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Advanced methods of earnings management: monotonic trends and change-points under spotlight in the Visegrad countries

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Abstract

Research background: Enterprises manage earnings in an effort to balance their profit fluctuations to provide increasingly consistent earnings in every reporting period. Earnings management

is legal and very effective method of accounting techniques and may be used to obtain specific objectives of the enterprises involving the manipulation of accruals. Therefore, there is a need to analyze it in the context of group of countries, while the issue of their detection in the new ways appears.

Purpose of the article: The analysis of annual earnings before interest and taxes (EBIT) of 5,640 enterprises from the Visegrad Four during the period 2009–2018 confirms that the development of earnings management in these countries is not a randomness. Thus, the aim of this article is to determine the existence of positive trend in earnings management and to detect the change-point in its development for each Visegrad country.

Methods: Grubbs test, Mann-Kendall trend test and Buishand test were used as appropriate statistical methods. Mann-Kendall test identifies significant monotonic trend occurrence in earnings manipulation in every country. Buishand test indicates significant years, which divides the development of EBIT into two homogenous groups with individual central lines.

Findings & Value added: Based on the statistical analysis applied, we rejected randomness in the managing of earning, but we determined the trend of its increasing. The positive earnings manipulation was not homogenous in the analyzed period, however, a change-point was defined. Year 2014 was identified as a break-point for Slovak, Polish and Hungarian enterprises considering the earnings manipulation. Year 2013 was detected as a change-point in Czech enterprises. The methodical approach used may be very helpful for researchers from other countries to determine, detect and understand earnings management as well as for the investors to make decisions based on a specificities of an individual country.

Introduction

The concept of Industry 4.0 means a new paradigm of modern business. This phenomenon requires continuous development (Durana *et al.*, 2019). A question arises — How to be a successfully adapted and still a profitable enterprise in the new conditions? Many research studies devoted to this issue have been published recently (e.g. Hollowel *et al.*, 2019, pp. 9–15; Hayhoe *et al.*, 2019, pp. 31–36; Ludbrook *et al.*, 2019, pp. 21–26). The solution of applying the principles of corporate social responsibility proposed by Nadanyiova and Durana (2019) represents one of the ways to gain a competitive advantage for the enterprises, and at the same time to improve its image and increase brand value, attract new customers and also increase corporate profits. Ashander *et al.* (2019, pp. 57–62) provide own view through the decision-making logic of big data algorithmic analytics, providing both quantitative evidence on trends and numerous in-depth empirical examples to be prosperous despite of new circumstances. Tuffnell *et al.* (2019, pp. 7–12) perform analyses and estimate profits using artificial intelligence for enterprise applications of market worldwide manufacturing systems in the environment of Industry 4.0. Lafferty (2019, pp. 19–24) analyses and estimates earnings regarding transformation approach taken by drivers of change and time to impact. Plumpton (2019, pp. 23–29) emphasizes top challenges in changing strategy for Industry 4.0. However, the approaches mentioned above are only partial answers. Earnings manage-

ment is considered as a comprehensive solution and business management plays a vital role in building processes, structures, and the business environment (Michalkova *et al.*, 2019, pp. 37–45). Earnings management, as well as Industry 4.0, represents great phenomenon, consequences of which are still unexplored in the region of Visegrad Four (Rahman *et al.*, 2018, pp. 132–148). It is a powerful tool of managerial opportunistic behaviour exemplified in the management of accounting earnings (Saona *et al.*, 2020, pp. 98–133). Earnings management use a variety of methods and techniques (etc. accounting principles, creative accounting, discretionary accrual, non-discretionary accruals) to legal profit manipulation. Thus, it is really important for researchers to discuss comparative analysis of earnings management used in the countries, deal with the individual connections, describe the studies of models of earnings management detection as well as identify the changes of the trends. We see great significance on the side of the enterprises to understand earnings management and strategically plan their own success and profitability if the current time of Industry 4.0. Kowo and Akinbola (2019, pp. 38–50) confirm that there is a significant influence of strategic planning on sustaining enterprises profit performance.

We argue that the managers in the Visegrad region use earnings management in larger measures. The aim of this article is to determine the existence of positive trend in earnings management and to detect the change-point in its development for each Visegrad country.

The paper is structured as follows. Firstly, the theoretical background provides the overview of publications in the field of earnings management supported by bibliometric analysis realized by Vos viewer. Secondly, the materials used and methods applied in this research are portrayed. EBIT data was gained from Amadeus database supplied by Bureau van Dijk. Research methods as Grubbs test, Z-Score, Mann-Kendall trend test and Buishand tests are used. The third part of the article presents the research results and discusses comparative studies. Finally, the limitations of the research, potential areas of further research, as well as the conclusions, are highlighted.

Literature review

Valaskova *et al.* (2019, pp. 3922–3932) sum up the approaches to the definitions of earnings management. One of the oldest is the definition of earnings management by Schipper (1989, pp. 91–102), which claims earnings management to be a meaningful interference in the external financial reporting process in order to gain profits for shareholders or managers. Hea-

ley and Wahlen (1999, pp. 365–383) presented earnings management as a phenomenon that occurs when business management intervenes in financial statements and internal transactions to make the necessary changes either to mislead shareholders in relation to the financial performance of an enterprise, or to influence outputs of contracts that are based on the corporate financial results (Gavurova *et al.*, 2017, pp. 852–876). Fields *et al.* (2001, pp. 255–307) reported in their study that earnings management arises when managers exercise their discretionary power to intervene in accounting. Ronen and Yaari (2008) defined the principles of earnings management differently, claiming that this is a set of managerial decisions that result in not producing real short-term value-maximizing profits as is known to management. McKee (2005) defined earnings management as the purposeful and legal management of decision-making and reporting in order to achieve stable and predictable results.

Hepworth (1953, pp. 32–39) is the first author in history who used the term of earnings management. The study portrayed several tactics, how to balance revenues through specific accruals that can be used to transfer net earnings to subsequent accounting periods. Gordon (1964, pp. 251–263), Dopuch and Drake (1966, pp. 192–219) and Archibald (1967, pp. 164–180) presented first approaches to disclose earnings management in the enterprises by graphical techniques of time series. Gordon *et al.* (1966, pp. 221–231) used mathematical modelling for the detection of earnings management. Copeland (1968, pp. 101–116) proposed to use more than one variable in the empirical tests of the occurrence of earnings management. The study of White (1970, pp. 260–273) includes a number of various dependent variables in the tests and regression analysis was applied for the first time. Beidleman (1973, pp. 653–667) was the first researcher who empirically proved the existence of earnings smoothing in American conditions. Healy (1985, pp. 85–107) estimated the discretionary accruals using the average total accruals, and therefore tried to measure the earnings management. DeAngelo (1986, pp. 400–420) continued in the previous study of Healy (1985, pp. 85–107) adding an accrual from the previous period. This model was again improved by McNichols and Wilson (1988, pp. 1–32) capturing the discretionary accruals as a rate of earnings management, instead of total accruals. Jones (1991, pp. 193–228) created an original model quantifying normal total accruals. This model was modified several times. Firstly, Dechow *et al.* (1995, pp. 192–225) revised the model completing the year-on-year change in receivables. Key (1997, pp. 309–337) added intangible assets to the original model, Kasznik (1999, pp. 57–81) modified the model by changes in cash flow and McNichols (2000, pp. 313–345) cash flows of the previous, current and future periods. These models were

not the last corrections of the original Jones model. Dechow *et al.* (2003, pp. 355–384) put division of discretionary and non-discretionary accruals within receivables, the addition of the accrual from the previous period and the addition of a variable controlling the growth of revenues. Kothari *et al.* (2005, pp. 163–197) focused on the return of assets. Beneish (1997, pp. 271–309) constructed his model (M-score) based on 5 or 8 variables. Compared to the vast majority of models which are based linear regression, models of Höglund (2012, pp. 9564–9570) are based on the application of artificial neural networks and artificial intelligence and some of them on genetic algorithms (Höglund, 2013, pp. 2633–2372).

