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Management and Economic Sustainability of the Slovak Industrial Companies with Medium Energy Intensity

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Abstract: Industry 4.0 and related automation and digitization have a significant impact on competition between companies. They have to deal with the lack of financial resources to apply digital solutions in their businesses. In Slovakia, Industry 4.0 plays an important role, especially in the mechanical engineering industry (MEI). This paper aims to identify the groups of financial ratios that can be used to measure the financial performance of the companies operating in the Slovak MEI. From the whole MEI, we selected the 236 largest non-financial corporations whose ranking we obtained according to the amount of generated revenues in 2017. Using factor analysis, from eleven traditional financial ratios, we extracted four independent factors that measure liquidity (equity to liabilities ratio, quick ratio, debt ratio, net working capital to assets ratio, current ratio), profitability (return on sales, return on investments), indebtedness (financial leverage, debt to equity ratio), and activity (assets turnover, current assets turnover) of the company. Our analysis is an essential prerequisite for developing a realistic financial plan for companies operating in the MEI, especially when considering investments in new technologies related to Industry 4.0.

Keywords: Industry 4.0; mechanical engineering industry; economic sustainability; factor analysis; Slovakia

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1. Introduction

In the 21st century, it is especially necessary to point out the importance and usability of electrical energy in everyday life and in industry. The sectors of industry and industrial production are interconnected because of the consumption of the energy industry. Energy machinery of the mechanical engineering industry is focused on a wide range of machines and devices used in the manufacturing, transformation, and accumulation of different forms of energy concerning environmental requirements involved in the production, construction, and operation of energy systems, machinery, and equipment. Industry 4.0 appeals even to companies with vast experience in implementing automatization. Industry 4.0 represents the interconnection between IT technologies and the production process, flexible just-in-time deliveries, advanced quality management and growing robotics, automation, and digitalization. Digitalization has literally become a megatrend in the mechanical engineering industry (MEI). Mechanical engineering companies apply energy fundamentals and mechanics to create extensive types of machines, devices, or systems for energy transformation, biofuel production, materials treatment and processing, environmental regulation, or transportation [1]. In the coming years, the number of manufactured components in selected mechanical engineering companies will decrease due to increased electromobility, as electric vehicles will require a higher volume

of electricity and a lower number of components produced by mechanical engineering companies. It follows that it is necessary to build a network of electric vehicle charging stations and that sufficient electricity must be available. The MEI assists in the progress of a clean energy future because it develops subsequent generation marine, solar, and wind energy, as well as electrical energy storage materials, devices, or systems. Moreover, it provides grid integration [2]. It follows that energy efficiency improvements in the MEI represent a crucial challenge in maintenance sustainability and achieving emissions reduction objectives [3–7]. Therefore, the sustainability of the competitiveness of the industry and individual business entities depends on the successful implementation of modern technologies and the development of the intelligent industry. However, the impact of the new technologies introduction on corporate finance also needs to be considered.

Power quality indicators such as voltage range, voltage fluctuations, and asymmetries, minimum short-circuit power, and higher harmonic voltages are a priority of the energy engineering and energy machinery of the MEI. In this area, from a financial point of view, we can deal with efficiency indicators and apply multi-criteria evaluations. The analysis of financial efficiency and intensity indicators of the mechanical engineering companies, as one of the major consumers of the energy industry and industry with the medium energy intensity, is highly relevant.

The industry in Slovakia is dominated mainly by the automotive and mechanical engineering industries, which, together with the electrical engineering industry, are the main sources of growth in industrial production. The Slovak MEI is one of the principal pillars of the Slovak economy. Although in the recent past, it has been assumed that the focus of economic activity in developed countries has shifted from industrial production to the services sector, the industry will remain the engine of productivity growth and innovation in the years to come. Innovations are extremely essential for the success of the MEI [8]. It is possible to assume that mechanical engineering companies in Slovakia will be forced to follow current trends and invest in applied research, development, and high-tech services to increase productivity and added value. Therefore, economic performance and financing is a substantial component in the involvement of companies in Industry 4.0. However, the introduction and application of modern technologies related to Industry 4.0 necessarily require a huge amount of financial resources. For many companies, the low profitability and lack of financial resources is an obstacle [9]. Therefore, it is principal to know the financial performance of companies that are in the spotlight. The question is which financial indicators should be analyzed. The problem in setting specific financial indicators is the fact that each industry or company operates in a different business environment and country. It is demanding to come up with a universal model, so it is easiest to focus on a particular country's industry. This paper aims to identify the groups of financial ratios that can be used to measure the financial performance of the companies operating in the Slovak MEI.

2. Theoretical Background

2.1. Economic Sustainability

Since COVID-19 appeared, it is even more obvious that the economic sustainability of business entities is one of the main factors affecting the long-term economic growth of a company. The principle of economic sustainability is currently becoming one of the generally accepted principles of effective business development. Economic sustainability represents non-declining economic welfare [10]. It is explained as the allocation of savings and investment with providing the highest degree of prosperity for present and future generations [11]. On the micro and local levels, Bertelmus [10] (p. 121) defines economic sustainability of capital maintenance as "produced and natural capital maintenance for sustaining the productivity of enterprises". Economic sustainability is affected by investment choices that institutional investors make [12]. The economic aspect of sustainability emphasizes resource efficiency. It means that economic sustainability manages losses and surpluses to ensure maximum economic efficiency and focuses on the trade to receive

specific results and keep business strategy going [13]. It follows that companies should pay more attention to the sustainability of short-run returns and economic performance as a whole [14]. The theory of economic sustainability is presented in [15–19].

