potential investors. By knowing the methods and methods of detecting these practices and the ability to interpret them, investors can assess where and in what amount to deposit their free funds.

There are different methods, models, and techniques used to detect the earnings manipulation in enterprises. However, the aim of this paper is to apply a specific method. Benford's law, which has been recently observed in many scientific data sets, and detect earnings management practices.

The paper is divided as follows. The literature review section summarizes the most relevant studies published in the fields. The methodology section describes the methodological steps of the research and explains the system of the Benford's law in the process of the earnings management detection. The Results section is focused on the outputs of the Benford's law in corporate practice and discusses the results in the context of other relevant studies.

Theoretical background

Accounting is an integral part of a company's financial side. Under this term, the registration and information about the financial and property situation of the company, i.e. the management of the company, is understood. The accounts should be kept within the limits of the laws and principles to which they apply. In order to transform the company's financial results, its management seeks to window dress the accounting data. The company's financial results are an important tool for many internal and external entities. As they are often the only source of information that informs business partners and investors about the activities of managers, it is necessary to present these results using real numbers. However, companies prefer to achieve better results by applying the principles of creative accounting, which in other words creates space for accounting manipulation. Unwanted business results are thus transformed into acceptable ones (Blazek et al., 2020). Of course, such and other practices have not been overlooked for years and have been termed earnings management. Earnings management is a complex concept occurring in various forms. It presents an idea of the diversity and differences of attitudes of managers and entrepreneurs to revenue management. The scientific literature points to various discussions of experts on the topic of earnings management, but in none of them do we encounter a comprehensive and uniform definition of this term. According to Valaskova et al. (2020), earnings management can be considered as "a process in which the company's management intervenes in the financial statements in order to point out what is the desired state and not what is the real result".

The literature points to various discussions on the topic of earnings management. Some studies simply focus on the theoretical aspect of this issue, such as Healy and Wahlen (1999), Dechow and Skinner (2000), and Rath and Sun (2008), which focus on major advances in earnings management research. Dechow and Skinner (2000) emphasize that experts and regulators often perceive earnings management as ubiquitous, problematic, and requiring immediate corrective action. Mulford and Comiskey (2002) argue that earnings management is used to achieve revenue targets that can be set by internal or external parties. In this sense, it is an active manipulation of profit. Phillips et al. (2003) define earnings management as managerial decisions about accounting decisions and operating cash flows. Subsequently, Giroux (2004) describes the motivation of management to manipulate earnings

under different conditions and defines earnings management as the planning and control of the accounting and reporting system in order to meet the personal requirements and goals of management. Ning (2005) introduces the concept of earnings manipulation. According to the study, this profit manipulation is a management activity, the result of which is the achievement of the required level of reported profits. It also defined five characteristics of such a manipulation. First, profits are manipulated by management rather than by accountants. Second, earnings are manipulated consciously and intentionally. Thus, the handling of earnings is different from unintentional errors, such as incorrect entry of numbers by accountants. Third, the steps taken to manipulate earnings include not only accounting decisions but also actual business decisions. For example, accelerating the timing of sales through increased price discounts or more lenient lending conditions may lead to an increase in reported current profit but a decrease in the expected value of the firm. Fourth, the ultimate purpose of manipulating actual profits is to influence reported profits. Fifth, the extent of profit manipulation (that is, how far profit manipulation would go) depends on the level of reported profits required by management. If the manipulation of profit is carried out through the exercise of discretion granted by accounting standards and laws in such a way that the expected value of the company is not adversely affected, it is earnings management; otherwise, it is accounting fraud. In profit manipulation, fraud is seen as a negative aspect, while earnings management is a positive aspect. He generally argues that earnings management is a strategic tool for a company to maximize its value and reduce risk. Different ways of managing profits also provoke further discussions. It may be an accrual manipulation with no direct effect on cash flows, referred to as an accrual manipulation. Other authors talk about actual revenue management, where managers try to influence reported profits through steps that significantly change the company's cash flows, thereby affecting reported profits, for example. This was addressed by Dechow et al. (1995), Bartov (1993), Gunny (2005), Roychowdhury (2006) and others.