Earnings management in the enterprises is undoubtedly not only a local or national, but a global phenomenon, which attracts attention of academic researchers for long time, as evidenced by a significant number of scientific papers. The article sums up also international research articles through bibliometric analysis based on the scientific database Web of Science Core Collection, which is realized by Vos viewer to support and especially extend the literature review. 462 articles, from 1990 to 2020 are comprehensively analysed focusing on the profit context to extend the close issue of earnings management. Three bibliometric maps are created from the international research articles related to the profit.

Firstly, based on the Vos viewer analysis, four clusters are detected considering the issue of the profit (Figure 1). It is assessed by the occurrence of business profit as well as connected items in the title and in the abstracts of the articles. The first cluster, the basic one, involves business profit and its nine narrow categories: business cycle, case, data, economy, effect, problem, profitability, society and type.

The second cluster connected to the profit is named business model. It involves seven categories: cost, goal, management, non-profit organization, order, organization, and relation. The third cluster perceives earnings from the theoretical point of view. It is formed of six components: theory, American business, concept, ethics, profit maximization, small business. The last cluster oriented to investment is created by investment and business saving.

Finally, bibliographic coupling of twelve countries of the articles related to the profit are determined by Vos viewer (Figure 2). Four connected clusters of bibliographic coupling are found. The first cluster with the biggest portion is created by: USA, Germany, France and Belgium. Brazil, Canada and Taiwan are relevant in the second cluster. England and New Zealand represent the third cluster. Last cluster is indicated by Australia and China. This bibliographic map proves which countries are dealing with the issue of earnings management most frequently

Research methodology

The earnings before interest and taxes (EBIT) of enterprises in Visegrad Four are used to analyse the enterprises. The sample of 5,640 enterprises was extracted from Amadeus database capturing years 2010 to 2018. It includes 1,347 Slovak enterprises, 859 Czech enterprises, 2,554 Polish enterprises and 880 Hungarian enterprises. The variable EBIT is selected to abstract the impact of different tax and interest, moreover, EBIT is one of the most used kinds of earnings. The enterprises have to meet three set criteria:

- the value of total assets minimum 3,000,000 €;
- the value of total sales minimum 2,000,000 €;
- the value of net income at least 100,000 €.

We used following methodological approaches (processed by XLSTAT Premium).

1. *The identification and removal of incomplete data*

The database Amadeus provide a lot of data, but there are some missing or non-available values. If we have a sufficiently large data file, we can afford a simple solution in the form of removing those units from the file that have missing values (Svabova & Michalkova, 2018).

2. *The detection and removal of outliers*

An outlier in a sample survey is an observation far away from most or all other observations (Ghosh & Vogt, 2012). Different methods and tests are used to determine the existence of outliers in raw samples. Svabova and Michalkova (2018) recommend the use of Dixon or Grubbs tests when pre-processing the data related to the issue of earnings management. The test is selected based on the sample Size. Grubbs test is preferred for the datasets containing more than 25 observations. Basic studies work on the assumption that the sample data are drawn from a normal population (Ghosh & Vogt, 2012). Two sided Grubbs test (Grubbs, 1950, pp. 27–58) is often used to evaluate measurements, coming from a normal distribution of size n , which are suspiciously far from the main body of the data. Grubbs test appears to be a very useful tool in single outlier detection (Solak, 2009). As soon as an outlier is found, it is removed from the data set and the process is repeated until no more outliers are detected (Solak, 2009). For a two-sided Grubbs test, testing if the minimum or maximum values are outliers, the test statistic (G) is defined as:

$$G = \frac{\bar{x} - x_1}{s} \text{ or } G = \frac{x_n - \bar{x}}{s} \quad (1)$$

where x_1, \dots, x_n are the values of observations, \bar{x} is the sample mean and s is the standard deviation. The critical value (C) of the Grubbs test is calculated as:

$$C = \frac{n - 1}{\sqrt{n}} \sqrt{\frac{t^2_{\left(\frac{\alpha}{2n}, n-2\right)}}{n - 2 + t^2_{\left(\frac{\alpha}{2n}, n-2\right)}}} \quad (2)$$

where n is the number of observations, $t^2_{\left(\frac{\alpha}{2n}, n-2\right)}$ denotes the critical value of the t-distribution with $(n-2)$ degrees of freedom and a significance level of $\frac{\alpha}{2n}$.

If $G \geq C$, then the suspected measurement is an outlier (Solak, 2009; Grubbs, 1950, pp. 27–58). In case of multiple suspect observations for instance having a few measurements lumped together away from the main body of data, sequential application of Grubbs test may not detect (due to masking effect) outliers correctly (Solak, 2009).

We support the results of Grubbs test by Z-score. Z-score is a frequently used method to detect outliers (Garcia, 2012). If the mean and standard deviation of the population are known, then the Z-score of the most extreme candidate outlier is computed and an estimate is made for the likelihood of the most extreme value being in the two tails associated with that Z-score. If this is low, as in hypothesis testing, we declare that the value is an outlier. As in hypothesis testing, the decision about what is a low value is subjective (Ghosh & Vogt, 2012). The problem with Z-score may occur in a small sample, because of affecting the mean and the standard deviation by outliers and it is necessary to modify Z-score. Garcia (2012) marks outliers based on a common rule that absolute value of Z-score is greater than 3 and notes that the criteria may change depending on the data set and a research maker. Z-score is defined as:

$$Z_{score}(i) = \frac{x_i - \bar{x}}{s} \quad (3)$$

Nagy (2016) claims the possibilities of doing after detection of the outliers: do not consider/ignore outliers, exclude outliers or exclude only ex-

treme values (far outliers). We decide for the possibility of removal of all outliers to robust statistics and results insensitive to the outliers which is also supported by the study of Svabova and Durica (2019, pp. 359–375). They argue that it could be appropriate to exclude outlined enterprises from the database because the values of outliers could cause changes in the results of statistical tests and procedures. Hansen *et al.* (1983, pp. 411–414) warn that the removal of outlier from the sample could change the estimate of a parameter of interest by 10 percent or more, but Ghosh and Vogt (2012) highlight that keeping the outliers in the sample may overvalue it and cause the estimate to vary drastically from the true population value.

3. *The determination of a monotonic trend.*

The determination of a randomness against monotonic trend is possible by parametric as well as nonparametric ways. We prefer nonparametric ones in this research. Nonparametric statistic method is a statistic method which does not depend on a certain distribution without serial correlation (Chen *et al.*, 2020). The assumption of normality does not have to be met. Mann (1945) proposes a first nonparametric trend test, this issue is continued by Kendall (1948) and complemented by Hirsch *et al.* (1982, pp. 107–121 and 1984, pp. 727–732). The non-parametric Mann-Kendall trend test is used to detect monotonic trends in the time series. The purpose is to test whether there is a consistent trend in nonstationary time series. The minimum number of recommended measurements is at least 8 to 10, data is not collected seasonally and only one data point per time period is required (Khambhammettu, 2005). The research sample consists of annual EBIT of enterprises from the Visegrad Four of nine-year-long period. The above criteria are met. The null hypothesis, H_0 , is that the data comes from a population with independent realizations and are identically distributed. The alternative hypothesis, H_A , presents that the data follow a monotonic (non-null, negative, positive) trend (Pohlert, 2020). The Mann-Kendall test statistic (S) is defined as:

$$S = \sum_{k=1}^{n-1} \sum_{j=k+1}^n \text{sgn}(X_j - X_k) \tag{4}$$

with

$$\text{sgn}(x) = \begin{cases} 1 & \text{if } x > 0 \\ 0 & \text{if } x = 0 \\ -1 & \text{if } x < 0 \end{cases} \tag{5}$$

where $sgn(X_j - X_k)$ is an indicator function that takes on the values 1, 0 or -1 according to the sign of $X_j - X_k$. The mean of S is $E[S] = 0$ and the variance σ^2 is

$$\sigma^2 = \frac{1}{18} \left\{ n(n-1)(2n+5) - \sum_{j=1}^p t_j(t_j-1)(2t_j+5) \right\} \quad (6)$$

where p is the number of the tied groups in the data set and t_j is the number of data points in the j -th tied group (Pohlert, 2020). The statistic S is approximately normal distributed provided that the following Z-transformation is employed:

$$Z = \begin{cases} \frac{S-1}{\sigma} & \text{if } S > 0 \\ 0 & \text{if } S = 0 \\ \frac{S+1}{\sigma} & \text{if } S < 0 \end{cases} \quad (7)$$

where σ is the standard deviation. It is much easier to interpret statistics that are closely linked to S , and more well-known, as Kendall's τ (Kanovsky, 2018, pp. 429–447; Pohlert, 2020) which is given by:

$$\tau = \frac{S}{D} \quad (8)$$

where

$$D = \left[\frac{1}{2} n(n-1) - \frac{1}{2} \sum_{j=1}^p t_j(t_j-1) \right]^{1/2} \left[\frac{1}{2} n(n-1) \right]^{1/2} \quad (9)$$