Economic sustainability deals with financial performance, utilization of resources in an optimal way, and the profitable long-term functioning of the company [20]. Financial and economic analysis plays a significant role in the decision-making of corporate management. Every manager should be able to interpret financial and economic indicators to maintain the economic sustainability of a business. Economic sustainability requires fair, impartial, and fiscally sound decision-making while taking other aspects of sustainability into account [21].

The company's performance is evaluated from several aspects, which differ depending on the interest groups. In particular, shareholders are interested in increasing the value of invested capital into the business, while they prefer the profit-generating aspect, return on equity, economic value added, and market value indicators. The ultimate goal of the company is not only to generate value for shareholders, but also to form economic, environmental, and social value [22]. Therefore, business models and corporate governance mechanisms should focus beyond the organization as an economic entity [23]. Specifically, sustainable management is oriented towards economic, environmental, and social aspects of corporate governance aimed to increase the company's competitiveness (see Figure 1).

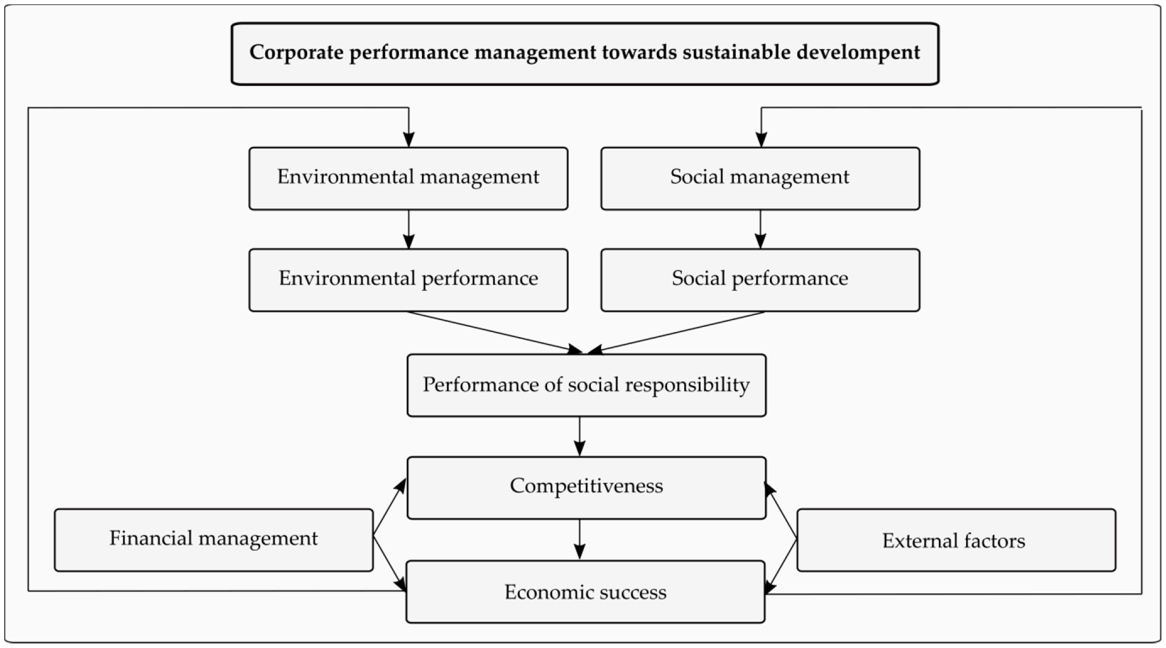

Figure 1. The impact of performance on economic success in sustainable management. Source: our processing according to [24].

The performance analysis of the decision-making unit has an irreplaceable role in the production transformation process. Capital structure and economic performance are some of the main factors that could influence corporate performance. Economic performance can be understood as production capability at the micro, macro, or international level. Companies can maximize their performance and minimize their financial costs by maintaining an adequate capital structure [25]. Kocmanová and Dočekalová [26] state the following specific economic key performance sector-based indicators: turnover, sales, revenues, costs, added value, income from operations, and safe and good-quality products. However, what if such indicators are not available to determine economic performance? In order to evaluate the company's economic performance, it is necessary to choose the appropriate indicators that can be used to measure it.

2.2. Factor Analysis of Financial Ratios

The priority of industrial companies in a constantly floating environment is to recognize valid methods and measures that would allow adaptation to volatile situations. As stated in [27,28], the company can face financial problems if it does not adapt to market conditions. Only those companies that will be able to respond in a timely manner to the changing environment and adopt technologies resulting from Industry 4.0 will be successful.