Ronen and Yaari (2008) provide a general definition of earnings management that focuses on management's goal of influencing the interpretation of reported revenue, including intentional measures to affect reported revenue and its interpretation. They also distinguish between two main activities of profit manipulation in a real economic and accrual way. According to them, earnings management is the implementation of accounting decisions that affect the value of profits and their interpretation after the realization of actual profits.

Walker (2013), in his definition, speaks of earnings management as the use of managerial authority to select revenue returns and actual economic decisions to influence how underlying economic events reflect earnings rates. Darmawan et al. (2019) describe earnings management as a choice of accounting policies or specific measures that affect income in order to achieve certain profit objectives reported in the financial statements. According to Callao et al. (2014), one of the main problems in defining earnings management is its ambiguity and immeasurability. Nevertheless, they have provided a definition that reads as follows: earnings management is a targeted intervention in financial reporting designed to achieve target revenues through a variety of accounting policies. However, it is an act that takes place without necessarily violating accounting rules and that makes use of the choices in accounting policy. It can mislead stakeholders, leading them to make decisions based on financial reports that they would not otherwise make. Their definition of earnings management underlines the common elements found in many definitions. The purposeful action of managers, indicating the deliberate and conscious action of managers; dealing with external aspects of data, always with regard to corporate data reporting; manipulation of the company's financial data; achieving the goals and specific intentions of managers; the use of flexibility in the choice of accounting procedures; the subjectivity of managers by the choice of standards that help to achieve the planned results and the choice within the possibilities of standards; the misleading nature of the information, where the information presented may conceal or even falsify the facts. At the same time, they noted that different authors perceive some aspects of earnings management differently. Omar et al. (2014) report on the problem of earnings management, which shows that this management tool is always associated with profit manipulation and fraudulent financial reporting practices, resulting in arguments among researchers as to whether it is correct or incorrect. They argue that in today's dynamic and challenging business environment, it is almost impossible to find a company that does not practice earnings management, as far as it is allowed. They also focused their attention on two key types of earnings management, namely: accrual earnings management (AEM) and real earnings management (REM). Subramanyam (2014) also talks about the existence of two forms of earnings management. One form is a change in the real accounting method, while the other is the use of accounting and policy estimates, which change accounting calculations and are hidden forms of earnings management. Susanto (2017) pointed out that economic profit management is the manipulation performed by the company's management through operating activities that directly affect cash flow. Profit management is performed by assigning the cost of goods sold to the value of inventories so that the cost of goods sold is reduced.

We are talking about managing real profits, because the company's management manipulates the cost of goods sold. The team of authors, Omar et al. (2014), expressed the general assumption that profit management is not always a fraudulent activity that negatively affects the company and its operations. According to them, it is necessary to pay more attention to the motives that stand out using the given techniques. However, he sees another problem in how to distinguish the "right" from the "wrong".

The absence of rules prohibiting earnings management allows the company's management to choose and apply accounting policies and methods that open up the opportunity to practice earnings management. Management motivation to manage profits is an incentive bonus, debt motivation, political motivation, tax motivation, change of directors, and motivation to sell shares (Watts and Zimmerman, 1986).

Methodology

For the practical application of Benford's law, we used a company from the economic sector NACE A -Agriculture, Forestry and Fishing which is a sector often linked to earnings manipulation. In the practical part, we obtained data from the balance sheet and profit and loss statements in the range of accounting periods from 2019 to 2020, to cover both, the period before and during the pandemic.

The verification of the occurrence of earning management was carried out by the application of Benford's law. Benford found that people are more likely to look for numbers that start with low numbers rather than high numbers. He also claimed that there are more numbers that start with lower digits. He tested his hypothesis by analysing more than 20,000 numerical data points in 20 different data sets. In this way, Benford found that numbers fall into a pattern where low digits occur more often in the first position than larger digits. This mathematical principle defining the frequency of occurrence of digits is known as Benford's law (Durtschi et al., 2004). Benford's law is therefore based on the assumption that the sequences of numbers follow certain formulas that can be predicted. Analysts can use this law to detect certain fluctuations in data that may signal fraudulent reporting (Collins, 2017).