The advantage of Kendall's τ is that it is normalized so that it takes values from -1 to 1, with negative values indicating a downward trend and positive values with an upward trend (as in the case of S) (Kanovsky, 2018). In our case, this means that a significant downward trend (negative τ and S values) indicates a significant decrease in earnings management and a significant upward trend (positive values of τ and S) indicates a significant increase in earnings management. The analysis allows us to formulate

the following hypotheses related to the significant monotonic trend in earnings management of the enterprises in the Visegrad Four:

Hypothesis₁: *There is a positive trend in the earnings management of enterprises in individual countries (Slovakia, Czech Republic, Poland and Hungary).*

However, it is not sufficient to test only the monotonic trend, because it may happen that the monotonic trend for the whole period is not significant, but there is a significant change-point (Kanovsky, 2018). It means that the heterogeneity of times series may occur and it is necessary to support Mann-Kendall trend test by some homogeneity test that confirms the invariant mean.

4. *The detection of homogeneity.*

A practical problem in time-series analysis after determination of the monotonic trend is to find statistical techniques for testing an abrupt change in the mean at unknown time (Buishand, 1984, pp. 51–69). Homogeneity tests detect if time series may be considered as homogeneous over the time, or if there is a moment (in our case the year) in which a change-point occurs. These tests are testing the null hypothesis of homogeneity against a shift in the mean at an unknown point (Buishand, 1984 pp. 51–69). Many methods have been proposed to test the homogeneity. We prefer the test of annual data that are robust to large data gaps (Meals *et al.*, 2011) and select Buishand test (1982, pp. 11–27) based on Q or R statistics. Q statistics provides also the possibility of one-sided hypotheses, but R statistics developed by Buishand provides only the possibility of a bilateral hypothesis. The Buishand test (1982, pp. 11–27) may use variables following any type of distribution and the test also identifies a year in which there is a shift between homogeneous series, detecting the change-point in the variable mean. It is a suitable technique developed in the situation of single time series (Buishand, 1984, pp. 51–69), but mostly studied for the normal variate and used to identify the break point in the middle of the time series (Agha *et al.*, 2017, pp. 57–63; Kang & Yusof, 2012, pp. 9–22). The following model with a single shift Δ (change-point) can be proposed according to Pohlert (2020):

$$x_i = \begin{cases} \mu + \epsilon_i & i = 1, \dots, m \\ \mu + \Delta + \epsilon_i & i = m + 1, \dots, n \end{cases} \quad (10)$$

where $i = 1, \dots, m$ is the observation order, μ is the mean of the population and $\epsilon \approx N(0, \sigma)$. The null hypothesis $\Delta = 0$ is tested against the alternative hypothesis $\Delta \neq 0$. In the Buishand range test (Buishand, 1982, pp. 11–27), the rescaled adjusted partial sums (S_k) are calculated as:

$$S_k = \sum_{i=1}^k (x_i + \bar{x}) \quad (1 \leq i \leq n) \quad (11)$$

Rescaled adjusted partial sums (Q) are obtained by dividing the values of S_k by the sample standard deviation (D_x). The test statistic is calculated as:

$$Q = \max \left| \frac{S_k}{D_x} \right| \quad (12)$$

with

$$D_x = \sqrt{n^{-1} \sum_{i=1}^n (x_i - \bar{x})^2} \quad (13)$$

Another statistic test which could be used is the range which computes the difference between the maximum and minimum value of the rescaled adjusted partial sums. The formula is given as follows:

$$R = \frac{\max S_k - \min S_k}{D_x} \quad (14)$$

Buishand (1982, pp. 11–27) gives critical values for both homogeneity tests R/\sqrt{n} and Q/\sqrt{n} (Ahmad & Deni, 2013, pp. 141–150). The p-value is estimated using a Monte Carlo simulation with m replicates. We run both tests and their p-values are estimated using a Monte Carlo simulation with 10,000 replicates. The analysis allows us to formulate the following hypotheses considering the significant change-points in EBIT of the Visegrad Four enterprises:

Hypothesis₂: *There is at least one year in the analysed period which is a change-point of the mean in the earnings management of enterprises in individual countries (Slovakia, Czech Republic, Poland and Hungary).*

Results

The earnings before interest and taxes of 5,640 enterprises from the Visegrad Four during the period 2009–2018 were included in the origin sample to be analysed. The first point of the study is to detect the number and the existence of incomplete data and eliminate them. It was identified based on table 1; 189 incomplete cases in Slovakia, 154 in the Czech Republic, 1,100 in Poland and 125 in Hungary. After the removal of missing values, the subsequent assessment of the occurrence of outliers in observations of EBIT of Slovak, Czech, Polish and Hungarian enterprises was tested by Grubbs test and supported by Z-score.

Hypothesis₀: *There is no outlier in the data of EBIT.*

Hypothesis₁: *There is at least one outlier in the data of EBIT.*

As the computed p-value is lower than the significance level alpha (0.05), the null hypothesis H_0 should be rejected, and the alternative hypothesis H_1 accepted based on the results portrayed in table 2. There is at least one outlier in the observations of EBIT. The situation was the same for all Visegrad. The results of Grubbs test supported the values of Z-scores. Based on Figures 3 to 6, the outlined observations of EBIT were detected, the red values are outliers indicated for all analysed countries. Based on table 1 it can be summarized that there are 100 outlined values in Slovakia, 17 in the Czech Republic, 78 in Poland and 24 in Hungary. Thus, the final sample consists of 3,853 observations for every year from the period 2009–2018.

Based on annual results of earnings before interest and taxes of 1,058 Slovak enterprises, 688 Czech enterprises, 1,376 Polish enterprises and 731 Hungarian enterprises, the final step of the data pre-processing in the analysis of earnings management was the calculation of annual average EBIT of Visegrad enterprises during the analysed nine-year period (Table 3).

Then, we tested the first set of hypotheses to prove the existence of a positive trend in earnings management for each Visegrad country by Mann-Kendall trend test.

Hypothesis₁₀: *There is no trend in the earnings management of enterprises.*

Hypothesis_{1A}: *There is a positive trend in the earnings management of enterprises in individual countries (Slovakia, Czech Republic, Poland and Hungary).*

As the computed p-value is lower than the significance level alpha (0.05), the null hypothesis H_{10} should be rejected and the alternative hypothesis H_{1A} accepted based on Table 4. The continuity correction was applied and similar significant monotonic trend was confirmed. There is a positive trend in the earnings management of Slovak, Czech, Polish and Hungarian enterprises. The managers from all Visegrad countries use earnings management not randomly, but an upward trend in earnings manipulation is confirmed. It is necessary to disclose if a year causing a significant change of mean in the earnings management exists in the analysed period. That is why we must check the homogeneity of the time series, investigate the possible occurrence of heterogeneity in annual values of EBIT. Subsequently, we detect which year was the break-point in the development of this legal manipulation of earnings. The detection of a development break-point is calculated for each country to identify the similarities or disparities in managerial activities across Visegrad countries.

