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APPRAISAL OF EARNINGS MANAGEMENT ACROSS THE SECTORS

Pavol DURANA*, Katarina VALASKOVA, Anna SIEKELOVA, Lucia MICHALKOVA

Department of Economics, Faculty of Operation and Economics of Transport and Communications, University of Zilina, Zilina, Slovakia

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Abstract. Financial managers intentionally use the legal manipulation of earnings to the business development. Earnings management is a widespread business finance phenomenon. The approaches and the ways of this practice are marked by many parallels. The main target of the article is to show the clusters with the close approach of the enterprises to the earnings manipulation and demonstrate hidden relations of the earnings management between sectors in the Visegrad Group. The study estimates the earnings management by the Modified Jones model. 52,545 discretionary accruals are computed for Slovak, Czech, Hungarian, and Polish enterprises for 5-year horizon in 19 sectors classified by the NACE. The clusters of close practices of the earnings management are identified based on principal component analysis and cluster analysis in every country of Visegrad Four. Moreover, the results detect the dependences between sectors in the region and the specificity of the sectors.

Keywords: business finance, cluster analysis, discretionary accrual, earnings management, PCA, Visegrad Four.

JEL Classification: M48, G30, F60.

Introduction

Earnings management means a significant issue for the current researchers, which has become a very hot topic in the recent decade (Hussain et al., 2020). This fact confirms almost 3,500 research papers published in the last 3 years in Web of Science Core Collection and more than 2,000 in Scopus. Earnings management has not created only academic matter, but it is legal and really preferred tool of business development and the managers of the business finance. The economic development of European emerging countries over the past 20–30 years, especially for their joining the European Union and inclusion in OECD countries, has faced several challenges (Angelova et al., 2017; Stefko et al., 2020; Gavurova et al., 2021a), and understanding earnings management is one of them.

*Corresponding author. E-mail: *pavol.durana@fpedas.uniza.sk*

Earnings management detection is not easy to be revealed as different practices are used; manipulation with earnings can be based on accruals, profits and cash flow management, or can use time series to identify the earnings management behavior (Pajuste et al., 2020). The accruals were used in the outcomes of Sosnowski (2018), Lizinska and Czapiewski (2018), Orazalin and Akhmetzhanov (2019). Time series analysis was implemented in the studies of Durana et al. (2020), Valaskova et al. (2020), Kliestik et al. (2020b). The issue of earnings management was presented by Savov et al. (2017), Sosnowski and Wawryszuk-Misztal (2019), Sosnowski (2021), Michalkova (2021) in countries of V4 region. Stefko et al. (2019), Nica et al. (2020), Connolly-Barker et al. (2020), Podhorska et al. (2020) suggest for the financial management to be a part of the innovations in the economic community.

Thus, this paper uses new approach that combine the earnings detection through discretionary accruals with multidimensional statistical methods (principal component analysis and cluster analysis). The content of the research is not focused generally but deliver cross-sectoral and cross-region investigation. The purpose of the provided study is to show the clusters with the close approach of the enterprises to the earnings manipulation and demonstrate hidden relations of the earnings management between sectors in V4 region.

The structure of the paper is as follows: introduction describes originality and significance of the analyzed issue. Theoretical background summarizes the results of last research in earnings management. The next chapter describes the aim, set research questions, the nature of dataset and methodological steps used. Results chapter determines the main results that are compared to other studies from the field in the Discussion. The last part of the paper concludes the main results, further ways of research, and limitations of the study.

1. Literature review

Literature review is divided into practice of earnings management, background of earnings management, determinants of earnings management, corporate governance and earnings management, and taxes versus earnings management.

1.1. Practice of earnings management

Research studies have focused on the practice of earnings management as follows. Managers try to use their managerial wisdom in financial management practice and when deciding on financial transactions to modify financial reports to deceive business partners into thinking that the economic and financial performance of the enterprise is stable and appropriate and thus, they are able to influence also the contractual outcomes based on the positive financial development (Kjærland et al., 2020; Paskaleva & Stoykova, 2021). Lo et al. (2017) investigate how the readability of annual reports varies with earnings management. The research predicts and detects that enterprises most likely to have managed earnings to beat the prior year's earnings. Nikulin and Downing (2020) compare earnings management of banks before and after changes in banking regulation. They found that banks use loan-loss provisions for earnings management both before and after the changes. Kim et al. (2017) are the first who tested the dependence between the language grammar system and financial reporting features. The outputs of the study explain that accrual-based earnings management and

real earnings management are more accepted in the time disassociation in the language is stronger, and vice versa. Collins et al. (2017) portray the non-linear association of the relation of quarterly accruals and backward-looking / forward-looking increase in sales. They suggest refinements to the Jones models to be able to indicate the occurrence of earnings manipulation in a sample of restatement enterprises. Putri and Prasetyo (2020) use multiple linear regression analysis techniques to indicate that the expertise of the audit committee can reduce the level of earnings management in the enterprise. Kadhin et al. (2020) add that the modular effect of business diversity on the relation of profit sustainability and business credit is positive and meaningful, and the modular effect of business credit on the relation between real profit management and business credit is not meaningful. Donatella et al. (2019) pursue the impact of costs of audit services on the earnings manipulation. It is evident that the increased cost of audit services positively influence the tendency to manipulate earnings. However, it should be noted that there are some discrepancies in the probability of earnings management occurrence considering the engagement of the audit company. Bereskin et al. (2018) examine the consequences of real earnings management from an innovation perspective. They find that research and development cuts related to earnings management lead to fewer patents, less influential patent output, and lower innovative efficiency.

1.2. Background of earnings management

Earnings management is a complex and multifaceted phenomenon existing in enterprises regardless of their area of business, size, or country (Strakova, 2020). Haga et al. (2019) note that the corporate culture may play an important role, as those enterprise with short-term focused culture tend to manipulate earnings to improve their current financial position; the reason for such behavior may be linked to the importance of quick outputs and the bottom line. The managers from long-term oriented countries manage earnings to convey useful private information to investors and supply information to stakeholders in general. Kundelis and Legenzova (2019) assess the impact of base erosion and profit shifting on performance of subsidiaries of multinational corporations. They note the fact when the tax rate differences between Baltic and the foreign countries decrease by 1%, reported profits in Baltic countries increased by 2.3%, indicating profit-shifting behavior. On the contrary, Siekelova et al. (2019) note that there is no statistically significant relation between profit shifting and the region, where the enterprise does business. Sumiyana (2020) clarifies the relation between the anticipated gross domestic product and aggregate of earnings in the context of differently developed countries. The mutual dependence was revealed declaring that the increase of the gross domestic product may be influenced by aggregate of accounting earnings. The comparison of this phenomenon within the countries with divergent level of development shows not similar properties of the gross domestic product prediction. Cepel (2019) determines the significance of cultural and social components. The outputs declare that relatively low political and public perception of earnings manipulation activities is experienced by enterprises. Saona and Muro (2018) analyze enterprise and country level determinants of the earnings management. The research shows that earnings management is positively influenced by the payment of dividends. The manipulation with earnings may be both eliminated and worsen by the specificity of the ownership

structure. Li and Zhang (2020) discuss the mutual dependence of political spending of business executives and earnings management. The results of the study confirm that those executives who are fully engaged in earnings management make their political spending using the private channels of own recipients compared to those, whose political spending are made through corporate channel of recipients.

1.3. Determinants of earnings management

Irwandi and Pamungkas (2020) also investigate the financial reporting quality and its determinants. The research indicates that the quality of the financial reporting can be influenced by the risk of no-confidence on investors. However, the expert knowledge of authorities responsible for audit may strengthen the mutual bonds between the risk of no-confidence and quality of financial reports. Setyoputri and Mardijuwono (2020) mark other determinants of earnings management. Their study provides empirical evidence regarding the effect of managerial ownership, leverage, and the size of the enterprise on earnings management. The results show that managerial ownership and leverage affect earnings management. But the size of the enterprise has no effect on earnings management. Khanh and Thu (2019) explain only the effect of leverage on the form and extent of earnings management with the same positive relationship between leverage and earnings management. Pisar and Bilkova (2019), Pisar and Mazo (2020) determine the impact of the controlling management system. They conclude that controlling is the crucial tool for creating a management system which will enhance enterprises to better standards in earnings performance, and Belas et al. (2020) add that improvements in management should be results-oriented. Liu et al. (2017) examine how corporate social responsibility (CSR) activities of a business affects the earnings management practices. The study confirms that CSR performance is not significantly related with either accrual-based or real earnings management behavior.

1.4. Corporate governance and earnings management

Grofcikova (2020) explore the relations between selected determinants of corporate governance and earnings performance. Sadiq et al. (2020) add the influence of corporate governance on financial reporting quality and determine the role of political influences. The use of correlation and multiple regressions reveal that corporate governance has a positive and significant relation with the audit quality and political influences has a negative significant relation with corporate governance. Salehi et al. (2018) assess the effect of corporate governance on quality of corporate financial reports, which is measured by managerial entrenchment index. Based on the study, it can be concluded that a significantly negative relation is described between entrenched managers and accrual-based earning management. Nonetheless, the study reveals that these managers are likely to be involved also in the real earnings management practices. Tran et al. (2020) explores the role of corporate governance in listed banks in the context of earnings management. Two different measures – having different effect on earnings management practices – were identified: board of directors with foreign members and audit committee.