Financial management has been developing since the 2nd industrial revolution. At the time of the 4th industrial revolution, its importance is growing [28] because the implementation of strategies connected with Industry 4.0 requires significant funding [9,29]. A relative lack of financial resources can cause a considerable disadvantage and reduce the development possibilities of industrial companies [9].

Financial analysis of the industry helps companies to understand their position relative to other participants in the industry; it makes it possible to compare companies with their competitors, to see the differences, take advantage of the positives, reveal weaknesses, and create a plan for the favorable direction of the company. As stated in [30], evaluation of the company's economic performance should be performed simply and quickly.

There is no uniform system of financial measures for evaluating the economic condition of a company or industry; however, financial ratios are mainly used (e.g., ratios of liquidity, activity, profitability, indebtedness) [31]. In financial analysis, it is possible to consider many financial ratios; however, in terms of financial management, time management, and quick decision-making, it is essential to choose the most crucial. Therefore, financial analysts aim to decrease many financial ratios to only a few of them while providing identical information to the primary dataset. In this case, factor analysis seems to be the most appropriate method. The factor analysis is a method based on the principle of early warning of emerging financial problems. The factor analysis concentrates on the main indicators that characterize the economic position of the company or industry. It makes it possible to specify, in particular, the weak or risky aspects of financial stability. The aim of factor analysis in financial analysis is to diminish the number of financial indicators that are correlated with each other and obtain new independent variables that contain information from the original variables.

Researchers have adapted factor analysis on financial ratios of several industries of different countries; e.g., the steel industry of the Slovak Republic [32], the agricultural industry of the Czech Republic [33], the cement industry of India [34], the construction industry [35] and the largest industrial enterprises of Turkey [36], the pharmaceutical industry [37] and the listed companies in China [38], the largest companies of Croatian market [39], or IT companies of the Czech Republic [30]. However, each study used specific financial ratios appropriate for the specified business environment, economic conditions of the country, and available financial data (see Table 1).

As is stated in [40], it is inappropriate to use universal models, because they cannot be repeated in other conditions. As we have already mentioned, the MEI is truly essential for the Slovak economy. The current industrial revolution has widespread effects on the economy and the behavior of mechanical engineering companies. One of the main reasons why Slovak companies invest little in the development of innovations is their weak financial condition, which is still affected by the crisis that occurred ten years ago [41]. It is, therefore, very important to specify the financial indicators that will determine the financial performance of companies in this sector. However, we have no knowledge about the existence of research that studies the financial performance of the Slovak mechanical engineering companies using factor analysis, and therefore, in this paper, we fill this gap. Our research hypothesis H1 is formulated as follows:

Hypothesis 1. *Financial ratios (indicators) of the non-financial companies of the Slovak MEI show common factors.*

Table 1. Financial indicators used in the existing literature.

Authors	Factors	Financial Indicators
Czillingová, Petruška, Tkáč [32]	Liquidity factor	Responsive liquidity; Current liquidity; Total liquidity; Insolvency
	Profitability factor	ROA; ROE; ROCE (Return on capital employed); ROS
	Factor of indebtedness	Total indebtedness; CF level; Financial leverage
	Activity factor	Stock turnover; AT
Hornungová, Milichovský [33]	Operational factor	CF; P/L before tax; Operating revenue; Sales; EBIT; P/L after taxes
	Profit factor	ROA; EBITDA; Profit margin; Profit per employees
	Return factor	ROCE; ROE
	Average cost per employee factor	Average costs of employees
De, Bandyopadhyay, Chakraborty [34]	Profitability and ROI factor	CP to TA; CP to average capital employed; EBITDA/capital employed; Return on average capital employed/net assets; CP to total income; CP to average shareholder's fund
	Cash position	CB to CA; CB to CA; CB to total income; CB to TA
	Capital structure	Shareholder's fund to total liabilities; Proprietary ratio; Total debt to TA; Net fixed assets to capital employed
	Asset and material management	Fixed AT; Total income to capital employed; Raw-material expenses to average raw-material
	Short-term liquidity	CR; QR
	Long-term solvency	CP to shareholder's fund/equity; Debt ER
	Dividend policy	Total dividend distribution ratio; Equity dividend distribution ratio
	Productivity of WC	WC turnover; CP to net WC
Öcal et al. [35]	Liquidity	QR; Cash ratio; EBIT/interest; CR;
	Capital structure and profitability	Debt ratio; ROA; EBT/net sales
	Activity efficiency	WC turnover; AT; Long term AT; Inventory turnover
	Profit margin and growth	EBIT/net sales; Gross profit/net sales; Assets growth rate
	Assets structure	Accounts receivable/TA; CA/TA
Erdogan [36]	Productivity	Labor productivity; Capital productivity
	Profitability and Capital structure	Pretax profit margin; ROE; Debt ratio
	Efficiency	AT; Equity turnover
	Export intensity and proportion of sales from production	Exports/net sales; Sales from production/net sales
Ming, Juqin, Lu [37]	Operating capacity	Inventory turnover; TAT Current AT; Asset-liability ratio; ER; CR
	Solvency	OPE (Main business profit/net sales revenue); Return on TA; ROE; Ratio to profits to cost
	Profit ability	TA growth rate; Earnings per share growth rate
	Growth ability	CROA (The current main business profit growth/main business profit of the previous period)
Yu et al. [38]	Solvency factor	CR; QR; Cash ratio; Asset-liability ratio; ER; Interest coverage
	Workability factor	Accounts receivable turnover; Inventory turnover; TAT; Operating cash/gross revenue
	Profitability factor	ROE; Earning per share; Return on TA; Net profit margin on sales
	Growth ability factor	Gross operating income; Net profit growth
Perisa, Kurnoga, Sopta [39]	Profit	ROA; ROI; ROCE
	Return	EBITDA margin; EBIT margin; Net profit margin
Hornungová [30]	Profitability	ROE; ROA; EBIT
	CF	Liquidity; Operating CF
	Returns	ROI; ROS