Thus, we finally tested the second set of hypotheses to achieve the aim of the paper related to the change-point in the development of earnings management for each Visegrad country. These hypotheses are tested by Buishand tests based on Q statistics and R statistics.

Hypothesis₂₀: *There is no year in the analysed period which is a change-point of the mean in the earnings management of enterprises in individual countries (Slovakia, Czech Republic, Poland and Hungary).*

Hypothesis_{2A}: *There is at least one year in the analysed period which is a change-point of the mean in the earnings management of enterprises in individual countries (Slovakia, Czech Republic, Poland and Hungary).*

P-values of both tests are estimated using a Monte Carlo simulation with 10,000 replicates. As the computed p-values are lower than the significance level alpha (0.05), the null hypothesis H_{20} should be rejected and the alternative hypothesis H_{2A} accepted, based on Table 5 for Q statistics and Table 6 for R statistics. The calculated statistics confirms the existence of the significant years, which divided the development of earnings management in the Visegrad Four into two homogeneity periods with individual central

(mean) lines. Based on the results of Buishand test (Table 5), we can label the significant years of development. The year 2014 was identified as a break-point considering the earnings manipulation in Slovak, Polish and Hungarian enterprises. The development of earnings management is very close in these countries. On the other hand, the year 2013 was detected as the change year in Czech enterprises. It means, that in the Czech Republic there are some disparities in managerial activities related to earnings compared to Slovakia, Poland and Hungary. Czech managers use this accounting method more flexible and sooner. The results confirm the discrepancies in managerial activities among countries and obviously the results considering central lines below because the mean values of EBIT are the highest in the Czech enterprises.

Finally, we indicate mean lines of development of earnings management. These central lines are always counted within a homogenous group created by the year 2013 in Czech case and the year 2014 in Slovak, Polish and Hungarian cases. They are also the outputs of Buishand tests. Figures 7 to 10 demonstrate the results for each country of V4. The green line portrays mean value of EBIT before the significant change-point and the red line the mean value of EBIT after the change-points (2013 or 2014). The mean values of EBIT for Slovak enterprises are 892.357 thousand € and 1,346 thousand € (difference of 453.643 thousand €). The mean values of EBIT for Czech enterprises are 2,873 thousand € and 3,696 thousand € (difference of 823 thousand €). The mean values of EBIT for Polish enterprises are 1,140 thousand € and 1,653 thousand € (difference of 513 thousand €) and for Hungarian enterprises, the mean values of EBIT are 1,000 thousand € and 1,828 thousand € (difference of 828 thousand €).

Discussion

Our analysis is focused on EBIT, however, Svabova *et al.* (2019, pp. 2046–2055) use also profit and loss before tax, profit and loss for period, profit and loss after tax, EBITDA and financial profit and loss to develop the issue of earnings management. They focus on the analysis of different levels of earnings in the Visegrad countries. They surveyed earnings levels in the V4 countries in terms of average values and focus on the analysis of the differences between them. Significant differences in the average earnings levels are sought by ANOVA. Their analysis focuses on the period 2013–2017, consisting of almost 300 thousand enterprises from Visegrad countries. Svabova *et al.* (2019, pp. 2046–2055) argue that the enterprises in the Czech Republic have, on average, the same value of different levels of

profits as the Polish enterprises. On the other hand, Slovak and Hungarian enterprises have equal results. This conclusion of parametric ANOVA, supported by Tamhane's T2 test and Dunnett's T3 Post Hoc tests does not confirm our results of Buishand test, that identifies similar development in earnings management between Slovakia, Poland and Hungary.

The critique may be focused on the selected representative of earnings management because we tried to determine the trend and detect the change-point using the average values of EBIT of Visegrad Four enterprises without applying any specific models related to individual profit models of earnings management detection. Strakova (2020), on the contrary to our study, finds and identifies the models which are most appropriate in the conditions of the V4 countries. From the total of twenty-nine profitable models (Figure 11), twenty-two models were excluded due to undetectable variables used in the models. The selection of profitable models resulted in the identification of the most suitable models in the V4 countries according to the form of earnings management and variables used in individual earnings models. These models include Jones model, modified Jones model, Jeter and Shivakumar model, Kasznic model, Key model, Teoh, Welch and Wong model, and Kothari model.

Kliestik *et al.* (2020) used the key financial indicators of 11,105 enterprises from the countries of the Visegrad Four in the period of 2014 to 2017. Each country offers an independent sample, which allows comparing the results from different countries. They investigate the manipulation with earnings based on chosen models: Jones model, modified Jones model, Industry based model, Jeter and Shivakumar model, Kasznic model, Key model, Teoh, Welch and Wong model and Kothari model. The modified Jones model was applied in each country to calculate the discretionary accruals which are used to detect the earnings manipulation, and it was proved that the modified Jones model proposes significant results estimating the discretionary accruals compared to other analysed models. The sign of manipulation is given by the proportional ratio of enterprise with the positive or negative sign of calculated discretionary accruals to the total number of companies. 59.43% of all the enterprises manage earnings upwards. It supports our results that there is a monotonic trend in the manipulation of the earnings (most of the enterprises manage earnings this way). Kliestik *et al.* (2020) also investigated if there are any statistically significant differences in earnings management among enterprises of diverse countries using the non-parametric Kruskal-Wallis test. The results declare that Poland is the biggest manipulator of earnings, followed by Hungary and the Czech Republic. The lowest manipulation with earnings was detected in Slovakia. Finally, Kliestik *et al.* (2020) and Rybicka and Rybicki

(2018, pp. 57–66) highlight that there are no statistically significant differences in earnings management between Czechia and Hungary. This conclusion is not consistent with our results. We detected that similarities are between Slovakia, Poland and Hungary.

Conclusions

The aim of the paper was to determine the existence of a positive trend in earnings management and to detect the change-point in its development for selected European countries. We determined the significant positive earnings manipulation that was not homogenous in the analysed nine-year period, but significant change-points occurred. The year 2014 was indicated as a break-point for Slovak, Polish and Hungarian enterprises considering the issue of earnings manipulation, the year 2013 was detected for Czech enterprises. Thus, it is evident that not only the managerial activities in enterprises play an important role in earnings management but also the general development in the countries. Significant changes in macroeconomic development may arouse new motives and incentives to enterprises, forcing them to manage earnings in order to maintain their financial position. State authorities, auditing and accounting companies should use all possible sources to identify the manipulation techniques in order to protect the market, investor and stakeholder from financial risks caused by crooked financial reports.

Our results may be used by the investors when making decisions based on specificities of countries of Visegrad. The methodology used can be very helpful for researchers from other countries to determine, detect and understand earnings management. It means a possible extension of further research, especially for the block of east economies as Estonia, Latvia, Lithuania, Romania and Bulgaria.

The limitation of our study is the use of annual average values of EBIT as well as the exclusive use of Mann-Kendall trend test and Buishand tests. Trend tests may be compared to the results of parametric linear regression and may be added by the magnitude of Sen's slope. The years of change-point in earnings management may be confronted to the results of SNHT test, Pettitt's test and von Neumann's test. Moreover, the repetition of observations each year enables concluding research over a period of time, a longitudinal research, which may be used to develop a general methodology for the detection of earnings management based on time series.