The next stage of Benford's research was to derive the expected frequencies of the numbers in the lists of numbers. The formulas for the frequency of the digits are shown in the following formulas, where D_1 represents the first digit, D_2 the second digit and $Prob$ indicates the probability of occurrence of the numbers in parentheses (Nigrini, 2012).

$$Prob(D_1 = d_1) = \log(1 + \frac{1}{d_1}); \qquad d_1 = \{1,2, \dots ,9\} \tag{1}$$

$$Prob(D_2 = d_2) = \sum_{d_1=1}^{9} \log(1 + \frac{1}{d_2}); \qquad d_1 = \{1,2, \dots ,9\} \tag{2}$$

Using these formulas, we can substitute information about the frequencies of occurrence of individual digits, which are shown in the following table (Table 1).

Table 1: Frequencies of occurrence of digits according to Benford's law

Digit	Frequency of the 1st digit	Frequency of the 2nd digit
0	-	11.97 %
1	30.10 %	11.39 %
2	17.61 %	10.88 %
3	12.49 %	10.43 %
4	9.69 %	10.03 %
5	7.92 %	9.67 %
6	6.69 %	9.34 %
7	5.80 %	9.04 %
8	5.12 %	8.76 %
9	4.58 %	8.50 %

Source: *own elaboration by Durtschi et al. (2004)*

Benford's law states that within the natural numbers 1-9, they will be the leading digits in the actual data set with some probability (Collins, 2017), Table 1.

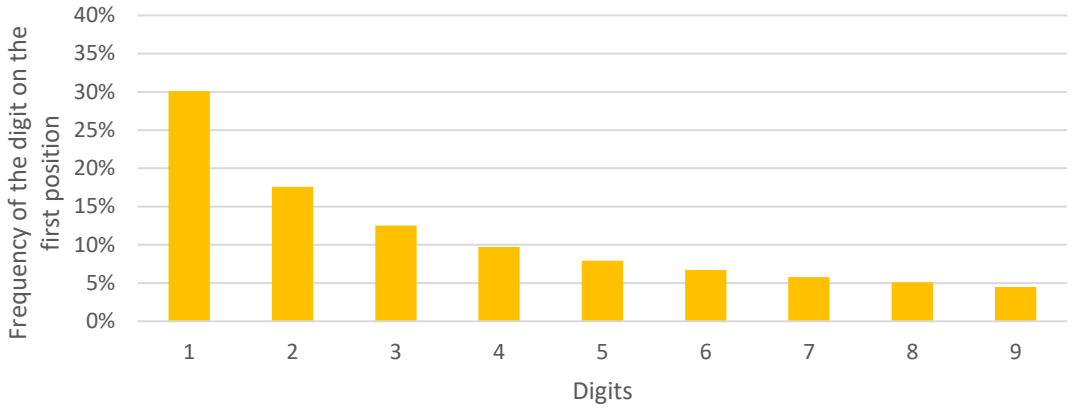

Figure 1. Benford's decomposition
Source: *own elaboration by Durtschi et al. (2004)*

Figure 1 monitors the probability of occurrence of individual digits. Each subsequent digit from 1 to 9 will be the leading digit with a decreasing probability of occurrence. This law is widely used in accounting to examine data for certain anomalies that may indicate fraud. We can compare the profit and loss account data with the Benford curve to verify its veracity. It can also be used to detect money laundering and tax evasion, to check invoices and accounts, and also to record fixed assets (Singleton, 2011; Aris et al., 2017). For example, if the audit aims to detect fraud in the reimbursement cycle, the auditor could use Benford's law to measure the actual occurrence of leading digits in the statements compared to the probability of occurrence of individual digits. Suffice it to say that this law does not say whether manipulations have taken place or not, but only points out certain abnormalities that could indicate possible data distortion (Singleton, 2011; Aris et al., 2017).