Source: own study based on [30,32–39]. Note: AT—assets turnover, CA—current assets, CB—cash and bank, CF—cash flow, CP—cash profit, CR—current ratio, EBIT–earnings before interest and taxes, EBITDA–earnings before interest, taxes, depreciation, and amortization, EBT–earnings before taxes, ER—equity ratio, QR—quick ratio, ROA–return on assets, ROCE–return on capital employed, ROE–return on equity, ROS–return on sales, TA—total assets, TAT–total assets turnover, WC—working capital.

3. Materials and Methods

3.1. The Slovak Mechanical Engineering Industry and Research Sample

The Slovak MEI is among the main pilots of the Slovak economy, with a stable history, and maintains its solid position among the Slovak industries. The mission of mechanical engineering is to improve the environment by manufacturing devices for the handling and processing of water, soil, air, and waste, as well as to facilitating the usage of renewable energy sources [42], such as fuel cells, wind turbines, and solar energy

converters [1]. The share of the Slovak MEI in Slovak industrial production in 2019 was 15.2%, which was the second highest value, just behind the automotive industry (32.4%). In general, the MEI is defined as a sum of four divisions of the Statistical classification of economic activities in the European Community (NACE Rev. 2), specifically: (i) Division 25—Manufacture of fabricated metal products, except machinery and equipment; (ii) Division 28—Manufacture of machinery and equipment n.e.c. (not elsewhere classified); (iii) Division 29—Manufacture of motor vehicles, trailers and semi-trailers; (iv) Division 30—Manufacture of other transport equipment. Depending on the nature of production, part of the groups and classes of Division 25 tend to belong to the metallurgical (metalworking) industry.

The research of Jenčová [43], which evaluates the competitiveness of the selected industries using revenue models, shows that among the Slovak MEI, in 2008–2019, Division 28 (Manufacture of fabricated metal products, except machinery and equipment) was the most competitive. A resulting coefficient of competitiveness was positive, and it means the industry was the driving force in the ranking of the global Slovak industry and industrial production. The Manufacture of fabricated metal products, except machinery and equipment (Division 25) decreased from the second position in 2008 to the ninth position in 2013–2015.

As we have already mentioned, Slovakia is an industrial country. In 2019, the Statistical Office of the Slovak Republic [44] registered 2542.6 thousand employees, which represent a 94.2% share of the economically active population of the Slovak Republic, of which 696.7 thousand people worked in industry. At the end of the first quarter of 2020, this figure was 2552.3 thousand employees, of which 708.5 thousand worked in industry. Before the COVID-19 crisis, the Slovak MEI registered 2100 companies and employed almost 104.2 thousand people. The average annual growth rate of costs computed as the geometric mean for 2008–2019 is 5.06% and the average annual growth rate of revenues is 5.5%. In 2019, the share of the MEI revenues on industrial production was 43.9%. In 2008–2019, the earnings before taxes (EBT) were positive, with the exception of 2009. In 2018, the EBT was 1177.09 thousand EUR and, compared to 2008, increased by 124.83% [45].

In 2018, among the Division 28 (Manufacture of machinery and equipment n.e.c.), the median of the return on assets (ROA) reached 3.88%, and median of return on equity (ROE) was almost 9.3%. The total debt was 57%. Earnings before interest, taxes, depreciation, and amortization (EBITDA) to sales ratio was 7.24%. The assets turnover ratio was 1.16 (specifically, assets were turned 1.16 times a year), inventory turnover was 8 days, and current ratio (CR) was 1.61 [45]. Among the Division 29 (Manufacture of motor vehicles, trailers and semi-trailers), the account receivable collection period was 52.6 days, and the inventory turnover was 13.28 days. The MEI generated €0.02 of earnings after taxes (EAT) for every €1 of total equity, and €1 of sales generated almost €0.03 of EBITDA. The median of added value to sales ratio was 1.38%; the coefficient of CR reached value of 1.54; the median of total debt was 58.04%; and the median of equity to liabilities ratio was 0.75 [45]. Among the Division 30 (Manufacture of other transport equipment), the account receivable collection period was 132.64 days, and the inventory turnover was 50 days. The MEI generated €0.02 of earnings after taxes (EAT) for every €1 of total equity, and €1 of sales generated almost €0.06 of EBITDA. The median of added value to sales ratio was 1.31%; the coefficient of CR reached a value of 1.85; the median of total debt was 50% [45].