1.5. Taxes versus earnings management

Kramarova (2021) investigates the role of controlled transactions related to earnings manipulation and tax avoidance. The results of the study indicate, that despite the fact that discretionary accruals were negative and earning were manipulated downwards, there is not any incentive that the earnings management behavior is linked to the tax liability minimization. Susanto et al. (2019) claim that taxation, independence and size of directors, quality of audit, managerial ownership, institutional ownership, corporate size, influence earning management behavior to a greater or lesser extent. The results show that tax aggressiveness, institutional ownership and leverage have an effect on earnings management. While director size, director independent, audit quality, managerial ownership, and the size of the enterprises statistically do not influence earnings management. Neifar and Utz (2019) examine the influence of earnings management (EM) and tax aggressiveness (TA) on shareholder wealth and on stock price crash risk (SPCR). The study confirms that EM and TA are not related in terms of affecting shareholder wealth and SPCR.

2. Aim, data and methodology

The main target of this study is to show the clusters with the close approach of the enterprises to the earnings manipulation and demonstrate hidden relations of the earnings management between sectors in V4 region.

RQ1: There is an existence of the clusters of sectors with the homogenous approaches in earnings manipulation in every country of the V4 region.

RQ2: There is a significant occurrence of the homogenous approaches in earnings management practices across the sectors in the V4 region.

To fulfil the given research questions following methodological steps were made:

1. Creation of an origin sample.

The enterprises had to meet these criteria to be involved in the dataset: total assets should be at least 3 million €, sales at least 2 million € and net income minimally 100,000 €. Together there were 13,754 enterprises (1,300 from Slovakia, 6,352 from Poland, 3,679 from the Czech Republic and 2,423 from Hungary) accepting the given limitations, which makes the research one of the most extensive studies in this field. The dataset is created on the base of outputs of the Amadeus database provided by Moody's analytics company Bureau van Dijk.

2. Removal of outliers.

The dataset contained missing or incomplete information and outlying values, which had to be removed to ensure the quality of the analyzed data. Thus, the final sample is made of 11,105 enterprises; 1,179 Slovak, 3,885 Polish, 3,498 Czech and 1,947 Hungarian enterprises. As the data were analyzed in the 5-year horizon, there were 52,545 observations to be examined.

3. Computation of discretionary accrual.

The study is based on the usage of the accrual-based model, as the application of the real earnings on a huge sample of enterprises from different countries is hardly accessible. Modified Jones model (1995), introduced by Dechow et al., was run for all enterprises in all countries. This model was proven to be the most relevant in the Visegrad conditions as

declared in the study of Kliestik et al. (2020a) and Blazek (2021). The adequacy of Modified Jones model used in this region is confirmed by the study of Metzker and Siekelova (2021) based on the highest explanatory power due to the adjusted coefficient and due to the predicted sign indicator, too.

$$\frac{NDA_{it}}{TA_{t-1}} = \alpha_0 \frac{1}{A_{it-1}} + \alpha_1 \frac{\Delta REV_{it} - \Delta REC_{it}}{A_{it-1}} + \alpha_2 \frac{PPE_{it}}{A_{it-1}} + \varepsilon_{it}; \quad (1)$$

$$(TA_{t-1} = NDA_{it} + DA_{it}), \quad (2)$$

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

The model is based on a linear regression model, which presupposes that the discretionary accrual is linearly dependent on the annual change in the value of revenues and receivables and on the value of the long-term tangible assets (lagged by total assets), Eq. (1). Total accrual (the dependent variable in the regression analyses) is calculated as a sum of annual change in receivables and inventories; annual change in payable accounts and depreciation are then subtracted from this sum. The output of the regression analyses enables the calculation of non-discretionary accrual, using the coefficients of the calculated regression equation in the Modified Jones model, and then the discretionary accrual is determined for individual years as indicated in Eq. (2).

4. Computation of annual discretionary accrual.

Annual discretionary accruals were calculated for the whole period for all 19 Czech, Hungarian and Polish sectors. Slovak research involved only 17 sectors because of the absence of two sectors (O and P) in the final sample. Thus, a total number of 370 average sectoral discretionary accruals for V4 region was created from 2015 to 2019.

5. Principal Component Analysis (PCA).

The resulting values are affected by the method of measurement and the meter itself (Kot & Rajiani, 2020). That is way PCA was running to provide independent factors. PCA is the general name for a technique which uses sophisticated underlying mathematical principles to transforms several possibly correlated variables into a smaller number of variables to spot trends and patterns (Richardson, 2009). Estimated 5-year sectoral discretionary accruals were used to create new not correlated factors for Slovakia, Czech Republic, Hungary, and Poland.

6. Agglomerative Hierarchical Clustering (AHC).

The cluster analysis tries to determine and identify homogeneous subgroups in a sample. This analytical tool allows researchers to divide different items into specific groups (clusters) accepting the highest association among the items in the cluster, and naturally, very low or minimal association between the different groups (Wierzchon & Klopotek, 2018). The principle of clustering groups together similar items which are then assigned into one cluster and similarity among them is measured respecting the distance between the items (Durica & Svabova, 2021; Gavurova et al., 2021b). It was measured by the Chebyshev distance d_{ij}. It is also called Maximum value distance $\max_k$, which computes the absolute magnitude of

the differences between coordinates of a pair of objects (Grabusts, 2011):

$$d_{ij} = \max_k \left| x_{ik} - x_{jk} \right|, \tag{3}$$

where x_{ik} is the value of the k-th variable for the i-th object, and x_{jk} is the value of the k-th variable for the j-th object and k is the number of variables used for clustering.

AHC was run to make dendrograms for all countries to show all possible clusters. Ward's method was implemented as an agglomeration method recommended by Durica and Svabova (2021) for clustering NACE sections. They declare the difference of this method compared to other methods used, as it is uses analysis of variance when forming clusters. Despite the fact, that the tenet of this method is the minimal increase of the within-group variability after adding new item into a cluster, the cluster are of the similar shape and size. In this case were clustered sectors according to the homogenous approaches in earnings manipulation in every country and subsequently to disclose close practices in whole V4 region based on factors created by PCA.

3. Results

The Modified Jones model assumes that discretionary accruals are linearly dependent on annual change in revenues, receivables, and long-term tangible assets. This model, as other models based on linear regression, is based on the calculation of total accrual, which is calculated using the annual change in receivables, inventories and payables and the value of depreciation. The coefficients of the linear regression (separately calculated for each year and for each country) were applied in the Modified Jones model to calculate the non-discretionary accruals, using the financial data of all analysed enterprises in the given 5-year period when determining the inputs of the model. The difference between the total accrual and calculated non-discretionary accrual presents the value of the discretionary accrual for each enterprise.

Then, the annual discretionary accruals were calculated for all analysed sectors and for all countries. These values were input variables in the principal component analysis. PCA creates new independent factors. The final number of factors depend on the cumulative percentage of explained variability of the samples. The conditions were set to cover 100% of variability. Thus, two factors were constructed from Czech and Polish annual discretionary accruals and three factors were constructed from Slovak and Hungarian annual discretionary accruals (Table 1). Table 2 contains computed individual factor scores.

Table 1. Number of computed factors (source: authors)

Factors	Slovakia			Czechia		Hungary			Poland	
	F1	F2	F3	F1	F2	F1	F2	F3	F1	F2
Eigenvalue (%)	1.465	0.987	0.548	2.537	0.463	1.445	1.088	0.468	2.539	0.461
Variability (%)	48.847	32.894	18.259	84.57	15.43	48.159	36.252	15.589	84.623	15.377
Cumulative (%)	48.847	81.741	100	84.57	100	48.159	84.411	100	84.623	100

Table 2. Factor scores (source: authors)

