Article

Sectoral Performance Trends and Differences in the Balkan and Eastern European Region

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Abstract: This article provides an empirical analysis aimed at evaluating the financial trends and disparities at the sector level within the Balkan and Eastern European region. The dataset encompasses a period of nine years and comprises more than 20 million firm-year observations from 24 industries in 21 countries. It uses 19 financial ratios to assess sectoral performance. In the empirical investigation, trend analysis and the two-step cluster analysis methods were used. Following the global financial crisis, a significant proportion of financial ratios exhibited favorable trends, indicating robust business and economic circumstances. Nevertheless, this trajectory was temporarily disrupted in 2020 due to the onset of the COVID-19 pandemic. By 2021, the financial ratios had reverted back to their historical patterns. Country membership, margin, liquidity, trade turnover, profitability, and leverage ratios are the most effective variables for explaining differences in sectoral performance. Sector membership is a comparatively less influential factor. Although this study effectively identified significant disparities in financial ratio profiles, it does not suggest that companies in the most developed countries in the region attain the most favorable financial performance. Stakeholders who have a vested interest in this region should carefully contemplate the ramifications of the findings from this study.

Keywords: sectoral performance; financial ratios; financial performance; emerging markets finance; two-step cluster analysis

1. Introduction

Research on financial performance in emerging markets has attracted a lot of attention lately (Cumming et al. 2021; Bhaskar and Bansal 2022). Such markets, acting as research subjects, have attracted an idiosyncratic approach to combine research on investment and corporate finance with fields of international economics, development economics, law, demographics, and political science (Bekaert and Harvey 2002). Although their corporate leverage rates have increased since 2010 amid favorable global financial conditions, emerging market firms have experienced significant economic growth and have consequently emerged as significant players in global business (Demirkan et al. 2019; Alter and Elekdag 2020). Inter alia, one of the most fascinating emerging economic regions to research is the Balkan and Eastern European countries (Ipsmiller and Dikova 2021). Any region's development is significantly influenced by its industrial cluster formation policy (Kuchiki 2021).

Financial ratios have historically served as measures of a company's overall performance, which can then be combined to represent sectoral performance at the level of economic sectors (Kliestik et al. 2020). Financial ratios can also be grouped according to different approaches (Kovacova et al. 2019; Amoa-Gyarteng 2021). Recent empirical research in various settings has shown that sector and country membership influence a company's stock market performance, with country membership having a greater impact than the sector (Vidal-Llana et al. 2023).

This study aims to analyze financial trends and differences at the sector level in the Balkan and Eastern European region. As a result, this article fits into the academic

literature as a comparative empirical study at the regional level, covering the behavior of corporate financial ratios at the sector level in the field of emerging markets finance. Three research hypotheses have been formulated to substantiate our empirical research, which are elaborated upon in Section 2.

Empirical research in this study encompasses the collection of data for non-financial firms located in the Balkan and Eastern European region. Within the framework of this article, the Balkan and Eastern European region incorporates twenty-one countries as follows: Albania (AL), Belarus (BY), Bosnia and Herzegovina (BA), Bulgaria (BG), Croatia (HR), Czechia (CZ), Estonia (EE), Greece (GR), Hungary (HU), Kosovo (KV), Latvia (LV), Lithuania (LT), Moldova (MD), Montenegro (ME), North Macedonia (MK), Poland (PL), Romania (RO), Serbia (RS), Slovakia (SK), Slovenia (SI), and Ukraine (UA). Although these countries belong geographically to a well-defined region, national historical and cultural factors, courses of economic development, and differences in respective political environments lead them to substantially differ from each other. This aspect also applies to the financial performance of companies and sectors in given countries. Based on our current understanding, prior empirical investigations examining the financial performance of emerging markets have not taken into account this particular group of countries as a distinct research entity when analyzing sector-level corporate financial ratios.

This article makes use of a large corporate finance dataset that spans from 2013 to 2021 to examine trends and regional differences in sectoral performance. More than 20 million firm-year observations have been retrieved and processed using nineteen financial ratios in order to evaluate the financial performance of twenty-one countries and twenty-four sectors. Financial performance trends have been evaluated by fitting trend functions to the time series evolution of aggregated financial ratios. The next step involved applying multivariate cluster analysis to investigate sectoral performance disparities. Since country and sector membership are categorical variables and financial ratios are continuous, the two-step cluster analysis was used to handle mixed data types.