Until 2019, the Slovak MEI showed the most significant increase in sales. Unfortunately, in 2020, due to the crisis caused by COVID-19, sales for the first quarter fell by 18% compared to the previous period. The results of non-financial companies in the MEI for 2019 may partially signal how the non-financial companies were prepared to cope with the unfavorable situation and what the current development will do with their future economy. Most mechanical engineering companies have long-term system solutions to crisis situations, especially in the area of costs. The companies paid attention to the emphasis and principle of compliance with the rules. There were concerns about the deterioration in payment discipline and the increase in uncollectible receivables. Due to the COVID-19

crisis, on the one hand, there is a decline in demand from abroad, but, on the other hand, companies are forced to respond by changing processes or procedures to be better prepared for unexpected adverse situations. They are looking for solutions that will help them to be more efficient and productive. In connection with COVID-19, companies in the MEI have begun to reform many of the processes they have done so far, either manually or not at all, using automation and information technology. It is estimated that there will be a greater skilled labor shortage with technical capabilities, regardless of the sector.

The research sample involves a set of the 236 largest non-financial companies of the Slovak MEI. The ranking was compiled according to the amount of generated revenues in 2017 listed in the FinStat database. This database obtains data from the Register of Financial Statements of the Slovak Republic, detects the financial health of the Slovak companies [46], and registers a total of 2644 companies operating in the MEI [47]. On the other hand, the Slovak Investment and Trade Development Agency (SARIO) lists only 872 active companies in the Slovak MEI [48]. For each of the decision-making units, we collected selected financial indicators from 2017 and calculated eleven financial ratios given in Table 2.

Table 2. Variables entering the analysis.

Code	Description
E/L	Equity to liabilities ratio
ROS	Return on Sales (ROS) = earnings before interest, taxes, depreciation and amortization (EBITDA)/sales,
ROI	Return on Investments (ROI) = earnings before interest, taxes (EBT)/total capital
QR	Quick ratio (QR) = (current assets − inventory)/current liabilities
AT	Assets turnover = sales/assets
DR	Debt ratio (DR) = total debt/total assets ratio
FL	Financial leverage (FL) = assets/equity = equity multiplier
NWC/A	Net working capital to assets ratio
CR	Current ratio = current assets/current liabilities
CAT	Current assets turnover = sales/current assets
D/E	Debt to equity ratio

The equity to liabilities ratio affects the financial stability of the company. It determines whether the company is in crisis or whether the company is threatened by the crisis. Abroad, this indicator is not widely used. However, in Slovakia, Act no. 513/1991 Coll. Commercial Code [49] establishes the minimal value of the equity to liabilities ratio for every year. For the year for which our analysis was made, it was 0.06. Companies should monitor their equity to liabilities ratio more often than once a year. Return on sales (ROS) is used to evaluate an operational efficiency of the firm. It measures how much profit is being produced per euro of sales. In other words, how efficiently a company transforms sales into profits. ROS is sometimes called profit margin [50]. Decreasing ROS could indicate impending financial problems. Return on investment (ROI) calculates the benefit an investor will receive in relation to their investment cost. ROI is the amount earned as a result of that investment [50]. The current ratio specifies the scope to which current liabilities (i.e., accounts payable, short-term notes, or accrued expenses) can be covered by current assets (e.g., inventory, accounts receivable, or cash). The quick ratio, in comparison to the current ratio, excludes inventory because inventory is often illiquid. Anyway, the higher the quick (current) ratio, the safer a position the firm is in [51]. Assets turnover and total assets turnover are efficiency ratios and indicate the effectiveness of the firm's use of its assets (total assets) in generating sales [52]. It indicates how many euros of sales a firm generates per euro of asset investment [53]. Debt ratio can help investors to determine a firm's risk level [54]. It estimates the proportion of total assets financed by a company's creditors [53]. Financial leverage represents the amount of money the company has borrowed to finance the purchase of assets. In our paper, we use the equity multiplier that is calculated by dividing the asset by equity. It measures the proportion of assets

financed by a firm's equity [53]. In general, it is better to have a low financial leverage. The purpose of the working capital to sales ratio is to determine the working capital needed in relation to projected sales [52]. A higher ratio highlights the working capital-intensive nature of business [55]. Finally, the debt to equity ratio estimates to which extent the firm is financed by its debt holders compared with its owners [51,56]. A very high debt to equity ratio indicates that a company has a large amount of debt, and usually is much more risky than those with lower debt to equity ratios. Table 3 presents descriptive statistics of the given variables for our research sample.

Table 3. Descriptive statistics of variables entering the analysis.

Variable	Mean	Std. Dev.	Min	Max
E/L	1.317359	2.751604	−0.28862	31.56228
ROS	0.043808	0.090276	−0.39727	0.482496
ROI	0.055478	0.114313	−0.31327	0.591286
QR	1.155496	1.716645	0.017055	20.69541
AT	1.827275	0.979476	0.250104	7.832292
DR	0.601763	0.247309	0.03071	1.405719
FL	5.670203	16.79358	−101.806	166.3051
NWC/A	0.202056	0.289388	−1.05706	0.819416
CR	2.194666	2.147463	0.097574	22.9207
CAT	3.229475	1.722648	0.50229	10.83912
D/E	4.499063	16.55731	−102.806	165.3051

Note: Std. Dev. denotes standard deviation, Min is minimum value, and Max denotes maximum value, respectively.