Factor	Slovakia			Czechia		Hungary			Poland	
scores / NACE	F1	F2	F3	F1	F2	F1	F2	F3	F1	F2
A	0.054	–0.471	0.324	0.793	–0.082	–0.748	0.968	0.567	1.225	–0.579
B	2.408	0.368	–0.19	0.957	0.018	2.256	–0.743	–0.219	0.775	–0.185
C	0.449	–0.028	0.079	0.711	0.048	–0.034	0.581	0.256	0.354	–0.085
D	–0.044	–0.64	1.038	1.141	0.557	–0.188	0.506	0.385	–0.698	0.111
E	0.812	0.58	0.069	–0.056	0.501	0.696	0.851	0.506	0.783	0.092
F	–0.577	0.033	0.414	0.768	–0.075	–1.398	–2.956	0.164	–0.832	0.769
G	0.556	0.151	0.14	1.278	–0.004	–0.163	0.616	0.164	0.836	–0.223
H	0.051	–0.518	–1.063	–1.177	0.102	–0.008	–0.176	0.066	–1.261	–0.085
I	1.432	1.584	1.074	0.477	1.46	0.447	0.752	0.31	0.485	0.155
J	0.02	–1.355	–0.432	–2.09	–0.332	0.123	–0.786	–0.968	–0.375	–0.939
K	–2.669	–1.439	1.076	–3.171	0.356	0.49	–0.231	0.585	–1.425	0.499
L	–1.932	2.708	0.15	3.775	0.313	0.36	1.413	0.697	2.616	–0.36
M	–1.03	–0.006	0.156	–1.151	0.253	0.134	–0.333	0.057	–0.331	–0.19
N	–0.271	–0.283	–1.045	–1.093	–1.276	–0.53	–1.447	–0.566	–0.541	0.353
O	–	–	–	–1.278	–0.105	2.741	0.466	–1.569	2.595	0.518
P	–	–	–	–1.448	0.814	–0.586	–0.346	0.865	2.38	0.163
Q	–0.279	0.227	–0.738	–0.144	0.042	–0.128	–0.718	0.512	–0.405	–0.266
R	–0.706	0.283	–1.533	–0.664	–1.396	–3.239	1.555	–1.495	–2.536	1.84
S	1.727	–1.192	0.48	2.373	–1.194	–0.225	0.027	–0.316	–3.644	–1.588

The last part of the research was the implementation of the cluster analysis. AHC was run using Chebyshev distance and Ward's method of the agglomeration. Created factor scores were the inputs of this analysis and individual dendrograms (Figures 1–4) were the outputs.

This part is related to the research question 1.

RQ1: There is an existence of the clusters of sectors with the homogenous approaches in earnings manipulation in every country of the V4 region.

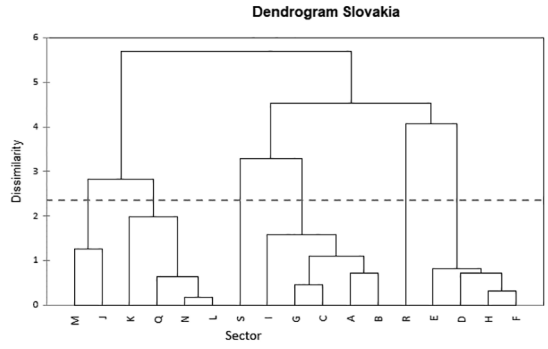

Figure 1. Dendrogram Slovakia (source: authors)

It may be determined that there is a significant existence of the clusters of sectors with homogenous approaches in earnings manipulation in every country of the V4 region. For every country, six homogenous clusters (dashed line in Figures 1–4) were detected. Tables 3–6 show the content of individual clusters.

Table 3. Clusters of Slovakia (source: authors)

Cluster	C1	C2	C3	C4	C5	C6
Number of objects	2	4	1	5	1	4
NACE 1	J	K	S	A	R	D
NACE 2	M	L		B		E
NACE 3		N		C		F
NACE 4		Q		G		H
NACE 5				I		

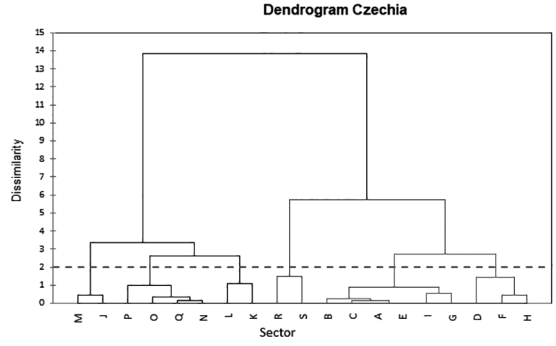

Figure 2. Dendrogram Czech Republic (source: authors)

Table 4. Clusters of Czech Republic (source: authors)

Cluster	C1	C2	C3	C4	C5	C6
Number of objects	2	4	2	2	6	3
NACE 1	J	N	K	R	A	D
NACE 2	M	O	L	S	B	F
NACE 3		P			C	H
NACE 4		Q			E	
NACE 5					G	
NACE 6					I	

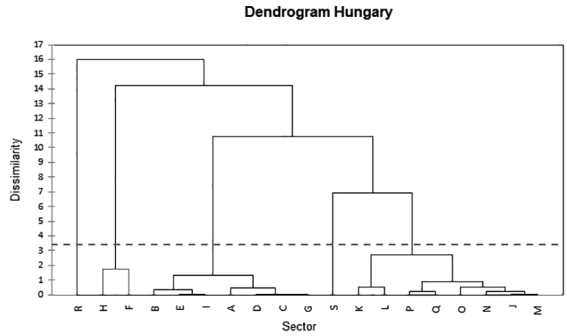

Figure 3. Dendrogram Hungary (source: authors)

Table 5. Clusters of Hungary (source: authors)

Cluster	C1	C2	C3	C4	C5	C6
Number of objects	1	2	7	1	2	6
NACE 1	R	F	A	S	K	J
NACE 2		H	B		L	M
NACE 3			C			N
NACE 4			D			O
NACE 5			E			P
NACE 6			G			Q
NACE 7			I			

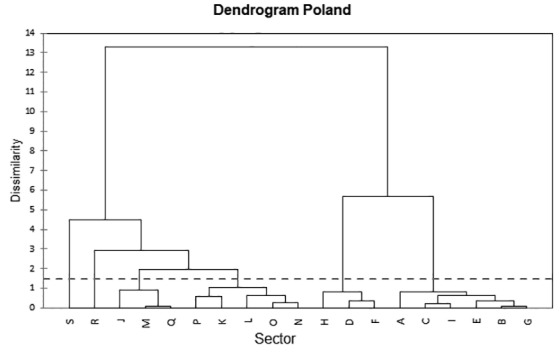

Figure 4. Dendrogram Poland (source: authors)

Table 6. Clusters of Poland (source: authors)

Cluster	C1	C2	C3	C4	C5	C6
Number of objects	1	1	3	5	3	6
NACE 1	S	R	J	K	D	A
NACE 2			M	L	F	B
NACE 3			Q	N	H	C
NACE 4				O		E
NACE 5				P		G
NACE 6						I

This part is related to the research question 2.

RQ2: There is a significant occurrence of the homogenous approaches in earnings management practices across the sectors in the V4 region.

It may be determined that there is a significant occurrence of the homogenous approaches in earnings management practices across the sectors in the V4 region based on delivered results of AHC. Four clusters of sectors exist in a broader sense. The first and the second clusters have only one subject. Those are sectors R and S. These two sectors are so specific in their nature (Arts, entertainment and recreation, Other service activities) that they were 3 times clustered alone and only in the Czech case they created own cluster. The third cluster is represented by J, K, L, M, N, O, P, Q, and the last one is covered by A, B, C, D, E, F, G, H, I.

Seven clusters of sectors exist in a narrower sense. These clusters are created by the sectors in which the approach to earnings management is very close across the countries. R and S sectors have their own unique practice of earnings management as written above. Clusters of J (Information and communication) and M (Professional, scientific, and technical activities) is almost identical because these sectors were clustered together for all countries in the analyzed region. The same dependence is between the sectors K (Financial and insurance activities) and L (Real estate activities), also four times common occurrence. The classified similarity is narrow between sectors N (Professional, scientific, and technical activities), O (Public administration and defence; compulsory social security), P (Education), Q (Human health and social work activities). The identical earnings practices are set for A (Agriculture, forestry and fishing), B (Mining and quarrying), C (Manufacturing), G (Wholesale and retail trade; repair of motor vehicles and motorcycles), I (Accommodation and food service activities) in all countries, with the addition of E (Water supply; sewerage, waste management and remediation activities) three times. F (Construction) and H (Transportation and storage) has very close bonds (whole V4), and both with D (Electricity, gas, steam, and air conditioning supply) (three times, except Hungary).

Descriptive statistics (mean, median, standard deviation, and coefficient of variance) of selected 11 variables were computed for all clusters in the broader also in the narrower sense (five-year average value). All values may be found in tables in Appendix.

4. Discussion

Delivered results are discussed to the studies that cover last approaches to the presented issue from V4 region and emerging European markets. Filipovic et al. (2020) confirm the selected approach of estimating the level of earnings management using the value of discretionary accruals for 5-year period and computing Modified Jones model. Susak (2020) uses the same model but prefers panel data. On the other hand, Bilan and Jurickova (2021) calculate the earnings manipulation in the analysed region. They do not use the Modified Jones model, but Beneish score (1997) because of preferring the model based on discriminant analysis not linear regression. An overall M-score was generated, characterizing the degree of possible manipulation or fraudulent activities such as concealment or fraud. Pavlovic et al. (2019) run the same model focusing only on earnings management in agribusiness. Svabova et al. (2020) create a new discriminant model of the earnings manipulators detection inspired by the Beneish model, extended by the values of indicators from three consecutive years. Ajaz Khan et al. (2019) assess the Slovak and Czech enterprises not by NACE but according to the statement of the service sector. They affirm that Slovak business entities operating in the sector of services achieve higher score in the macroeconomic environment, consumption and competition practices, and lower score in access to financial sources. The result of the study shows no statistically significant differences in business environment of enterprises operating in the service and non-service structures. Jackson (2018) denotes, that inappropriate results may be presented about earnings management behavior in other enterprises, as the decisions of business partners may modify regression coefficients and residuals in accrual detection models. The practices of earnings management mean legal risk for the enterprises. Virglerova et al. (2020) deal with this issue for SMEs. They find out that more than 50% of SMEs ponder upon the legal risk management, which is surprisingly not considered to be harmful for the business. It should be noted, that Slovak, Polish, Hungarian and Ukrainian responses are slightly different. While in Poland the approval statement is the lowest (31.46 =), more than 83% of enterprises operating in Ukraine manage legal risk properly and their business activities are not threatened. Czech enterprises agree with this statement much more than entrepreneurs from Slovakia and Poland and much less than entrepreneurs from Hungary and Ukraine. Nikulin et al. (2020) focus on paths across the board of directors. The conclusion demonstrates the inverse relationship between the magnitude of earnings management and several attributes of the board of directors – its size, presence of the audit committee, proportion of independent directors in the board. There is a positive relationship between the number of directorships positions of the audit committee members and the magnitude of earnings management.