References

- Agha, O. M. A. M., Bağçacı, S. Ç., & Şarlak, N. (2017). Homogeneity analysis of precipitation series in North Iraq. *IOSR Journal of Applied Geology and Geophysics*, 5(03). doi: 10.9790/0990-0503025763.
- Ahmad, N. H., & Deni, S. M. (2013). Homogeneity test on daily rainfall series for Malaysia. *Matematika*, 29. doi: 10.11113/matematika.v29.n.586.
- Archibald, T. R. (1967). The return to straight-line depreciation: an analysis of a change in accounting method. *Journal of Accounting Research*. doi: 10.2307/2489918.
- Ashander, L., Kliestikova, J., Durana, P., & Vrbka, J. (2019). The decision-making logic of big data algorithmic analytics. *Contemporary Readings in Law and Social Justice*, 11(1). doi:10.22381/CRLSJ11120199.
- Beidleman, C. R. (1973). Income smoothing: the role of management. *Accounting Review*, 48(4).
- Beneish, M. D. (1997). Detecting GAAP violation: implications for assessing earnings management among firms with extreme financial performance. *Journal of Accounting and Public Policy*, 16(3). doi: 10.1016/S0278-4254(97)00023-9.
- Buishand, T. A. (1982). Some methods for testing the homogeneity of rainfall records. *Journal of Hydrology*, 58(1-2). doi: 10.1016/0022-1694(82)90066-X.
- Buishand, T. A. (1984). Tests for detecting a shift in the mean of hydrological time series. *Journal of Hydrology*, 73(1-2). doi: 10.1016/0022-1694(84)90032-5.
- Chen, T., Xing, J., & Huo, X. D. (2020). Study on nonparametric statistic method applied to nuclear criticality safety analysis of spent fuel rack. *Annals of Nuclear Energy*, 137. doi: 10.1016/j.anucene.2019.107065.
- Copeland, R. M. (1968). Income smoothing. *Journal of Accounting Research*. doi: 10.2307/2490073.
- DeAngelo, L. E. (1986). Accounting numbers as market valuation substitutes: a study of management buyouts of public stockholders. *Accounting Review*, 61(3).
- Dechow, P. M., Richardson, S. A., & Tuna, I. (2003). Why are earnings kinky? An examination of the earnings management explanation. *Review of Accounting Studies*, 8(2-3). doi: 10.1023/A:1024481916719.
- Dechow, P. M., Sloan, R. G., & Sweeney, A. P. (1995). Detecting earnings management. *Accounting Review*, 4.
- Dopuch, N., & Drake, D. F. (1966). The effect of alternative accounting rules for nonsubsidiary investments. *Journal of Accounting Research*. doi: 10.2307/2490182.
- Durana, P., Kral, P., Stehel, V., Lazaroiu, G., & Sroka, W. (2019). Quality culture of manufacturing enterprises: a possible way to adaptation to Industry 4.0. *Social Sciences*, 8(4). doi: 10.3390/socsci8040124.
- Fields, T. D., Lys, T. Z., & Vincent, L. (2001). Empirical research on accounting choice. *Journal of Accounting and Economics*, 31(1-3). doi: 10.1016/S0165-4101(01)00028-3.

- Garcia, F. A. A. (2012). *Tests to identify outliers in data series*. Rio de Janeiro: Pontifical Catholic University of Rio de Janeiro, Industrial Engineering Department.
- Gavurova, B., Belas, J., Kocisova, K., Kliestik, T. (2017). Comparison of selected methods for performance evaluation of Czech and Slovak commercial banks. *Journal of Business Economics and Management*, 18(5).
- Ghosh, D., & Vogt, A. (2012). Outliers: an evaluation of methodologies. In *Joint Statistical Meetings*. San Diego: American Statistical Association.
- Gordon, M. J. (1964). Postulates, principles and research in accounting. *Accounting Review*, 39(2).
- Gordon, M. J., Horwitz, B. N., & Meyers, P. T. (1966). Accounting measurements and normal growth of the firm. *Research in Accounting Measurement*, 23(4).
- Grubbs, F. E. (1950). Sample criteria for testing outlying observations. *Annals of Mathematical Statistics*, 21(1).
- Hansen, M. H., Madow, W. G., & Tepping, B. J. (1983). An evaluation of model-dependent and probability-sampling inferences in sample surveys. *Journal of the American Statistical Association*, 8(384). doi: 10.1080/01621459.1983.10477018.
- Hayhoe, T., Podhorska, I., Siekelova, A., & Stehel, V. (2019). Sustainable manufacturing in Industry 4.0: cross-sector networks of multiple supply chains, cyber-physical production systems, and AI-driven decision-making. *Journal of Self-Governance and Management Economics*, 7(2). doi:10.22381/JSME7220195.
- Healy, P. (1985). The impact of bonus schemes on the selection of accounting principles. *Journal of Accounting and Economics*, 7(1-3).
- Healy, P. M., & Wahlen, J. M. (1999). A review of the earnings management literature and its implications for standard setting. *Accounting Horizons*, 13(4). doi: 10.2308/acch.1999.13.4.365.
- Hepworth, S. R. (1953). Smoothing periodic income. *Accounting Review*, 28(1).
- Hirsch, R. M., & Slack, J. R. (1984). A nonparametric trend test for seasonal data with serial dependence. *Water Resources Research*, 20(6). doi: 10.1029/WR020i006p00727.
- Hirsch, R. M., Slack, J. R., & Smith, R. A. (1982). Techniques of trend analysis for monthly water quality data. *Water Resources Research*, 18(1). doi: 10.1029/WR018i001p00107.
- Höglund, H. (2012). Detecting earnings management with neural networks. *Expert Systems with Applications*, 39(10). doi: 10.1016/j.eswa.2012.02.096.
- Höglund, H. (2013). Estimating discretionary accruals using a grouping genetic algorithm. *Expert Systems with Applications*, 40(7). doi: 10.1016/j.eswa.2012.10.048.
- Hollowell, J. C., Rowland, Z., Kliestik, K., Kliestikova, J. & Dengov, V. V. (2019). Customer loyalty in the sharing economy platforms: how digital personal reputation and feedback systems facilitate interaction and trust between strangers. *Journal of Self-Governance and Management Economics*, 7(1). doi: 10.22381/JSME7120191.

- Jones, J. J. (1991). Earnings management during import relief investigations. *Journal of Accounting Research*, 29(2). doi: 10.2307/2491047.
- Kang, H. M., & Yusof, F. (2012). Homogeneity tests on daily rainfall series. *International Journal of Contemporary Mathematical Sciences*, 7(1).
- Kanovsky, M. (2018). The research effectivity of Slovak universities: quantitative analysis of trends 2008–2017. *Slovak Sociological Review*, 50(4). doi: 10.31577/sociologia.2018.50.4.17.
- Kaszniak, R. (1999). On the association between voluntary disclosure and earnings management. *Journal of Accounting Research*, 37(1). doi: 10.2307/2491396.
- Kendall, M. G. (1948). *Rank Correlation Methods*. Oxford: Griffin.
- Key, K. G. (1997). Political cost incentives for earnings management in the cable television industry. *Journal of Accounting and Economics*, 23(3). doi: 10.1016/S0165-4101(97)00012-8.
- Khambhammettu, P. (2005). Appendix Mann-Kendall analysis for the fort ord site. *Annual Groundwater Monitoring Report*. HydroGeoLogic, Inc.
- Kliestik, T., Belas, J., Valaskova, K., Nica, E., & Durana, P. (2020). Ethicality of earnings management: the evidence of earnings smoothing and inflating. *Economic Research-Ekonomska Istraživanja* (forthcoming).
- Kothari, S. P., Leone, A. J., & Wasley, C. E. (2005). Performance matched discretionary accrual measures. *Journal of Accounting and Economics*, 39(1). doi: 10.1016/j.jacceco.2004.11.002.
- Kowo, S. A., & Akinbola, O. A. (2019). Strategic leadership and sustainability performance of small and medium enterprises. *Ekonomicko-manazerske Spektrum*, 13(1). doi: 10.26552/ems.2019.1.38-50.
- Lafferty, C. (2019). Sustainable internet-of-things-based manufacturing systems: Industry 4.0 wireless networks, advanced digitalization, and big data-driven smart production. *Economics, Management, and Financial Markets*, 14(4). doi: 10.22381/EMFM14420192.
- Ludbrook, F., Frajtova Michalikova, K., Musova, Z., & Suler, P. (2019). Business models for sustainable innovation in Industry 4.0: smart manufacturing processes, digitalization of production systems, and data-driven decision making. *Journal of Self-Governance and Management Economic*, 7(3).
- Mann, H. B. (1945). Nonparametric tests against trend. *Econometrica: Journal of the Econometric Society*. doi: 10.2307/1907187.
- McKee, T. E. (2005). *Earnings management: an executive perspective*. Indiana: Thomson.
- McNichols, M. F. (2000). Research design issues in earnings management studies. *Journal of Accounting and Public Policy*, 19(4-5). doi: 10.1016/S0278-4254(00)00018-1.
- McNichols, M., & Wilson, G. P. (1988). Evidence of earnings management from the provision for bad debts. *Journal of Accounting Research*. doi: 10.2307/2491176.
- Meals, D. W., Spooner, J., Dressing, S. A., & Harcum, J. B. (2011). Statistical analysis for monotonic trends, *Tech Notes*, 6.