3.2. Statistical Analysis

In order to understand and identify how the variables are connected, we use factor analysis that decreases many of the variables into a smaller set of variables (or factors) [57]. To assess the relevance of given data for factor analysis, we use a Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy [58,59] and Bartlett's test of sphericity [60]. A value of KMO higher than 0.50 and the significance of Bartlett's test ($p < 0.05$) indicate that factor analysis is suitable.

Since the factor structure for the Slovak MEI was not already provided in previous studies, we use explanatory factor analysis and the principal component analysis extraction method. To find the best distribution of the factor loadings in terms of the meaning of the factors [61,62], we use varimax rotation and factors with an eigenvalue greater than 1. We also use the scree plot to determine the isolation of factors. Factor loadings characterize how each of the variables correlates with each of the factors. Hair et al. [63] consider factor loadings from 0.5 to 0.7 to be practically significant, and those higher than 0.7 as characteristic of a well-defined structure.

The data were processed using the Stata software provided by StataCorp (College Station, TX, USA).

4. Results

In Section 4, we verify the established hypothesis that financial ratios of the non-financial companies of the Slovak MEI show common factors. Before we move on to the factor analysis, we have to compute a correlation matrix that illustrates individual correlation values of the chosen financial ratios. Table 4 shows that most financial indicators have some correlation with each other ranging from r = −0.6055 for debt ratio and net working capital to assets ratio to r = 0.998 for debt to equity ratio and financial leverage. Due to relatively high correlations among considered financial indicators, this would be appropriate for factor analysis.

Table 4. Correlation matrix.

Variable	E/L	ROS	ROI	QR	AT	DR	FL	NWC/A	CR	CAT	D/E
E/L	1										
ROS	0.2268 [d]	1									
ROI	0.1558 [c]	0.8333 [d]	1								
QR	0.5489 [d]	0.1736 [d]	0.1732 [d]	1							
AT	−0.1679 [d]	−0.0082	0.2215 [d]	−0.0432	1						
DR	−0.6052 [d]	−0.3771 [d]	−0.4243 [d]	−0.4251 [d]	0.0892	1					
FL	−0.1113 [b]	−0.0606	−0.0880	−0.1048	−0.0330	0.2628 [d]	1				
NWC/A	0.2848 [d]	0.3731 [d]	0.3748 [d]	0.4677 [d]	0.0460	−0.6055 [d]	−0.2804 [d]	1			
CR	0.5670 [d]	0.1837 [c]	0.1418 [b]	0.9114 [d]	−0.1274 [a]	−0.5146 [d]	−0.1409 [b]	0.6284 [d]	1		
CAT	−0.0594	−0.1112 [a]	0.0529	−0.1343 [b]	0.6721 [d]	0.1215 [a]	0.0484	−0.3729 [d]	−0.2478 [d]	1	
D/E	−0.1086 [a]	−0.0528	−0.0830	−0.1024	−0.0284	0.2631 [d]	0.9980 [d]	−0.2788 [d]	−0.1381 [b]	0.0515	1

Note: [a], [b], [c], and [d] denote statistical significance at 10%, 5%, 1%, and 0.1% levels, respectively.

Although the KMO measure is close to the minimum value of 0.5 (KMO = 0.570), we verified the sampling adequacy for the analysis and it permits a preliminary investigation of the factors. Bartlett's test of sphericity (χ^2 (55) = 2850.250, $p < 0.001$) indicated that variables are not intercorrelated.

Next, we select a principal component solution with the minimum eigenvalue criterion of 1.0 for factor extraction, while Table 5 shows that the principal components analysis produced four factors meeting this criterion. The scree plot in Figure 2 also confirms this selection. In this figure, the eigenvalues are plotted against the factor number, with factor one being the first point on the *x*-axis. The resulting curve is used to judge the cut-off point by observing the angular changes in the slope [64].

Table 5. Eigenvalues.

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor 1	**3.8711**	1.9582	0.3519	0.3519
Factor 2	**1.9129**	0.0929	0.1739	0.5258
Factor 3	**1.8200**	0.4124	0.1655	0.6913
Factor 4	**1.4076**	0.5882	0.1280	0.8192
Factor 5	0.8194	0.2511	0.0745	0.8937
Factor 6	0.5683	0.2937	0.0517	0.9454
Factor 7	0.2746	0.1052	0.0250	0.9704
Factor 8	0.1694	0.0676	0.0154	0.9858
Factor 9	0.1018	0.0489	0.0093	0.9950
Factor 10	0.0529	0.0510	0.0048	0.9998
Factor 11	0.0019		0.0002	1

Note: Marked eigenvalues are higher than 1.0.