Conclusions

The main objective of the article was to show the clusters with the close approach of the enterprises to the earnings manipulation and demonstrate hidden relations of the earnings management between sectors in the V4 region. The research shows that there is a close approach between earnings management in the sectors. Six clusters of sectors were made for

each country. R and S sectors were marked for individual approaches to the earnings manipulation. Within our study, hidden relations of earnings management between sectors in V4 region were disclosed. Seven clusters (including R and S) were detected. The homogenous approach is between J and M; K and L; N, O, P, and Q. The tight bonds are also between A, B, C, G, E, and I; D, F, and H.

There are some limitations to the research. Earnings management is estimated by discretionary accruals. Then, the research does not involve all sectors of Slovakia because of the absence of the data from NACEs O-Public administration and defence; compulsory social security and P-Education for set criteria. The next limitation is the use of annual value of discretionary accruals for sectors except of panel data. Finally, the method of agglomerative hierarchical clustering offers many possible ways of clustering. That is why the results are influenced by selected distances of dissimilarity and agglomeration method.

Further research may focus on setting the criteria that enable to include the sector O and P in the investigation to provide a comprehensive view of earnings management for V4 region. The research should be extended by the examination of the second region – Baltics (Estonia, Latvia, and Lithuania) or all emerging European countries. Gained sectoral results of the principal component analysis and cluster analysis should be supported with the conclusions of the method using panel data the 5-year discretionary accrual. The use of other distances of dissimilarity and agglomeration method appropriate for this type of research and dataset to compare the final clusters may also improve the outcomes. Finally, it may be investigated hidden paths between earnings management and risk of the bankruptcy.

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Author contributions

Conceptualization, P. D. and A. S.; methodology, P. D. and K.V.; software, P. D. and L. M.; validation, L. M. and A. S.; formal analysis, P. D. and K. V.; investigation, P. D. and K. V.; resources, L. M. and A. S.; data curation, K. V.; writing–original draft preparation, P. D.; writing–review and editing, P. D. and K. V.; visualization, A. S.; supervision, P. D., K. V., A. S. and L. M.; project administration, K. V.; funding acquisition, K. V. All authors have read and agreed to the published version of the manuscript.

Disclosure statement

The authors declare no conflict of interest.

References

Ajaz Khan, K., Cera, G., & Netek, V. (2019). Perception of the selected business environment aspects by service firms. *Journal of Tourism and Services*, *10*(19), 111–127. https://doi.org/10.29036/jots.v10i19.115

Angelova, G., Parvanov, P., Krasteva, N., & Krastev, V. (2017). Sustainability in tourism cadre training and selection in Bulgaria. *Revista Inclusiones*, *4*(3), 144–156.

Belas, J., Amoah, J., Petrakova, Z., Kliuchnikava, Y., & Bilan, Y. (2020). Selected factors of SMEs management in the service sector. *Journal of Tourism and Services*, *21*(11), 129–146. https://doi.org/10.29036/jots.v11i21.215

Beneish, M. D. (1997). Detecting GAAP violation: Implications for assessing earnings management among firms with extreme financial performance. *Journal of Accounting and Policy*, *16*(3), 271–309. https://doi.org/10.1016/S0278-4254(97)00023-9

Bereskin, F. L., Hsu, P. H., & Rotenberg, W. (2018). The real effects of real earnings management: Evidence from innovation. *Contemporary Accounting Research*, *35*(1), 525–557. https://doi.org/10.1111/1911-3846.12376

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

Blazek, R. (2021). Creative accounting as a global tool for tax optimization. *SHS Web of Conferences*, *92*, 02007. https://doi.org/10.1051/shsconf/20219202007

Cepel, M. (2019). Social and cultural factors and their impact on the quality of business environment in the SME segment. *International Journal of Entrepreneurial Knowledge*, *7*(1), 65–73. https://doi.org/10.2478/ijek-2019-0005

Collins, D. W., Pungaliya, R. S., & Vijh, A. M. (2017). The effects of firm growth and model specification choices on tests of earnings management in quarterly settings. *The Accounting Review*, *92*(2), 69–100. https://doi.org/10.2308/accr-51551

Connolly-Barker, M., Gregova, E., Dengov, V. V., & Podhorska, I. (2020). Internet of things sensing networks, deep learning-enabled smart process planning, and big data-driven innovation in cyber-physical system-based manufacturing. *Economics, Management, and Financial Markets*, *15*(2), 23–29. https://doi.org/10.22381/EMFM15220203

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

Donatella, P., Haraldsson, M., & Tagesson, T. (2019). Do audit firm and audit costs/fees influence earnings management in Swedish municipalities? *International Review of Administrative Sciences*, *85*(4), 673–691. https://doi.org/10.1177/0020852317748730

Durana, P., Valaskova, K., Chlebikova, D., Krastev, V., & Atanasova, I. (2020). Heads and tails of earnings management: Quantitative analysis in emerging countries. *Risks*, *8*(2), 57. https://doi.org/10.3390/risks8020057

Durica, M., & Svabova, L. (2021). Cluster analysis of the economic activity of Slovak companies regarding potential indicators of earnings management. *SHS Web of Conferences*, *92*, 07018. https://doi.org/10.1051/shsconf/20219207018

Filipovic, I., Susak, T., & Krvavac, B. (2020). Effect of non-audit services provision on the relationship between going concern issue emphasis and earnings management. *Ekonomska Misao i Praksa-Economic Thought and Practice*, *29*(2), 393–407. https://doi.org/10.17818/EMIP/2020/2.4

Gavurova, B., Belas, J., Zvarikova, K., Rigelsky, M., & Ivankova, V. (2021a). The effect of education and R&D on tourism spending in OECD countries: An empirical study. *Amfiteatru Economic*, *23*(58), 806–823. https://doi.org/10.24818/EA/2021/58/806

Gavurova, B., Privara, A., Janikova, J., & Kovac, V. (2021b). Quantification of tourism sector parameters related to competitiveness of countries according to macroeconomic indicators. *Journal of Competitiveness*, *13*(3), 56–72. https://doi.org/10.7441/joc.2021.03.04

Grabusts, P. (2011). The choice of metrics for clustering algorithms. *Environment, Technologies, Resources*, *2*, 70–76. https://doi.org/10.17770/etr2011vol2.973

Grofcikova, J. (2020). Impact of selected determinants of corporate governance on financial performance of companies. *Ekonomicko-manazerske spektrum*, *14*(2), 12–23. https://doi.org/10.26552/ems.2020.2.12-23

Haga, J., Huhtamaki, F., & Sundvik, D. (2019). Long-term orientation and earnings management strategies. *Journal of International Accounting Research*, *18*(3), 97–119. https://doi.org/10.2308/jiar-52501

Hussain, A., Akbar, M., Kaleem Khan, M., Akbar, A., Panait, M., & Catalin Voica, M. (2020). When does earnings management matter? Evidence across the corporate life cycle for non-financial Chinese listed companies. *Journal of Risk and Financial Management*, *13*(12), 313. https://doi.org/10.3390/jrfm13120313

Irwandi, S. A., & Pamungkas, I. D. (2020). Determinants of financial reporting quality: Evidence from Indonesia. *Journal of International Studies*, *13*(2), 25–33. https://doi.org/10.14254/2071-8330.2020/13-2/2

Jackson, A. B. (2018). Discretionary accruals: Earnings management... or not? *Abacus*, *54*(2), 136–153. https://doi.org/10.1111/abac.12117

Kadhim, S. C., Hasan, H. F., & Khalbas, H. N. (2020). The effect of business diversity on the relation between profit sustainability, real earnings management and commercial credit in companies of securities and exchange organization of Iraq. *Industrial Engineering & Management Systems*, *19*(4), 908–915. https://doi.org/10.7232/iems.2020.19.4.908

Khanh, M. T. H., & Thu, P. A. (2019). The effect of financial leverage on real and accrual-based earnings management in Vietnamese firms. *Economics and Sociology*, *12*(4), 299–312. https://doi.org/10.14254/2071-789X.2019/12-4/18