Then the application of the χ^2 test help verify the agreement or difference between the empirically obtained and theoretically expected probabilities of the occurrence of digits. When verifying, a null hypothesis must be formulated. The null hypothesis (H0) states that there is no statistically significant difference between empirical and expected probabilities, so they are equal. In contrast, the alternative hypothesis (H1) states that there is a statistically significant difference between empirical and expected probabilities. Based on the final value of the χ^2 test results, it is decided whether or not to reject the null hypothesis (H0). χ^2 test is calculated using the following formula:

$$\chi^2 = \sum_{i=1}^{n} \frac{(e-t)^2}{t} \tag{3}$$

Where n is the total number of categories (digits), e is the empirical probability and t is the theoretical probability. When calculating the value of χ^2 test, it is necessary to know whether it indicates the rejection or confirmation of the null hypothesis. For this purpose, we need to determine the degrees of freedom (df) and level of significance ($\alpha = 0.05$). The degrees of freedom represent the number of categories minus one (in our case df 8). Subsequently, the corresponding table value of 15.51 was set, which is the limit value for rejection or confirmation of the null hypothesis.

Results

It can be expected that most of the accounting data will correspond to the Benford distribution and will therefore be suitable candidates for this analysis. Typical accounts consist of transactions that result from combining numbers. For example, receivables represent the number of items purchased multiplied by the price per item. Account size, the number of records or transactions, is also important. In general, analysis results are more reliable if the entire account is analyzed rather than just a sample of it. (Durtschi, 2004). Currently, it is difficult to find an accurate mathematical test to determine whether the data conforms to Benford's law. Nevertheless, much experience has been gained in assessing compliance with Benford's law. For our purposes, the mean absolute deviation (MAD) test developed by M. Nigrini (2012) is sufficient. MAD is a measure of variability that indicates the average distance between observations and their average and it helps to get an idea of how the values in the file are distributed. The larger the values, the greater the distance from the average (Table 2).

Table 2: Frequencies of occurrence of digits according to Benford's law

MAD critical values	
$MAD \leq 0.006$	Absolute match
$0.006 < MAD \leq 0.012$	Acceptable match
$0.012 < MAD \leq 0.015$	Limit match
$0.015 < MAD$	No match

Source: *own elaboration by (Nigrini, 2012)*

The system of the Benford's law was verified on corporate accounts, which are part of its financial statements, for the accounting periods of 2019 and 2020. These two years were selected to examine the company's possible handling practices before and during the COVID-19 pandemic. The necessary accounts (treasury – account 211, payables to suppliers – account 321, value added tax – account 343, material consumption – account 501, sold goods – account 504, sales of goods – account 604 and revenues from own products – account 601) were obtained from the accounting software Money S3. These accounts were arranged in tables, where for each of the numbers from 1 to 9 their absolute numbers within a particular account were listed, together with the probability of occurrence of numbers in % (expected according to the Benford distribution and empirical, found from real data), the difference between these probabilities, the absolute value of the difference between the probabilities, and based on that, the compliance with Benford's law according to the critical MAD values was determined and finally the statistical χ^2 test was used.

Benford verified that individual digits are likely to occur in nature and in various areas of life. That is, their occurrence can be predicted by certain patterns. We have used this law to disclose earnings management, and thus manipulation of financial statements. Our analysis was based on the assumption that if there is a certain fluctuation or abnormality in the occurrence of empirically obtained figures, it can be an earnings management and thus a distortion of the company's financial results. The following table 3 summarizes the results of this analysis.