- Michalkova, L., Frajtova Michalikova, K., & Tănase, A. (2019). Factor analysis and its application in innovation management within manufacturing enterprises in Romania. *Ekonomicko-manazerske Spektrum*, 13(2). doi: 10.26552/ems.2019.2.37-45.
- Nadanyiova, M., & Durana, P. (2019). Corporate social responsibility as a brand value-enhancing tool. In *8th International scientific symposium economy of eastern Croatia – vision and growth*. Osijek: University of Josip Juraj Strossmayer.
- Nagy, L. (2016). Ratio indicators database of HGN1 model for measuring enterprise performance. *Journal of Knowledge Society*, 4(2).
- Plumpton, D. (2019). Cyber-physical systems, internet of things, and big data in Industry 4.0: digital manufacturing technologies, business process optimization, and sustainable organizational performance. *Economics, Management, and Financial Markets*, 14(3). doi:10.22381/EMFM14320193.
- Pohlert, T. (2020). *Non-parametric trend tests and change-point detection*. CC BY-ND.
- Rahman, A., Rozsa, Z., & Cepel, M. (2018). Trade credit and bank finance – evidence from the Visegrad Group. *Journal of Competitiveness*, 10(3).
- Ronen, J., & Yaari, V. (2008). Earnings management. *Emerging insights, theory, practice, and research*. New York: Springer.
- Rybicka, K., & Rybicki, P. (2018). Chosen aspects of it systems in management and accounting in companies under globalization. *Ekonomicko-manazerske spektrum*, 12(2).
- Saona, P., Muro, L., & Alvarado, M. (2020). How do the ownership structure and board of directors' features impact earnings management? The Spanish case. *Journal of International Financial Management & Accounting*, 31(1). doi: 10.1111/jifm.12114.
- Schipper, K. (1989). Commentary on earnings management. *Accounting Horizon*, 11.
- Solak, M. K. (2009). Detection of multiple outliers in univariate data sets. *Paper SP06-2009*. New Jersey: Schering.
- Strakova, L. (2020). Earnings management in global background. In *SHS Web of Conferences* (74, 01032). EDP Sciences. doi: 10.1051/shsconf/20207401032.
- Svabova, L., & Durica, M. (2019). Being an outlier: a company non-prosperity sign? *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 14(2). doi: 10.24136/eq.2019.017.
- Svabova, L., & Michalkova, L. (2018). Pre-processing of data in earnings management. *Business Economics and Management*, 3.
- Svabova, L., Adamko, P., & Popescu, G. H. (2019). The analysis of various earnings levels in Visegrad group companies. In *Proceedings of the 33rd international business information management association conference*. IBIMA.
- Tuffnell, C., Kral, P., Durana, P., & Krulicky, T. (2019). Industry 4.0-based manufacturing systems: smart production, sustainable supply chain networks, and real-time process monitoring. *Journal of Self-Governance and Management Economics*, 7(2). doi:10.22381/JSME7220191.

- 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.
- White, G. E. (1970). Discretionary accounting decisions and income normalization. *Journal of Accounting Research*, 8(2). doi: 10.2307/2490111.

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Annex

Table 1. Samples

Samples	Slovakia	Czechia	Poland	Hungary
Origin	1,347	859	2,554	880
Missing values	189	154	1,100	125
Outliers	100	17	78	24
Final	1,058	688	1,376	731

Table 2. Grubbs test

Grubbs test	Slovakia	Czechia	Poland	Hungary
G (Observed value)	23.534	21.727	30.925	26.607
G (Critical value)	4.076	3.952	4.131	3.970
p-value (Two-tailed)	< 0.0001	< 0.0001	< 0.0001	< 0.0001
alpha	0.05	0.05	0.05	0.05

Table 3. Average EBIT [thousand €]

Year	Slovakia	Czechia	Poland	Hungary
2010	822.980	2,713.514	1,047.582	785.322
2011	845.013	2,833.784	1,058.515	829.670
2012	840.581	3,028.290	1,076.276	887.865
2013	887.496	2,917.464	1,198.926	1,144.424
2014	1,065.716	3,331.773	1,319.930	1,353.675
2015	1,229.561	3,681.751	1,466.919	1,572.282
2016	1,330.007	3,712.093	1,583.995	1,766.508
2017	1,405.572	3,947.410	1,756.605	1,924.639
2018	1,420.607	3,805.430	1,803.145	2,048.844

Table 4. Mann-Kendall trend test

Mann-Kendall trend test	Slovakia	Czechia	Poland	Hungary
Kendall's tau	0.944	0.889	1	1
S	34.000	32.000	36.000	36.000
Var(S)	92.000	92.000	92.000	92.000
p-value (One-tailed)	0.000	0.001	0.000	0.000
alpha	0.05	0.05	0.05	0.05

Table 5. Buishand test (Q statistics)

Buishand test	Slovakia	Czechia	Poland	Hungary
Q	4.194	4.128	4.051	4.021
t	2014	2013	2014	2014
p-value (Two-tailed)	0.005	0.009	0.009	0.001
alpha	0.05	0.05	0.05	0.05

Table 6. Buishand test (R statistics)

Buishand test	Slovakia	Czechia	Poland	Hungary
R	4.194	4.128	4.051	4.021
p-value (Two-tailed)	0.013	< 0.0001	0.003	0.002
alpha	0.05	0.05	0.05	0.05