Kim, J., Kim, Y., & Zhou, J. (2017). Languages and earnings management. *Journal of Accounting and Economics*, *63*(2–3), 288–306. https://doi.org/10.1016/j.jacceco.2017.04.001

Kjærland, F., Haugdal, A. T., Sondergaard, A., & Vagslid, A. (2020). Corporate governance and earnings management in a Nordic perspective: Evidence from the Oslo stock exchange. *Journal of Risk and Financial Management*, *13*(11), 256. https://doi.org/10.3390/jrfm13110256

Kliestik, T., Belas, J., Valaskova, K., Nica, E., & Durana, P. (2020a). Earnings management in V4 countries: The evidence of earnings smoothing and inflating. *Economic Research-Ekonomska Istraživanja*, 1–19. https://doi.org/10.1080/1331677X.2020.1831944

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. https://doi.org/10.24136/oc.2020.016

Kot, S., & Rajiani, I. (2020). Testing and identifying variable dependency through the Fisher exact test in central Europe enterprises. *Ekonomicko-manazerske spektrum*, *14*(1), 10–18. https://doi.org/10.26552/ems.2020.1.10-18

Kramarova, K. (2021). Transfer pricing and controlled transactions in connection with earnings management and tax avoidance. *SHS Web of Conferences*, *92*, 02031. https://doi.org/10.1051/shsconf/20219202031

Kundelis, E, & Legenzova, R. (2019). Assessing impact of base erosion and profit shifting on performance of subsidiaries of multinational corporations in Baltic countries. *Equilibrium – Quarterly Journal of Economics and Economic Policy*, *14*(2), 277–293. https://doi.org/10.24136/eq.2019.013

Li, S., & Zhang, Y. T. (2020). Managerial political spending choice and earnings management. *Review of Pacific Basin Financial Markets and Policies*, *23*(04), 2050035. https://doi.org/10.1142/S0219091520500356

Liu, M., Shi, Y., Wilson, C., & Wu, Z. (2017). Does family involvement explain why corporate social responsibility affects earnings management? *Journal of Business Research*, *75*, 8–16. https://doi.org/10.1016/j.jbusres.2017.02.001

Lizinska, J., & Czapiewski, L. (2018). Towards economic corporate sustainability in reporting: What does earnings management around equity offerings mean for long-term performance? *Sustainability*, *10*(12), 4349. https://doi.org/10.3390/su10124349

Lo, K., Ramos, F., & Rogo, R. (2017). Earnings management and annual report readability. *Journal of Accounting and Economics*, *63*(1), 1–25. https://doi.org/10.1016/j.jacceco.2016.09.002

Metzker, Z., & Siekelova, A. (2021). Explanatory power of earnings management models. *SHS Web of Conferences*, *92*, 02041. https://doi.org/10.1051/shsconf/20219202041

Michalkova, L. (2021). Earnings quality and accruals over company´s life cycle. *SHS Web of Conferences*, *92*, 02043. https://doi.org/10.1051/shsconf/2021920204

Neifar, S., & Utz, S. (2019). The effect of earnings management and tax aggressiveness on shareholder wealth and stock price crash risk of German companies. *Journal of Applied Accounting Research*, *20*(1), 94–119. https://doi.org/10.1108/JAAR-11-2016-0106

Nica, E., Janoskova, K., & Kovacova, M. (2020). Smart connected sensors, industrial big data, and real-time process monitoring in cyber-physical system-based manufacturing. *Journal of Self-Governance and Management Economics*, *8*(4), 29–38. https://doi.org/10.22381/JSME8420203

Nikulin, E., & Downing, J. (2020). Loan-loss provisions, earnings management, and capital management by Russian banks: The impact of changes in banking regulation and oversight. *Eurasian Business Review*, 1–19. https://doi.org/10.1007/s40821-020-00163-9

Nikulin, E. D., Sviridov, A. A., & Smirnov, M. V. (2020). The relationship of board of directors, audit committee and earnings management: Analysis of Russian public companies. *Rossiiskii Zhurnal Menedzhmenta-Russian Management Journal*, *18*(2), 189–216. https://doi.org/10.21638/spbu18.2020.203

Orazalin, N., & Akhmetzhanov, R. (2019). Earnings management, audit quality, and cost of debt: Evidence from a Central Asian economy. *Managerial Auditing Journal*, *4*(6), 696–721. https://doi.org/10.1108/MAJ-12-2017-1730

Pajuste, A., Poriete, E., & Novickis, R. (2020). Management reporting complexity and earnings management: Evidence from the Baltic markets. *Baltic Journal of Management*, *16*(1), 47–69. https://doi.org/10.1108/bjm-01-2020-0019

Paskaleva, M., & Stoykova, A. (2021). Globalization effects on contagion risks in financial markets. *Ekonomicko-manazerske spektrum*, *15*(1), 38–54. https://doi.org/10.26552/ems.2021.1.38-54

Pavlovic, 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.

Pisar, P., & Bilkova, D. (2019). Controlling as a tool for SME management with an emphasis on innovations in the context of Industry 4.0. *Equilibrium – Quarterly Journal of Economics and Economic Policy*, *14*(4), 763–785. https://doi.org/10.24136/eq.2019.035

Pisar, P., & Mazo, M. E. (2020). Controlling, communication and corporate culture – the opportunity for SMEs. *Economics and Sociology*, *13*(3), 113–132. https://doi.org/10.14254/2071-789X.2020/13-3/8

Podhorska, I., Vrbka, J., Lazaroiu, G., & Kovacova, M. (2020). Innovations in financial management: Recursive prediction model based on decision trees. *Marketing and Management of Innovations*, *3*, 276–292. https://doi.org/0.21272/mmi.2020.3-20

Putri, A. V., & Prasetyo, K. (2020). The Effect of good corporate governance mechanism on earnings management in Lq-45 companies. *Contemporary Economics*, *14*(4), 542.

Richardson, M. (2009). *Principal component analysis*. 1–23. http://aurora.troja.mff.cuni.cz/nemec/idl/09bonus/pca.pdf

Sadiq, M., Pantamee, A. A., Mohamad, S., Aldeehani, M. T., & Ady, S. U. (2020). Corporate governance and earnings management: Evidence from listed non-financial firms. *Polish Journal of Management Studies*, *22*(2), 456–469. https://doi.org/10.17512/pjms.2020.22.2.30

Salehi, M., Mahmoudabadi, M., & Adibian, M. S. (2018). The relationship between managerial entrenchment, earnings management and firm innovation. *International Journal of Productivity and Performance Management*, *67*(9), 2089–2107. https://doi.org/10.1108/IJPPM-03-2018-0097

Saona, P., & Muro, L. (2018). Firm-and country-level attributes as determinants of earnings management: An analysis for Latin American firms. *Emerging Markets Finance and Trade*, *54*(12), 2736–2764. https://doi.org/10.1080/1540496X.2017.1410127

Savov, R., Cheben, J., Lancaric, D., & Serences, R. (2017). MBNQA approach in quality management supporting sustainable business performance in agribusiness. *Amfiteatru Economic Journal*, *19*(44), 10–27. https://doi.org/10419/169054

Setyoputri, L. S., & Mardijuwono, A. W. (2020). The impact of firm attributes on earnings management. *Polish Journal of Management Studies*, *22*(1), 502–512. https://doi.org/10.17512/pjms.2020.22.2.30

Siekelova, A., Kovacova, M., Adamko, P., & Stehel, V. (2019). Profit management as an instrument for SMEs developing: the case for Slovakia. *Marketing and Management of Innovations*, *3*, 285–296. https://doi.org/10.21272/mmi.2019.3-22

Sosnowski, T. (2018). Earnings management in the private equity divestment process on Warsaw Stock Exchange. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *13*(4), 689–705. https://doi.org/10.24136/eq.2018.033

Sosnowski, T. (2021). The credibility of earnings announced by new stock companies: Accrual and real earnings management. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, *16*(3), 661–677. https://doi.org/10.24136/eq.2021.024

Sosnowski, T., & Wawryszuk-Misztal, A. (2019). Diversity on management and supervisory board and accuracy of management earnings forecasts in IPO prospectuses. *Ekonomia i Prawo. Economics and Law*, *18*(3), 347–363. https://doi.org/10.12775/Ei2019.024

Stefko, R., Bacik, R., Fedorko, R., Olearova, M., & Rigelsky, M. 2019. Analysis of consumer preferences related to the use of digital devices in the e-commerce dimension. *Entrepreneurship and Sustainability Issues*, *7*(1), 25–33. https://doi.org/10.9770/jesi.2019.7.1(2)

Stefko, R., Fedorko, R., Bacik, R., Rigelsky, M., & Olearova, M. (2020). Effect of service quality assessment on perception of TOP hotels in terms of sentiment polarity in the Visegrad group countries. *Oeconomia Copernicana*, *11*(4), 721–742. https://doi.org/10.24136/oc.2020.029

Strakova, L. (2020). Earnings management in global background. *SHS Web of Conferences*, *74*, 01032. https://doi.org/10.1051/shsconf/20207401032