Table 3: Benford's law verification

Year	Account	Absolute frequency	MAD	χ^2
2019	601	149	0.048	35.774
	343	501	0.018	5.037
	321	372	0.013	3.559
	211	805	0012	2.407
	501	444	0.010	1.718
2020	601	150	0.016	3.831
	343	702	0.023	6.075
	321	728	0.023	9.161
	211	1078	0.018	3.943
	501	448	0.016	4.212
	604	267	0.059	50.698
	504	238	0.030	14.224

Source: *own elaboration*

In the table, the results of the analysis of Benford's law are clearly presented. The most appropriate conditions for verification will be provided by a data set containing approximately 500 or more figures, which has not always been the case for company accounts. We assessed whether compliance with Benford's law was performed or not through MAD critical values and the χ^2 test. The calculated MAD values are in the table distinguished by colours. Green and yellow colours are used in the case of compliance and red in the case of non-compliance with Benfords's law. Only in 2019, the compliance with Benford's law was achieved for accounts 501, 211, and 321. Based on the level of significance and the corresponding degree of freedom, we used the assigned value of 15.51 as a threshold

for rejecting or not rejecting the null hypothesis. The null hypothesis (H0) states that there is no statistically significant difference between empirical and expected probabilities, i.e., they are equal, which means that we have no reason to suspect the company of practicing earnings management or accounting manipulation. We rejected this hypothesis in only two cases, namely the revenue accounts 601 in 2019 and 604 in 2020, which showed signs of the presence of earnings management practices. As far as these income accounts are concerned, the option was be accepted that these accounts were manipulated if enterprises needed to reduce their revenues in order to reduce taxes. To illustrate and compare the results more precisely, the graphical representation of the verification of Benford's law (blue colour) in the given years and individual accounts is presented (Figures 2-6).