According to empirical findings, financial performance in the region can differ significantly by country because it is highly dependent on the specific countries. The significance of variations in margin, liquidity, trade turnover, profitability, and leverage ratios through the application of diverse methodologies and financial ratios was next examined. Comparing sector membership to country and financial ratios, the former has a greater impact on clustering. The empirical research indicates that the corporate financial profile at the sector level in the least developed countries in the region is the least favorable. However, it is important to note that this observation does not apply to the more developed countries. Although this study effectively identified significant disparities in financial ratio profiles, it does not suggest that the companies in the most developed countries in the region attain the most favorable financial performance.

This article contributes to the body of knowledge on emerging markets finance by essentially serving as a novel benchmark empirical study in the field of sectoral performance research applied to the Balkan and Eastern European region. The region's investors, creditors, corporate finance experts, risk managers, and economic policy analysts ought to be cognizant of the implications arising from the empirical findings. Since data on emerging markets are becoming more readily available, they can serve as a practical basis for future studies of a similar nature that may be carried out for other emerging economies. Because of this, it might be easier to compare and evaluate their sectoral performance and gain more insight into the development trends and turning points in financial performance.

The arrangement of the article is as follows. A comprehensive review of the literature on the field's research trends is provided in Section 2. The details of variable specification, data preparation, data collection, and the applied statistical methodological approach are described in Section 3. Section 4 analyzes the data and delves into the empirical results, while Section 5 presents conclusions and suggests avenues for future research.

2. Literature Review

To investigate current scholarly discussions in the research field, a systematic literature search for scientific publications released between 2018 and 2023 was conducted in Crossref. The first thousand items were taken into consideration, with the following applied keywords used: "economic sectors", "industries", "financial performance", "financial ratios", "sectoral performance", and "competitiveness". It was decided to focus solely on journal articles as a first filter step. Thus, additional publication outlets were eliminated; consequently, 644 items from the original dataset were left. Articles that contained specific references to businesses, the financial or public sectors, or those that were limited in their focus to a single industrial sector were also eliminated in the second filtering step. Additionally, articles that did not seem to be cross-sectoral studies were excluded based solely on their titles. After a thorough selection process, thirty-eight items made the shortlist for further analysis. After these articles were processed further, it was discovered that some of them used a variety of different approaches (such as categorization into sectors of micro and small enterprises or listed companies) rather than defining research sectors in relation to industrial groupings. The final range of reviewed articles was narrowed down to twenty-five as a result of this process, and these are now being evaluated.

2.1. COVID-19-Related Publications in the Research Field

It is not surprising that empirical research on COVID-19 has been very active in recent years, with numerous articles demonstrating varying experiences in developed and emerging nations. For example, Muthu and Wesson (2023) discovered that cash-flow-related variables significantly affected performance levels and that COVID-19 generally had a severe negative impact on industrial sectoral performance in South Africa. Significant differences were found between the sectors after Oppusunggu et al. (2023) looked at market indicators and Wijayanto and Seno (2021) used multivariate analysis of variance (MANOVA) methods to study trends of sectoral performance in Indonesian business sectors, with a focus on COVID-19.

The effect of the COVID-19 pandemic on sectoral performance in Türkiye was assessed by Ataman et al. (2022). Of the twenty-two sectors that were examined, ten showed a negative impact, and twelve showed a positive impact. Similar differences were discovered in important Indian sectors by Suman et al. (2022), who also identified the sectors that recovered more successfully than the others. Huynh et al. (2021) examined the divergent effects of COVID-19 on Australian businesses' sectoral stock returns across a range of industries. The findings showed that sectors of the economy that received government funding were either insulated from the pandemic or had less of an impact.

Priya and Sharma (2023) looked into how economic disruption affected sectoral volatility in India using a variety of conditional volatility approaches.

2.2. Financial Performance-Related Publications in the Field

In certain empirical research, return on equity (ROE) and return on assets (ROA) ratios were used to measure and predict sectoral financial performance. The financial performance of industrial sectors in the Visegrad Four countries of Eastern Europe was researched by Kristóf and Virág (2022), who considered several financial ratios and machine learning techniques. It was determined that the ratios of leverage, turnover, and income margin were the best predictors. After analyzing the financial performance of Saudi Arabian companies in the manufacturing and insurance sectors, Rahman and Sharma (2020) came to the conclusion that size, leverage, operating cash flow, and industrial membership had a significant impact on financial performance. The best predictor ratios were cash turnover, asset turnover, and current ratio, according to Kurniawandi's (2021) research on the drivers of market book value (MBV) and return on assets (ROA) in three Indonesian sectors. Similar research by Wira (2021) showed that net profit margins, accounts receivable turnover rates, and debt ratios all significantly impacted firm value.