Sumiyana, S. (2020). Different characteristics of the aggregate of accounting earnings between developed and developing countries: Evidence for predicting future GDP. *Journal of International Studies*, *13*(1), 58–80. https://doi.org/10.14254/2071-8330.2020/13-1/4

Susak, T. (2020).The effect of regulatory changes on relationship between earnings management and financial reporting timeliness: The case of COVID-19 pandemic. *Zbornik radova Ekonomskog fakulteta u Rijeci: časopis za ekonomsku teoriju i praksu*, *38*(2), 453–473. https://doi.org/10.18045/zbefri.2020.2.453

Susanto, Y. K., Pirzada, K., & Adrianne, S. (2019). Is tax aggressiveness an indicator of earnings management? *Polish Journal of Management Studies*, *20*(2), 516–257. https://doi.org/10.17512/pjms.2019.20.2.43

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

Tran, Q. T., Lam, T. T., & Luu, C. D. (2020). Corporate governance and earnings management: A study of Vietnamese listed banks. *The Journal of Asian Finance, Economics, and Business*, *7*(12), 389–395. https://doi.org/10.13106/jafeb.2020.vol7.no12.389

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

Virglerova, Z., Conte, F., Amoah, J., & Massaro, M. R. (2020). The perception of legal risk and its impact on the business of SMEs. *International Journal of Entrepreneurial Knowledge*, *8*(2), 1–13. https://doi.org/10.37335/ijek.v8i2.115

Wierzchon, S. T., & Klopotek, M. A. (2018). Cluster analysis. In *Studies in Big Data: Vol. 34. Modern algorithms of cluster analysis* (pp. 9–66). Springer, Cham. https://doi.org/10.1007/978-3-319-69308-8_2

APPENDIX

Descriptive characteristics of cluster of sectors A, B, C, D, E, F, G, H, I for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0909	1.0630	0.1473	13.50%	1.1020	1.0861	0.1183	10.73%
Tangible assets	0.3680	0.3479	0.2645	71.88%	0.3816	0.3663	0.2529	66.28%
Intangible assets	0.0084	0.0005	0.0385	456.81%	0.2119	0.1835	0.1749	82.53%
Current assets	0.6879	0.6828	0.3005	43.68%	0.1037	0.0812	0.0847	81.60%
Cash flow	0.1497	0.1307	0.0968	64.69%	0.0453	0.0410	0.0315	69.60%
Inventory	0.1894	0.1533	0.1791	94.54%	0.2676	0.2462	0.2100	78.47%
Receivables	0.2775	0.2305	0.2189	78.88%	0.2190	0.1795	0.1747	79.78%
Payable accounts	0.4631	0.4205	0.2922	63.11%	0.3026	0.2600	0.2076	68.59%
Revenues	1.9626	1.5928	1.4018	71.43%	1.7316	1.4824	1.2459	71.95%
Depreciation	0.0503	0.0433	0.0394	78.33%	0.0416	0.0375	0.0290	69.61%
EAT	0.0994	0.0754	0.0900	90.55%	0.2464	0.1869	0.1962	79.61%
ROA	9.0578	7.1161	8.0206	88.55%	22.334	17.1453	17.4893	78.31%

Descriptive characteristics of cluster of sectors A, B, C, D E, F, G, H, I for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1693	1.0888	2.4593	210.32%	1.1121	1.0857	0.1458	13.11%
Tangible assets	0.3652	0.3318	0.2788	76.33%	0.4049	0.3786	0.2822	69.70%
Intangible assets	0.1812	0.1364	0.1805	99.61%	0.0137	0.0008	0.0648	472.88%
Current assets	0.1183	0.0932	0.0977	82.64%	0.6385	0.6559	0.3039	47.59%
Cash flow	0.0454	0.0357	0.0402	88.54%	0.1578	0.1363	0.1164	73.80%
Inventory	0.2331	0.2009	0.2233	95.81%	0.2009	0.1499	0.1978	98.43%
Receivables	0.1886	0.1461	0.1762	93.44%	0.2710	0.2342	0.2090	77.10%
Payable accounts	0.3762	0.3466	0.2042	54.28%	0.3842	0.3350	0.2490	64.80%
Revenues	1.7886	1.5085	1.2716	71.09%	1.8963	1.5992	1.4907	78.61%
Depreciation	0.0415	0.0327	0.0362	87.16%	0.0438	0.0347	0.0621	141.90%
EAT	0.3267	0.2591	0.2483	76.01%	0.1140	0.0920	0.0954	83.73%
ROA	29.1042	23.7678	20.9046	71.83%	10.2087	8.2980	8.5099	83.36%

Descriptive characteristics of cluster of sectors A, B, C, E, G, I for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0912	1.0624	0.1427	13.07%	1.1026	1.0878	0.1091	9.90%
Tangible assets	0.3603	0.3428	0.2558	71.00%	0.3785	0.3697	0.2407	63.61%
Intangible assets	0.0091	0.0007	0.0408	449.45%	0.2361	0.2068	0.1727	73.14%
Current assets	0.6963	0.6899	0.2845	40.85%	0.1044	0.0812	0.0847	81.17%
Cash flow	0.1486	0.1295	0.0984	66.17%	0.0450	0.0411	0.0297	65.92%
Inventory	0.2210	0.1819	0.1777	80.41%	0.2838	0.2622	0.2094	73.79%
Receivables	0.2650	0.2250	0.2057	77.62%	0.2100	0.1746	0.1601	76.25%
Payable accounts	0.4612	0.4205	0.2789	60.47%	0.3019	0.2577	0.2075	68.72%
Revenues	2.0064	1.6496	1.4009	69.82%	1.7529	1.4883	1.2512	71.38%
Depreciation	0.0479	0.0431	0.0351	73.20%	0.0413	0.0376	0.0272	65.86%
EAT	0.1007	0.0754	0.0927	92.08%	0.2362	0.1811	0.1897	80.33%
ROA	9.1787	7.1218	8.2542	89.93%	21.3813	16.3140	16.8759	78.93%

Descriptive characteristics of cluster of sectors A, B, C, E, G, I for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1861	1.0883	2.9325	247.24%	1.1160	1.0938	0.1311	11.74%
Tangible assets	0.3597	0.3463	0.2472	68.73%	0.3868	0.3632	0.2600	67.21%
Intangible assets	0.2356	0.2022	0.1809	76.79%	0.0115	0.0009	0.0460	400.24%
Current assets	0.1132	0.0926	0.0834	73.65%	0.6723	0.6819	0.2779	41.34%
Cash flow	0.0415	0.0350	0.0325	78.26%	0.1618	0.1427	0.0961	59.40%
Inventory	0.2796	0.2546	0.2244	80.24%	0.2482	0.2109	0.1898	76.48%
Receivables	0.1852	0.1477	0.1643	88.72%	0.2823	0.2485	0.1889	66.91%
Payable accounts	0.3693	0.3433	0.1998	54.10%	0.3984	0.3555	0.2455	61.61%
Revenues	1.9095	1.6304	1.2925	67.69%	2.1020	1.7655	1.5283	72.70%
Depreciation	0.0381	0.0319	0.0296	77.69%	0.0428	0.0361	0.0363	84.74%
EAT	0.2850	0.2373	0.1994	69.97%	0.1190	0.0998	0.0874	73.47%
ROA	25.6736	21.7877	17.5871	68.50%	10.6426	8.9995	7.6497	71.88%

Descriptive characteristics of cluster of sectors D, F, H for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0894	1.0672	0.1695	15.56%	1.0982	1.0705	0.1672	15.22%
Tangible assets	0.4072	0.3911	0.3031	74.42%	0.4030	0.3488	0.3228	80.09%
Intangible assets	0.0050	0.0002	0.0226	449.87%	0.0495	0.0172	0.0740	149.41%
Current assets	0.6446	0.5732	0.3702	57.43%	0.0994	0.0807	0.0841	84.62%
Cash flow	0.1549	0.1388	0.0886	57.17%	0.0471	0.0396	0.0419	88.88%
Inventory	0.0275	0.0053	0.0585	212.49%	0.1593	0.1343	0.1801	113.09%
Receivables	0.3422	0.3007	0.2687	78.54%	0.2797	0.2491	0.2435	87.08%
Payable accounts	0.4728	0.4222	0.3538	74.84%	0.3071	0.2711	0.2082	67.81%
Revenues	1.7375	1.3791	1.3891	79.95%	1.5883	1.3953	1.2013	75.63%
Depreciation	0.0624	0.0468	0.0551	88.31%	0.0437	0.0374	0.0388	88.76%
EAT	0.0925	0.0755	0.0741	80.15%	0.3150	0.2652	0.2233	70.91%
ROA	8.4364	7.0550	6.6802	79.18%	28.7339	24.4413	20.0334	69.72%