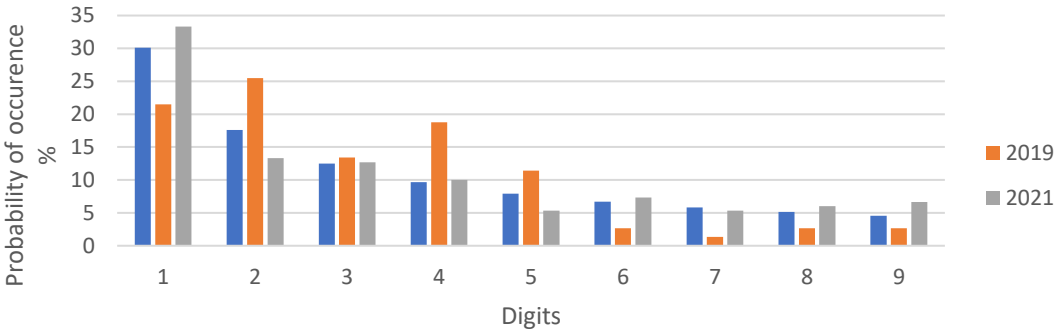

Figure 2. Verification of Benford's law (account 601)
Source: *own elaboration*

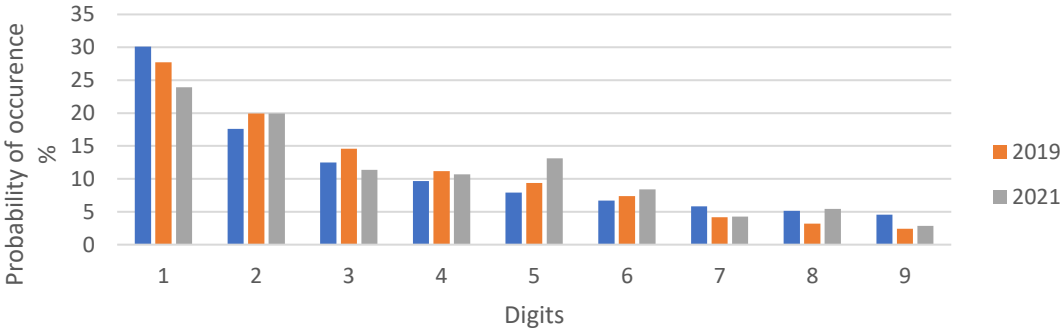

Figure 3. Verification of Benford's law (account 343)
Source: *own elaboration*

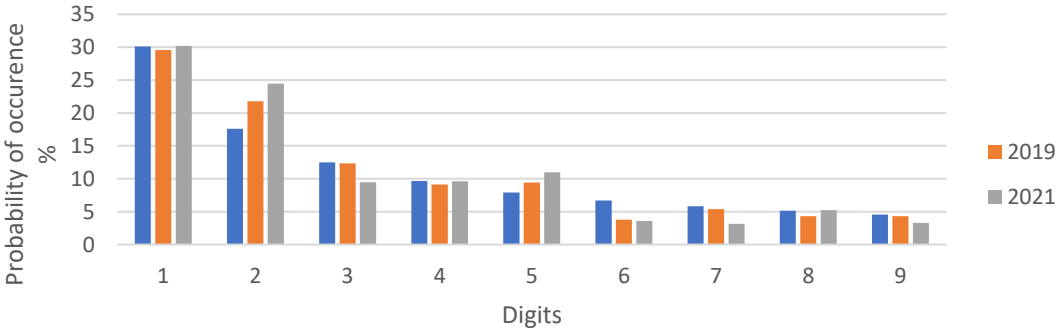

Figure 4. Verification of Benford's law (account 321)
Source: *own elaboration*

In account 343, we can see a great resemblance to Benford's distribution. We do not record significant changes in values here, with the exception of the number 5 in 2020. In general, we claim that this tax account was not manipulated in the company, which we also confirmed by an analysis of the account. From Figure 4 we can read that in the supplier account 321 there were worse results and more

frequent fluctuations in 2020 than in 2019, which is also indicated by the results of MAD critical values. In 2019, there was a limit match with the Benford distribution, while in 2020 it was already a disagreement. However, the χ^2 test did not confirm accounting manipulation in a given year in any given year.

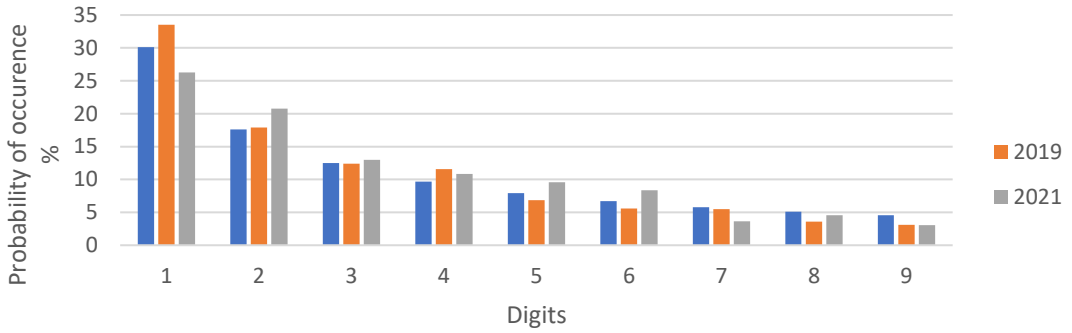

Figure 5. Verification of Benford's law (account 211)
Source: *own elaboration*

In the treasury account 211, the probability values reached a declining trend in both years. Only in 2019 did we record an agreement with the Benford distribution according to the MAD critical values. However, despite the fact that there was no agreement in 2020, χ^2 test did not confirm the accounting manipulation of this account in any of the years.