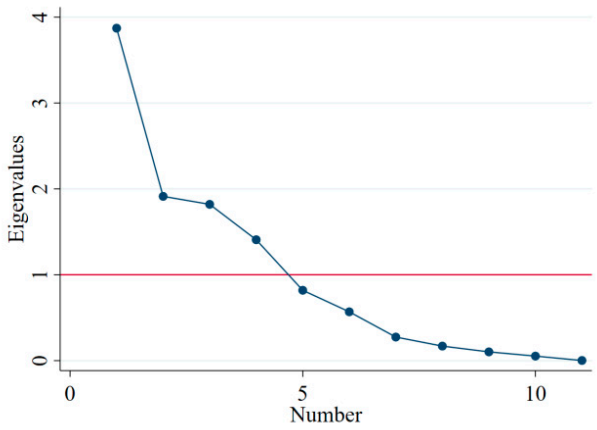

Figure 2. Scree plot.

Factor values have to be rotated in order to explain the solution set clearly [35,65,66]. In Table 6, factor loadings after varimax rotation represent the degree to which each of the financial indicators correlates with each of the factors.

Table 6. Factor loadings after varimax rotation.

Variable	Factor 1	Factor 2	Factor 3	Factor 4
E/L	**0.748781**	0.112240	0.034428	−0.045771
ROS	0.093536	**0.926614**	−0.004238	−0.082619
ROI	0.086565	**0.939693**	0.039352	0.147577
QR	**0.906875**	0.042029	0.017883	−0.003109
AT	−0.050905	0.127969	0.056484	**0.894689**
DR	**−0.614979**	−0.444085	−0.245355	0.082930
FL	−0.066312	−0.031874	**−0.990388**	−0.001757
NWC/A	**0.559429**	0.438856	0.288548	−0.186813
CR	**0.931262**	0.065504	0.071269	−0.129172
CAT	−0.109651	−0.070487	−0.053815	**0.920243**
D/E	−0.064453	−0.026275	**−0.991177**	0.002311
Expl. Var.	2.980915	2.173148	2.120997	1.736496
Prp. Totl.	0.270992	0.197559	0.192818	0.157863

Note: Marked loadings are higher than 0.5.

Our four factors explain 81.92% of the variance (see Table 7), and regarding the financial theory, these factors can be characterized as follows:

1. Factor of liquidity, which includes the equity to liabilities ratio, quick ratio, debt ratio, net working capital to assets ratio, and current ratio, describes items connected with cash management of the companies. Management of current assets and short-term financing are critical factors that affect the change in the state of net working capital, which is the generator of operating cash flow.
2. Factor of profitability is composed of return on sales and return on investments. It is an integral factor, which decomposes almost all factors and includes all business activities.
3. Factor of indebtedness is an important criterion for internal users, external entities, or potential investors. It is created by financial leverage, and debt to equity ratio. The variables quantify the creditworthiness of companies and provide information on the structure of the company's financial resources.
4. Factor of activity is formed of assets turnover, and current assets turnover. The factor is a reflection of the efficient use and management of the company's assets; specifically, how effectively the company is using its assets to generate sales.

Table 7. Factor analysis.

Factor	Variance	Difference	Proportion	Cumulative
Factor 1—Factor of liquidity	2.9809	0.8078	0.2710	0.2710
Factor 2—Factor of profitability	2.1732	0.0522	0.1976	0.4686
Factor 3—Factor of indebtedness	2.1210	0.3845	0.1928	0.6614
Factor 4—Factor of activity	1.7365		0.1579	0.8192

5. Discussion and Conclusions

Financial ratio analysis for individual companies from the given industry provides a means of obtaining an overview of the financial condition of the industry [35]. However, for each industry and each economy, we can specify different financial ratios that are fundamental for each area. The advantage of using traditional financial ratios in assessing the financial performance of the company is the relatively simple collection of data that are part of the mandatory financial statements.

This paper aimed to identify the groups of financial ratios that can be used to measure the financial performance of the companies operating in the Slovak MEI. Hypothesis 1 stated that financial ratios (indicators) of the non-financial companies of the Slovak MEI show common factors. In other words, we supposed that we could cluster some factors from the financial ratios of the non-financial companies operating in the Slovak MEI.

For the factor analysis, Kaiser Criterion (see [67]) suggests retaining those factors with eigenvalues equal to or higher than 1. Our analysis reveals, despite using limited but significant data, four independent factors that allow the measurement of liquidity, profitability, indebtedness, and activity of the company. These four factors account for 81.92% of the total variance. It means that we can confirm hypothesis 1.