Figure 1. Connections of titles and abstracts

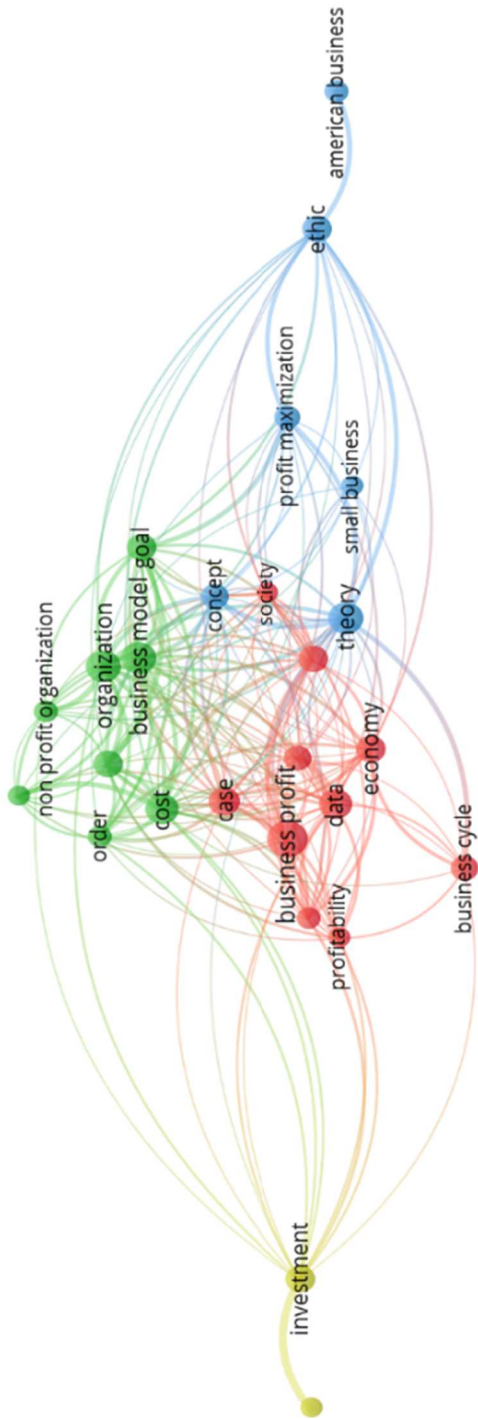


Figure 2. Bibliographic coupling of countries

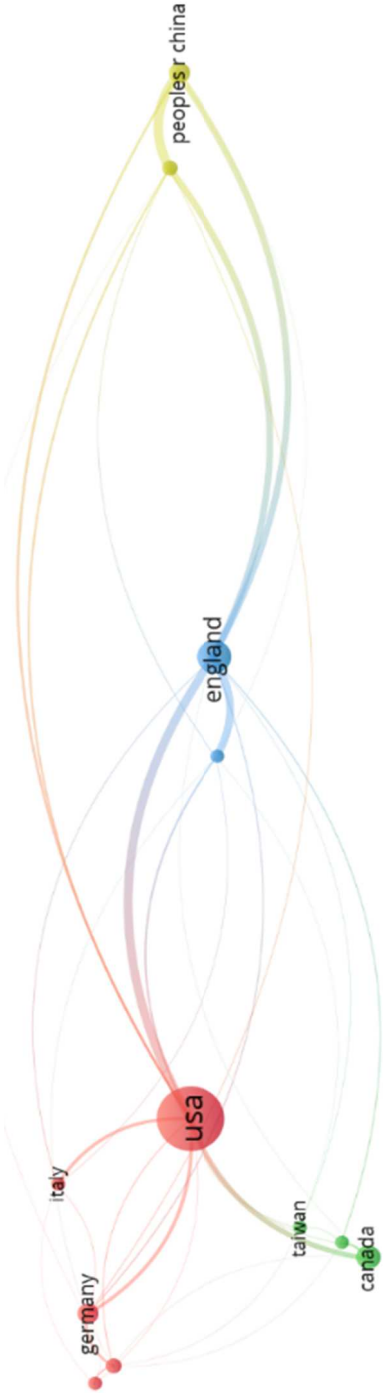


Figure 3. Slovakia Z-Scores

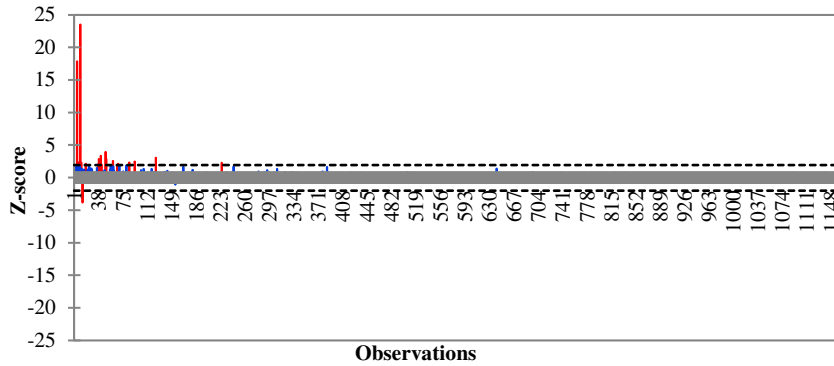


Figure 4. Czechia Z-Scores

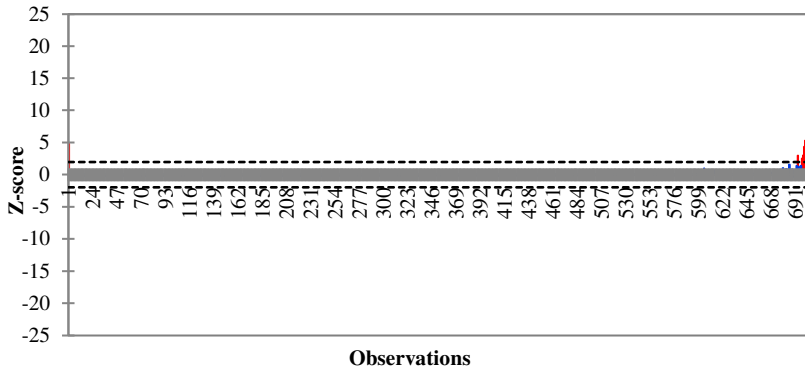


Figure 5. Poland Z-Scores

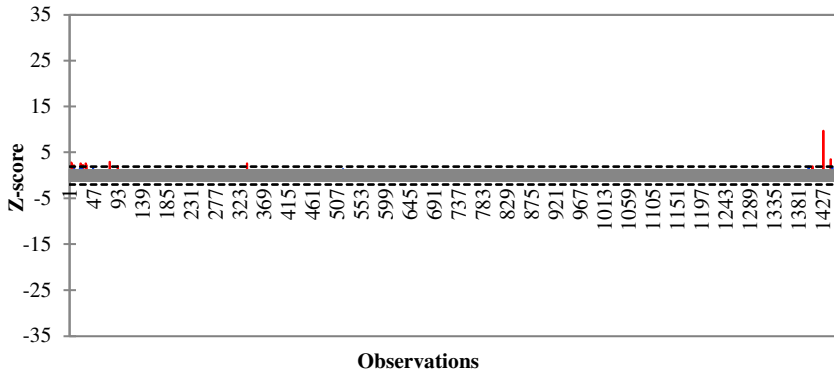


Figure 6. Hungary Z-Scores