Descriptive characteristics of cluster of sectors D, F, H for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1455	1.0949	0.2394	20.90%	1.1237	1.0944	0.2114	18.81%
Tangible assets	0.4311	0.4024	0.3173	73.60%	0.4204	0.3573	0.3140	74.70%
Intangible assets	0.0529	0.0142	0.0854	161.38%	0.0132	0.0005	0.1139	864.76%
Current assets	0.1117	0.0900	0.0990	88.59%	0.6244	0.6456	0.3268	52.33%
Cash flow	0.0548	0.0403	0.0461	84.07%	0.1653	0.1390	0.1076	65.07%
Inventory	0.1152	0.1062	0.1529	132.72%	0.1098	0.0336	0.2003	182.36%
Receivables	0.2240	0.1984	0.1809	80.74%	0.3034	0.2426	0.2451	80.79%
Payable accounts	0.3997	0.3525	0.2080	52.05%	0.3946	0.3363	0.2431	61.60%
Revenues	1.6077	1.3538	1.1051	68.74%	1.6053	1.3663	1.1762	73.27%
Depreciation	0.0504	0.0374	0.0420	83.43%	0.0557	0.0439	0.0521	93.60%
EAT	0.3880	0.3110	0.3268	84.21%	0.1096	0.0829	0.0892	81.40%
ROA	32.2523	27.0875	21.5641	66.86%	9.7437	7.3795	7.9136	81.22%

Descriptive characteristics of cluster of sectors J, K, L, M, N, O, P, Q for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0706	1.0314	0.1817	16.97%	1.1006	1.0737	0.1446	13.13%
Tangible assets	0.3294	0.1141	0.3583	108.76%	0.3577	0.2218	0.3448	96.39%
Intangible assets	0.0253	0.0008	0.0963	381.15%	0.0436	0.0038	0.1023	234.37%
Current assets	0.6526	0.7336	0.3959	60.67%	0.1225	0.0856	0.1365	111.43%
Cash flow	0.1613	0.1176	0.1387	86.02%	0.0513	0.0358	0.0555	108.30%
Inventory	0.0387	0.0020	0.1079	278.71%	0.1510	0.1022	0.2222	147.13%
Receivables	0.2791	0.1922	0.2617	93.78%	0.2260	0.1508	0.2297	101.66%
Payable accounts	0.4657	0.4316	0.3136	67.34%	0.3176	0.2802	0.2214	69.71%
Revenues	1.5327	1.1049	1.6086	104.95%	1.3337	1.1089	1.3167	98.72%
Depreciation	0.0450	0.0266	0.0542	120.62%	0.0468	0.0331	0.0492	105.20%
EAT	0.1163	0.0778	0.1303	112.05%	0.3787	0.3276	0.2762	72.94%
ROA	11.2076	7.3387	12.8508	114.66%	34.1199	29.6741	23.9166	70.10%

Descriptive characteristics of cluster of sectors J, K, L, M, N, O, P, Q for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1186	1.0852	0.1823	16.30%	1.0855	1.0409	0.1567	14.44%
Tangible assets	0.3264	0.1975	0.3494	107.06%	0.4824	0.5699	0.3424	70.98%
Intangible assets	0.0529	0.0076	0.0993	187.76%	0.0246	0.0009	0.0912	370.90%
Current assets	0.1444	0.1012	0.1399	96.90%	0.4844	0.3553	0.3576	73.82%
Cash flow	0.0526	0.0337	0.0543	103.06%	0.1324	0.0818	0.1893	142.99%
Inventory	0.1318	0.0649	0.1968	149.38%	0.0366	0.0025	0.1007	275.02%
Receivables	0.1785	0.0963	0.2150	120.44%	0.1961	0.0636	0.2557	130.41%
Payable accounts	0.3880	0.3498	0.2194	56.54%	0.3069	0.2036	0.2551	83.13%
Revenues	1.4133	1.1724	1.1593	82.03%	1.0896	0.6139	1.1378	104.42%
Depreciation	0.0472	0.0307	0.0473	100.25%	0.0394	0.0192	0.1317	334.65%
EAT	0.4605	0.4311	0.3015	65.48%	0.0930	0.0462	0.1291	138.79%
ROA	41.6968	38.1948	27.2563	65.37%	8.4373	4.3314	11.9988	142.21%

Descriptive characteristics of cluster of sectors J, M for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0705	1.0216	0.2057	19.22%	1.1172	1.0819	0.1726	15.45%
Tangible assets	0.1588	0.0527	0.2338	147.17%	0.1726	0.0823	0.2131	123.46%
Intangible assets	0.0313	0.0013	0.1177	375.58%	0.0620	0.0107	0.1268	204.55%
Current assets	0.8232	0.8845	0.3561	43.25%	0.1534	0.1105	0.1638	106.73%
Cash flow	0.1892	0.1453	0.1609	85.06%	0.0463	0.0322	0.0470	101.64%
Inventory	0.0290	0.0009	0.0722	248.83%	0.2162	0.2009	0.2018	93.31%
Receivables	0.3768	0.3411	0.2776	73.68%	0.2980	0.2694	0.2092	70.20%
Payable accounts	0.5275	0.4789	0.3388	64.23%	0.3686	0.3350	0.2185	59.27%
Revenues	1.8018	1.6082	1.2814	71.12%	1.5490	1.4182	0.8791	56.75%
Depreciation	0.0366	0.0188	0.0464	126.86%	0.0417	0.0297	0.0414	99.36%
EAT	0.1527	0.1079	0.1529	100.13%	0.4688	0.4537	0.2567	54.76%
ROA	14.5182	10.7707	14.7454	101.57%	42.0266	42.8575	21.7135	51.67%

Descriptive characteristics of cluster of sectors J, M for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1277	1.0906	0.1909	16.93%	1.1296	1.0913	0.2069	18.32%
Tangible assets	0.1877	0.1020	0.1935	103.13%	0.2313	0.1104	0.2610	112.82%
Intangible assets	0.0574	0.0138	0.0994	173.19%	0.0498	0.0049	0.1313	263.77%
Current assets	0.1738	0.1400	0.1557	89.59%	0.7468	0.7856	0.3346	44.81%
Cash flow	0.0509	0.0385	0.0435	85.61%	0.2138	0.1547	0.2716	127.01%
Inventory	0.1555	0.1112	0.2015	129.56%	0.0600	0.0133	0.1156	192.78%
Receivables	0.2191	0.1590	0.2271	103.63%	0.3427	0.2899	0.2764	80.66%
Payable accounts	0.4265	0.3990	0.2185	51.24%	0.4301	0.3861	0.2852	66.32%
Revenues	1.6485	1.4722	0.9719	58.95%	1.6255	1.3574	1.1634	71.57%
Depreciation	0.0458	0.0347	0.0386	84.22%	0.0615	0.0318	0.2243	364.48%
EAT	0.5382	0.4887	0.2778	51.61%	0.1523	0.0946	0.1644	107.93%
ROA	48.0220	44.4949	23.9220	49.81%	1.1296	1.0913	0.2069	18.32%

Descriptive characteristics of cluster of sectors K, L for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0685	1.0192	0.1731	16.20%	1.0564	1.0404	0.0911	8.63%
Tangible assets	0.4964	0.4276	0.4198	84.57%	0.6627	0.8203	0.3529	53.26%
Intangible assets	0.0158	0.0002	0.0574	363.24%	0.0033	0.0000	0.0191	571.57%
Current assets	0.4783	0.4900	0.3924	82.05%	0.0710	0.0371	0.0984	138.61%
Cash flow	0.1195	0.0809	0.1275	106.71%	0.0480	0.0304	0.0617	128.40%
Inventory	0.0219	0.0004	0.0921	419.88%	0.0341	0.0031	0.2114	619.47%
Receivables	0.1562	0.0342	0.2300	147.23%	0.0911	0.0123	0.2215	243.06%
Payable accounts	0.3878	0.3421	0.2846	73.39%	0.2278	0.1293	0.2237	98.19%
Revenues	0.7098	0.2504	0.9593	135.15%	0.3837	0.1442	0.6785	176.82%
Depreciation	0.0310	0.0241	0.0258	83.22%	0.0454	0.0290	0.0563	124.01%
EAT	0.0885	0.0424	0.1293	146.13%	0.2176	0.1278	0.2565	117.92%
ROA	8.6775	3.7784	13.1850	151.94%	20.1416	12.1644	22.8888	113.64%

Descriptive characteristics of cluster of sectors K, L for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0695	1.0485	0.1075	10.05%	1.0408	1.0051	0.1144	11.00%
Tangible assets	0.4383	0.4086	0.3743	85.39%	0.6030	0.7128	0.3083	51.12%
Intangible assets	0.0640	0.0011	0.1225	191.41%	0.0092	0.0002	0.0576	624.24%
Current assets	0.1245	0.0848	0.1294	103.87%	0.3141	0.2232	0.2790	88.82%
Cash flow	0.0322	0.0238	0.0260	80.51%	0.0538	0.0239	0.0753	139.88%
Inventory	0.0909	0.0339	0.1448	159.33%	0.0192	0.0008	0.0766	398.82%
Receivables	0.0847	0.0380	0.1038	122.52%	0.0834	0.0280	0.1643	197.07%
Payable accounts	0.3106	0.2679	0.2125	68.42%	0.2077	0.1400	0.2030	97.72%
Revenues	0.9311	0.5372	1.0291	110.53%	0.5058	0.3424	0.6098	120.57%
Depreciation	0.0303	0.0214	0.0236	77.82%	0.0105	0.0025	0.0194	185.45%
EAT	0.4122	0.3018	0.3390	82.24%	0.0434	0.0213	0.0668	154.00%
ROA	38.8592	29.0815	32.1567	82.75%	3.9433	2.0651	5.4443	138.06%