In the Slovak theory of financial analysis, our resulting factors are used most often. All of them may influence the company's competitive position, technological, productive, and expansion decisions. As stated in [68], liquidity and profitability are vital to the existence and subsequent performance of a business. Liquidity ratios show the company's ability to meet liabilities. Sufficient liquidity creates opportunities to pursue valuable investment opportunities [69], which are crucial in the context of Industry 4.0. Profitability is an indicator of a company's ability to create new resources or make a profit. A company's profitability lies at the heart of industrial companies' strategic aims and can be improved by increasing revenues or reducing costs [70]. Profitability ratios are very volatile because companies cannot monitor and manage lots of indicators affecting them [71]. The third factor resulting from our analysis is factor of activity. Activity ratios show how efficiently the company is utilizing its assets. Adequate utilization is a requirement of a stable financial situation. A financial analyst has to be extremely prudent about the explanation of results because very high values can identify difficulties in the long term, and, on the other hand, very low values can identify a contemporary problem of not generating sufficient revenues "or of not taking a loss for assets that are obsolete" [71] (p. 34). Insufficient utilization is such that the company has too many assets, and is thus associated with above-average costs because the assets need to be protected and maintained, a large part of which is covered by credit, and the high level of assets requires a significant loan, which produces high interest rates. On the other hand, insufficient amount of assets results in low production volumes and the company loses the sales it could achieve. The factor of indebtedness is the last factor determined by our analysis. Indebtedness is an economic term that refers to the fact that a company uses foreign capital to finance its assets. The use of foreign capital affects the profitability of the company and the degree of business risk. Indebted companies may face the reluctance of external investors to fund new projects because the benefits largely accrue to existing creditors [72].

We can compare our results with several existing studies using factor analysis to group common financial ratios when assessing the financial situation of companies. The most used financial ratios are from the group of profitability, because this factor was extracted in [30,32,33,36–39]. In [32,35], several financial ratios were grouped in the liquidity factor and the activity factor. The indebtedness factor resulted only from the analysis of [32]. Although the names of the extracted factors differ among the existing studies, some financial ratios of our analysis were part of the factor analysis of those works. The most used is assets turnover [32,36–38], current ratio [34,35,37,38], quick ratio [34,35,38], debt ratio [34–36], ROS [30,32], ROI [30,39], current assets turnover [37], debt to equity ratio [34], and financial leverage [32]. Interestingly, in two cases [37,38], the opposite indicator to financial leverage was used, namely equity ratio calculated as equity to assets. We are not aware of the previous studies focused on industry, in which the equity to liabilities ratio and net working capital to assets ratio were used in the factor analysis. Total debt to total assets ratio (or debt ratio) was also used in the study concerning the detection of falsified financial statements in Greece [73], in the research that identifies the effect of capital structure on the performance of the Jordanian manufacturing sector [74], in determining the working capital requirements of the manufacturing firms listed on Karachi Stock Exchange [75], and in evaluating the financial performance of Indian textile companies [76]. The net working

capital to assets ratio was used in [73,76,77]. As we mentioned in Section 3.1, the equity to liabilities ratio is not used in evaluating the financial situation of foreign companies. However, this indicator is regulated by Act no. 513/1991 Coll. Commercial Code [49] of the Slovak Republic; therefore, it occurs mainly in Slovak studies, e.g., [78–84].

Exploration and evaluation of financial indicators helps to assess the overall business performance [85] as well as the economic sustainability of the company. It is important to note that economic sustainability can improve but not necessarily guarantee the overall sustainability of economic performance and growth [10].

It is important to objectively analyze the individual relationships between the development of groups of indicators resulting from the factor analysis and the various stages of the financial failures of the companies. The application of factor analysis should contribute to the multi-criteria concepts of business performance evaluation and management as well as efficiency in business practice.

This paper has several limitations because we do not consider all companies from the MEI, and we analyze only one year. Therefore, it would be interesting to repeat the analysis with more companies or for a different year. Besides that, we can consider the regional segmentation of companies and other qualitative data. Moreover, in addition to factor analysis, we suggest using data enveloped analysis and the multidimensional scaling method, by which it is possible to assess the economic effectiveness of decision-making units and aspects of business performance. The lack of prior research studies on using factor analysis in the MEI is another limitation. Specifically, for the Slovak industries, there are no research studies that apply factor analysis using financial ratios but analyses based on qualitative data about the company predominate.

Because the essence of the fourth industrial revolution is that mechanical manufacturing is based on digitization, which integrates all smart technologies to optimize operations and production methods [86], industrial companies should invest in new technologies to improve their competitive position. The current level of credit indebtedness and also the total indebtedness of the Slovak industrial enterprises still gives the possibility to use bank loans as a form of financing such investments. However, the problem may be that the cost of repaying loans or financial instruments will reduce the level of profit generation and profitability. Therefore, companies need to move to higher value-added production. On the one hand, this may reduce the level of competitive advantage in the short term, which in Slovakia is based mainly on lower labor costs. On the other hand, in the long run, the share of such newly created value in terms of the company's revenues may increase, which will bring increased profitability of investments in Industry 4.0. Another option is to use funding from the European Union.

The MEI plays a substantial part in driving energy efficiency, supplies lots of services to industry (e.g., producing and delivering electrical power, providing heating, ventilation or air-conditioning), and creates demand for energy [3]. If companies operating in this sector want to be able to provide these services to the highest standard, they need to have a sufficient amount of financial resources. Our analysis is an important prerequisite for developing a realistic financial plan for companies operating in the MEI. This paper provides an enrichment of quantitative methods, financial management, and several other areas at the micro and macro levels, which is significant because the analyzed second largest industry in terms of Slovak industrial production significantly contributes to the Slovak GDP.

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