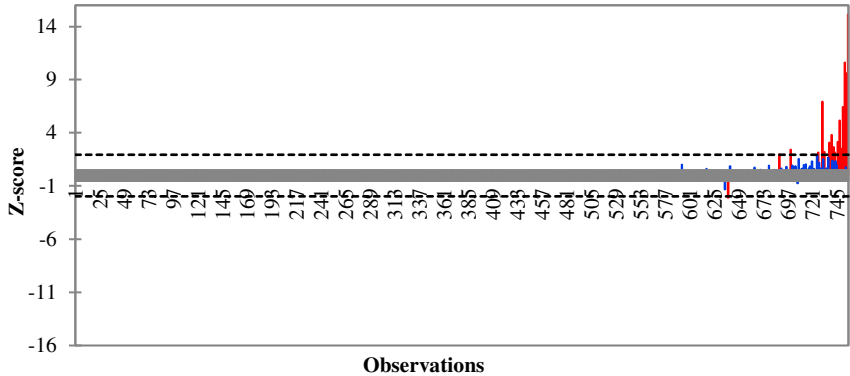


Figure 7. Slovakia change-point

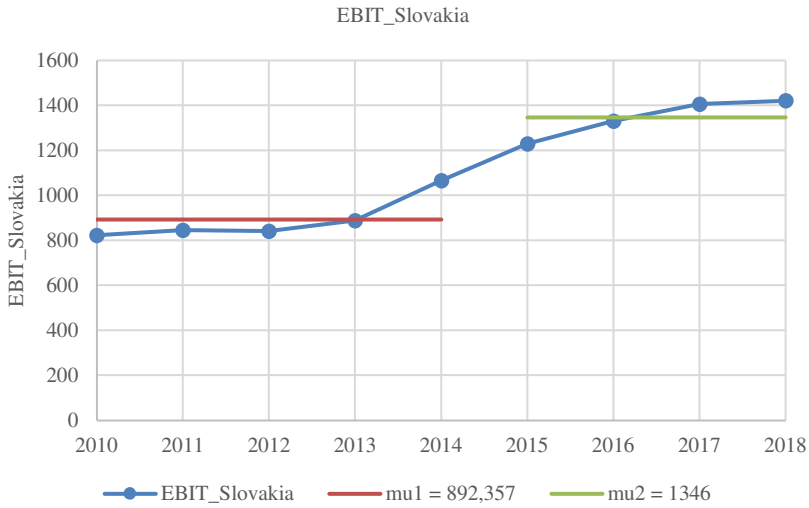


Figure 8. Czechia change-point

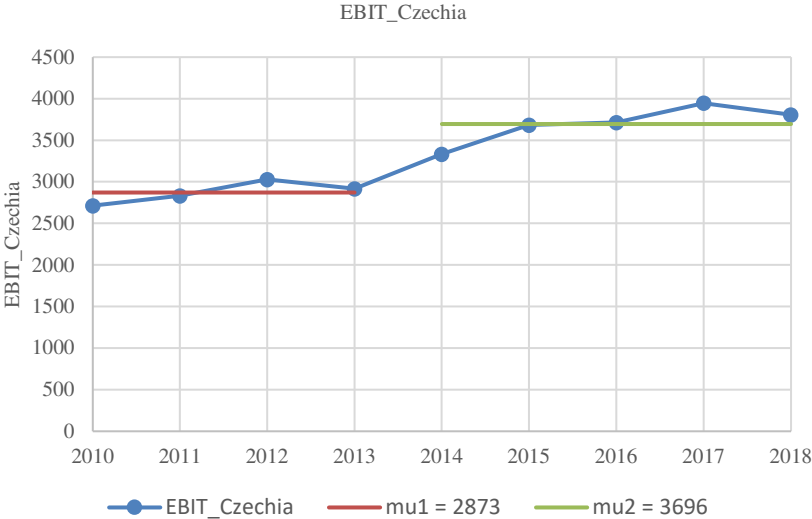


Figure 9. Poland change-point

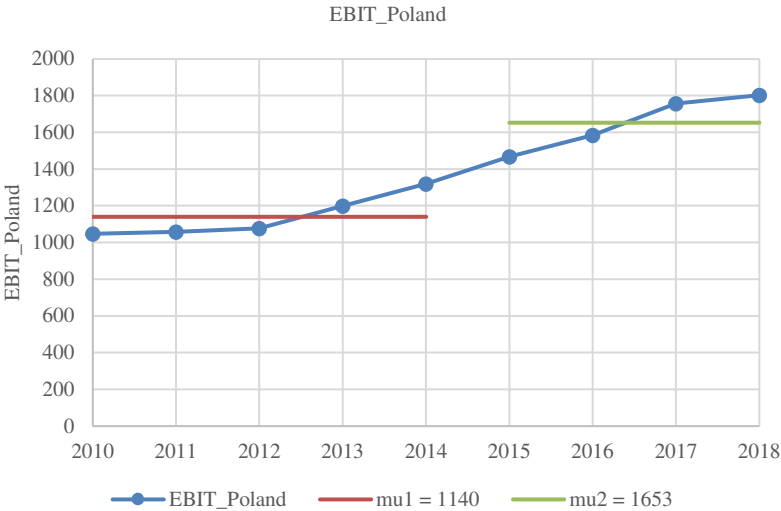


Figure 10. Hungary change-point

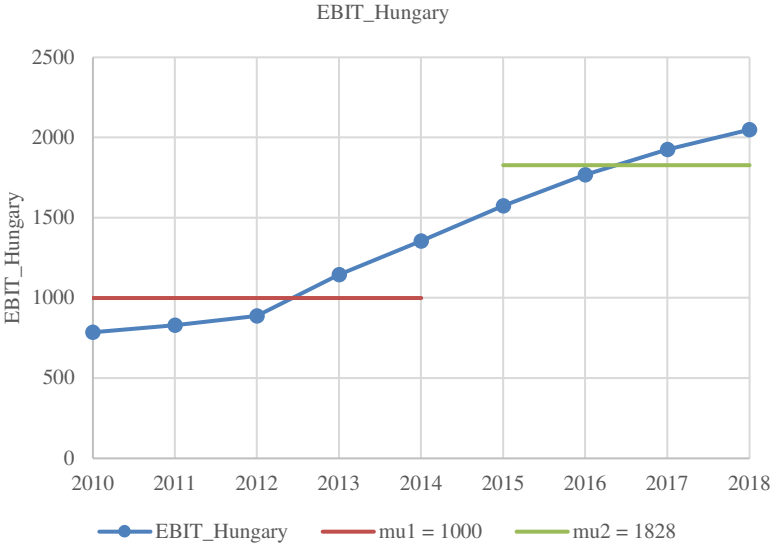
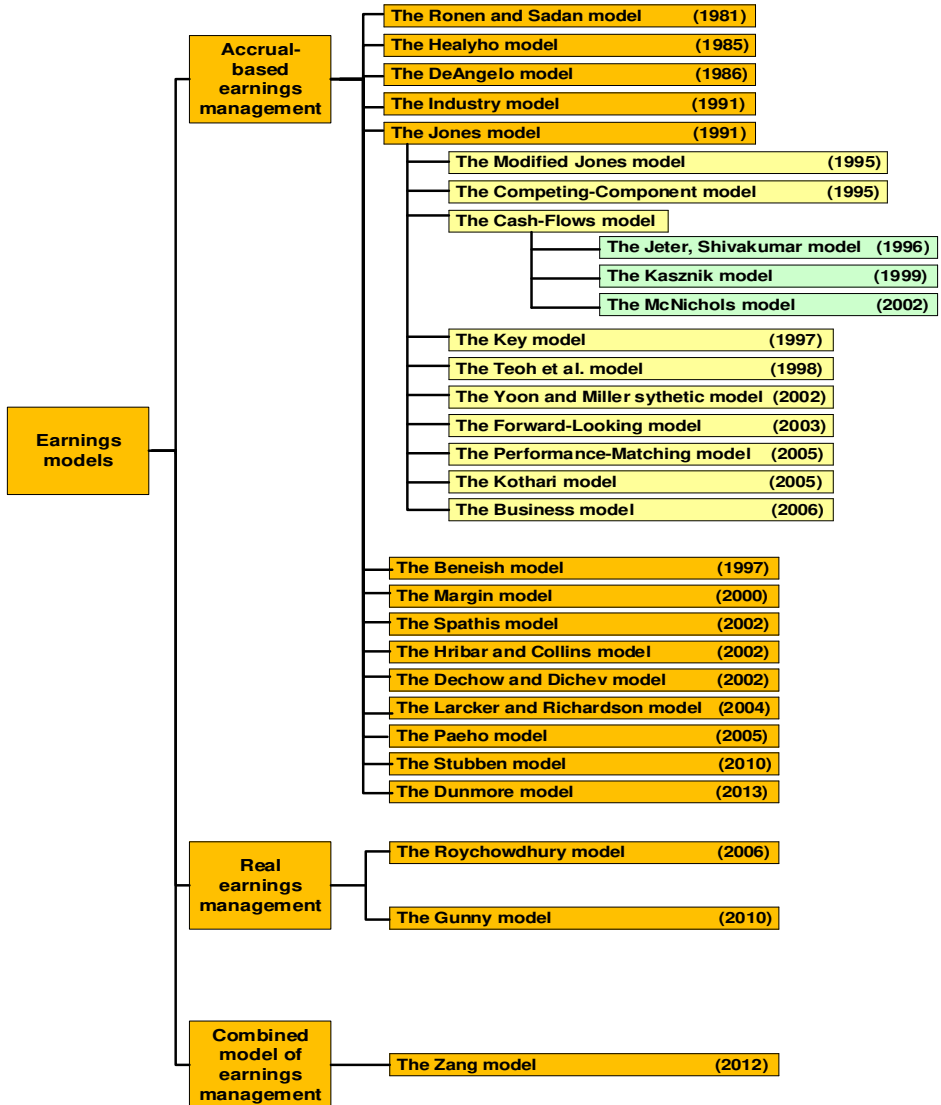


Figure 11. Models of earnings management



Source: Strakova (2020).