Descriptive characteristics of cluster of sectors N, O, P, Q for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0724	1.0520	0.1521	14.18%	1.1100	1.0861	0.1115	10.05%
Tangible assets	0.4442	0.3770	0.3531	79.49%	0.4416	0.4412	0.3110	70.42%
Intangible assets	0.0239	0.0005	0.0864	361.91%	0.0454	0.0122	0.0807	177.79%
Current assets	0.5432	0.5510	0.3594	66.18%	0.1089	0.0891	0.0754	69.23%
Cash flow	0.1533	0.1122	0.1009	65.79%	0.0651	0.0509	0.0632	97.23%
Inventory	0.0648	0.0093	0.1495	230.61%	0.1308	0.0932	0.2232	170.62%
Receivables	0.2337	0.1637	0.2072	88.67%	0.2095	0.1307	0.2161	103.13%
Payable accounts	0.4370	0.3586	0.2829	64.75%	0.3002	0.2654	0.1937	64.51%
Revenues	1.7694	1.0813	2.1363	120.74%	1.8316	1.3381	1.9499	106.46%
Depreciation	0.0672	0.0475	0.0713	106.07%	0.0588	0.0447	0.0547	93.02%
EAT	0.0860	0.0638	0.0728	84.59%	0.3506	0.3046	0.2564	73.13%
ROA	8.4509	6.1997	7.8640	93.06%	31.4941	27.6793	22.4674	71.34%

Descriptive characteristics of cluster of sectors N, O, P, Q for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1611	1.1279	0.2222	19.13%	1.1012	1.0641	0.1241	11.27%
Tangible assets	0.4488	0.3300	0.4412	98.31%	0.5921	0.7045	0.3184	53.78%
Intangible assets	0.0311	0.0076	0.0562	180.93%	0.0185	0.0024	0.0669	362.39%
Current assets	0.1137	0.0835	0.1082	95.19%	0.4355	0.3405	0.3109	71.39%
Cash flow	0.0805	0.0398	0.0801	99.41%	0.1554	0.1229	0.1413	90.95%
Inventory	0.1371	0.0537	0.2337	170.53%	0.0356	0.0069	0.1087	305.37%
Receivables	0.2162	0.1172	0.2548	117.86%	0.1950	0.0893	0.2584	132.56%
Payable accounts	0.4100	0.3747	0.2074	50.58%	0.3126	0.2442	0.2244	71.79%
Revenues	1.5578	1.2571	1.4344	92.07%	1.3419	0.8876	1.3085	97.52%
Depreciation	0.0701	0.0359	0.0695	99.22%	0.0568	0.0440	0.0523	91.98%
EAT	0.3743	0.3418	0.2609	69.71%	0.0986	0.0609	0.1237	125.51%
ROA	33.3796	31.6052	23.9363	71.71%	9.0675	5.2872	12.4320	137.11%

Descriptive characteristics of cluster of sectors R for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1012	1.0842	0.1930	17.52%	1.1183	1.0913	0.1642	14.68%
Tangible assets	0.4577	0.3356	0.3739	81.69%	0.2795	0.1271	0.3131	112.02%
Intangible assets	0.0042	0.0021	0.0063	151.18%	0.0067	0.0043	0.0087	130.47%
Current assets	0.5830	0.7282	0.3732	64.02%	0.1265	0.1034	0.0923	73.01%
Cash flow	0.2375	0.2251	0.1421	59.83%	0.0460	0.0476	0.0322	70.02%
Inventory	0.0042	0.0023	0.0053	125.83%	0.0422	0.0343	0.0798	189.04%
Receivables	0.1326	0.0916	0.1337	100.83%	0.0823	0.0845	0.0725	88.07%
Payable accounts	0.3359	0.2762	0.2376	70.73%	1.1183	1.0913	0.1642	14.68%
Revenues	3.9084	1.7067	4.0732	104.22%	0.2795	0.1271	0.3131	112.02%
Depreciation	0.0635	0.0520	0.0454	71.52%	0.0067	0.0043	0.0087	130.47%
EAT	0.1740	0.1598	0.1256	72.21%	0.1265	0.1034	0.0923	73.01%
ROA	1.1012	1.0842	0.1930	17.52%	0.0460	0.0476	0.0322	70.02%

Descriptive characteristics of cluster of sectors R for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.1506	1.0674	0.2278	19.79%	1.0970	1.0767	0.0920	8.38%
Tangible assets	0.6029	0.6276	0.3622	60.07%	0.5752	0.7128	0.3775	65.63%
Intangible assets	0.0067	0.0026	0.0096	143.94%	0.0284	0.0042	0.0512	180.64%
Current assets	0.1536	0.1349	0.1261	82.08%	0.4337	0.2542	0.3575	82.42%
Cash flow	0.0502	0.0520	0.0214	42.62%	0.1188	0.1034	0.0844	71.09%
Inventory	0.0056	0.0061	0.0061	110.22%	0.0081	0.0067	0.0075	92.61%
Receivables	0.0162	0.0089	0.0207	127.86%	0.0871	0.0397	0.1123	129.03%
Payable accounts	0.4021	0.3903	0.0394	9.79%	0.3537	0.2326	0.3432	97.03%
Revenues	2.0394	0.4656	3.2913	161.38%	1.3806	0.4953	2.0558	148.90%
Depreciation	0.0466	0.0517	0.0216	46.50%	0.0436	0.0414	0.0282	64.60%
EAT	0.4784	0.3643	0.5090	106.39%	0.0752	0.0509	0.0766	101.83%
ROA	36.5093	33.0429	34.6274	94.85%	6.9091	4.5443	7.3296	106.09%

Descriptive characteristics of cluster of sectors S for Slovakia a Czechia (source: authors)

Variables	Slovakia				Czechia			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	0.9777	0.9777	0.0111	1.14%	1.1123	1.0671	0.1240	11.14%
Tangible assets	0.1810	0.7652	0.3641	201.11%	0.2224	0.1799	0.2572	115.67%
Intangible assets	0.0003	0.0003	0.0018	689.31%	0.0411	0.0182	0.0589	143.24%
Current assets	0.7965	0.2111	0.3591	45.09%	0.0573	0.0363	0.0542	94.65%
Cash flow	0.1021	0.1091	0.0648	63.49%	0.0503	0.0139	0.0839	166.75%
Inventory	0.0061	0.0009	0.0031	51.30%	0.1321	0.0883	0.1585	119.97%
Receivables	0.0517	0.1027	0.0347	67.10%	0.1510	0.0883	0.1681	111.29%
Payable accounts	0.0909	0.3474	0.1528	168.08%	0.2499	0.1952	0.2379	95.22%
Revenues	0.8788	0.8788	0.0706	8.03%	0.7464	0.4548	0.7612	101.97%
Depreciation	0.0172	0.0560	0.0532	310.32%	0.0451	0.0122	0.0750	166.48%
EAT	0.0850	0.0850	0.0220	25.91%	0.6026	0.7233	0.3491	57.93%
ROA	8.6895	8.6895	2.3323	26.84%	54.1027	60.1074	31.5681	58.35%

Descriptive characteristics of cluster of sectors S for Hungary a Poland (source: authors)

Variables	Hungary				Poland			
	Mean	Median	St. dev.	Coef. of variance	Mean	Median	St. dev.	Coef. of variance
Total assets	1.0910	1.0573	0.1084	9.94%	1.0574	1.0586	0.0908	8.59%
Tangible assets	0.6236	0.6904	0.3641	58.38%	0.3173	0.1914	0.2690	84.79%
Intangible assets	0.0795	0.0252	0.1306	164.24%	0.0319	0.0074	0.0485	151.84%
Current assets	0.1223	0.0857	0.1218	99.64%	0.5890	0.6332	0.2284	38.78%
Cash flow	0.1073	0.0439	0.1221	113.77%	0.1884	0.0830	0.1764	93.63%
Inventory	0.1168	0.0863	0.1412	120.88%	0.0645	0.0340	0.0797	123.68%
Receivables	0.1601	0.1034	0.1792	111.93%	0.2202	0.1702	0.1653	75.08%
Payable accounts	0.3468	0.2946	0.2016	58.13%	0.3192	0.2628	0.2126	66.59%
Revenues	1.6215	0.9026	1.8536	114.32%	1.6557	1.1392	1.5352	92.72%
Depreciation	0.0989	0.0420	0.1127	113.93%	0.0834	0.0352	0.0947	113.65%
EAT	0.1887	0.0928	0.2177	115.38%	0.1051	0.0462	0.1338	127.37%
ROA	15.9616	9.3542	16.6543	104.34%	10.2471	5.1046	13.1158	128.00%