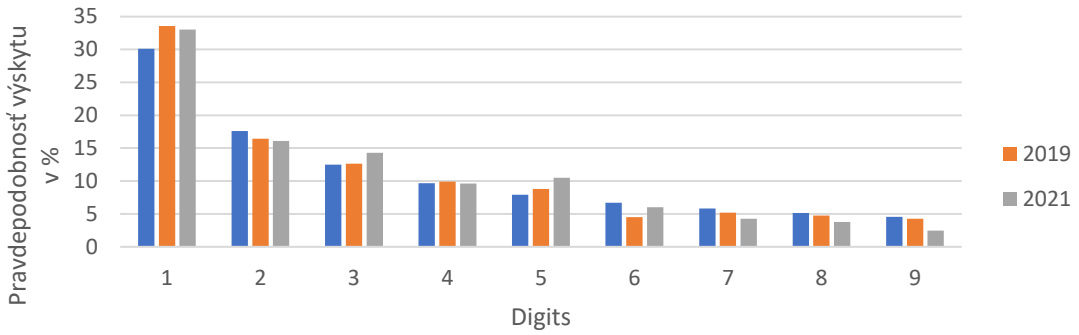

Figure 6. Verification of Benford's law (account 501)
Source: *own elaboration*

The last account, which was a subject of the calculation, was the cost account 501. We also did not record any rapidly changing values in this account. In 2019, we confirmed compliance with Benford's law, but in 2020, the MAD had already exceeded the limit of compliance. The χ^2 test confirmed that in none of the years has there been any distortion and manipulation of earnings.

When comparing the results of the verification of the Benford's law in 2019 and 2020, we can notice that in 2020 all MADs were critical values at a level indicating non-compliance with the law. This means the probability of the presence of earnings management and manipulation of financial statements. It should be noted that these two years represent a comparison of the situation before the COVID-19 pandemic and the situation during the greatest expansion of this recession. It is understood that these facts also affected the business activities, which were also reflected in this verification.

Discussion

The results of our study confirm that the application of Benford's law to detect earnings management practices may be very useful, which is also confirmed by other studies published in the international context (e.g. Minichilli et al., 2022; Nguyen et al., 2022; Walzenbach, 2021). Its practical application, identification of the argument for and against its usage in the accounting sector, and determination of this research method as an audit tool is presented in the review by Orth et al. (2020).

Grammatikos and Papanikolaou (2021) applied this law in the banking industry to detect accounting data manipulation, and they found out that banks adjust loan loss provisions to manipulate earnings and income upwards. The results of their study also proved that manipulation is magnified during the crisis and expands to encompass regulatory capital. The study by Lin et al. (2018) employed Benford's law to overcome the shortcomings of accrual models' insufficient explanatory power on the detection of earnings management. Qu et al. (2020) applied Benford's law to examine the accuracy of non-profit financial reports. They found out that deviations from Benford's law are smaller for organizations that are more professional, that report positive fundraising and administration expenses, and that face stronger funder oversight. The authors suggest the application of this method in corporate practice, which is in line with our outputs, as this law uses appropriate discriminating screening metrics and may simply reveal cosmetic earnings management (Hartlieb, 2020). The study by Mukherjee (2018) introduces Benford's Law and its applications within the corporate governance literature. The analysis devoted to the explanation of CEO pay shows that CEOs prefer to be paid in round figure values, especially 5. Finally, the negotiating tactics of CEOs were compared, and the impact of firm size on their compensation was also analysed. The same study, focusing on the relationship between the CEO and the quality of earnings, was realized by Nguyen et al. (2021). The relevance of Benford's Law in accounting practice is underlined by Theodoro et al. (2021), who declare that Benford's Law is useful as a tool in selecting audit samples, and it can also improve the work of supervisory bodies. Unfortunately, many entities knowingly manipulate revenues and expenses to manage earnings in a way that suits the entity management.

Conclusions

Detecting fraud in financial statements is the primary task of forensic accountants, and Isakovic-Kaplan et al. (2021) also advise Benford's law in the forensic analysis of corporate financial statements to detect earnings management practices. Jianu and Jianu (2021) focused on the reliability of financial data before and after the implementation of International Financial Reporting Standards using the first digit test of Benford's Law.

Thus, it can be concluded, that researchers and accountants often compare the leading digits of financial transaction data to a Benford curve to spot anomalies that may indicate fraud. It is then highly recommended for accountants and auditors to apply Benford's law to corporate data to discover number-pattern anomalies.

Despite the fact, the advantages of practical applications of Benford's Law in corporate practice are inalienable; their application to a limit number of accounts can be perceived as the limitation of the study. However, this may be a force for further research, to analyse all relevant accounts and compare the findings of potential earnings manipulation with other earnings management detection models, methods, and techniques.

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