The experience of empirical research in China demonstrated the significance of debt maturity and leverage in determining financial performance (Vijayakumaran and Vijayakumaran 2019). Furthermore, Manimannan and Lakshmi (2020) employed the k-means clustering method to identify sectoral performance differences according to fourteen financial ratios by forming five major sector groups from Indian industries.

Konar and Atmaca (2020) made an effort to rank and evaluate the financial performance of companies from three sectors that were listed on the Istanbul Stock Exchange by using different multi-criteria decision making (MCDM) techniques. The results showed that different rankings were obtained by applying the specified methods. Similar research was done for Egypt's manufacturing sectors, but the ranking methods showed no discernible differences (Abdel-Basset et al. 2020). In order to efficiently create a dynamic taxonomy in this context, Skoczylas and Batóg (2019) also presented a dynamic approach to measure and compare financial performance across sectors in Poland.

2.3. Novel Research Trends and Dissemination of Non-Financial Ratios

Studies pertaining to environmental, social, and governance (ESG) have been published much more frequently in recent years. Anqi and San (2022) conducted a study on heavy polluting industries in China and discovered that environmental performance had a positive impact on financial performance that went beyond the effects of revenue growth and company size. The relationship between environmental and financial performance was positively impacted by the proportion of female board members but negatively impacted by the total number of committees. After examining how audit committee characteristics affected ROA and Tobin's Q measures in Omani non-financial sectors, Shamsuddin and Alshahri (2022) came to the conclusion that corporate governance mechanisms needed to be improved in order to improve performance.

Vietnamese experience showed that auditors, supervisory size, and company size all significantly and negatively impacted performance (Dao and Ngo 2020). On the other hand, Pakistani empirical findings showed that social and financial performance were positively correlated (Shabbir et al. 2020). Moreover, research has shown that corporate social responsibility can help businesses become more resilient to adversity (Singh and Hong 2023).

In order to explain sectoral advancement in Nigeria, Tabash et al. (2022) and Omotola and Bank-Ola (2022) employed macroeconomic indicators as proxies of financial deepening. From this analysis, they derived recommendations for enhancing sectoral performance. Using S&P500 company data over a sizable historical period, VanderPal (2019) investigated the relationship between research and development (R&D) expenses and financial performance. Significant sectorial variance was found in this study with reference to this specific relationship.

2.4. Summary of the Literature Review and Hypothesis Formulation

Based on these results, it can be argued that since 2018, the majority of empirical studies have focused on the effects of COVID-19 on sectoral performance, optimizing statistical methods that had previously been used, identifying a range of relevant predictors, the emergence of ESG factors (mainly connected to corporate social responsibility), and the incorporation of macroeconomic and market indicators in applied research.

However, most studies were based on a limited number of observed sectors and companies; thus, typically a few thousand or a few hundred observations and multivariate clustering techniques were relatively underrepresented. Therefore, it is reasonable to conduct a novel empirical research exercise with a more extensive data background, indicating a research gap. Given that such data available to this extent are applied through traditional corporate financial ratios, our empirical research project utilizes these variables.

The following hypotheses have thus been formulated to support our empirical research:

H1: *COVID-19 severely negatively influenced all financial ratios in the Balkan and Eastern European region in 2020.*

H2: *Country and sector classifications sufficiently explain differences in sector-level financial performance in the Balkan and Eastern European region.*

H3: *The variations in sectoral performance in the Balkan and Eastern European region can be adequately elucidated by leverage, profitability, liquidity, and margin indicators.*

3. Materials and Methods

3.1. Data Collection and Analysis

Financial data for Balkan and Eastern European companies were available in Moody's Analytics Orbis database. The data collection period encompassed 2013 to 2021, with solely the financial records of active companies being taken into account. No restriction on company size was imposed.

Companies with registrations in Türkiye and the Russian Federation were excluded from this analysis. Although both countries are, to varying extents, geographically located in the Balkan peninsula and Eastern Europe, it would not have been possible to determine the exact geographical location of companies registered in either country, as they may, for instance, operate in Anatolia, Central Asia, or the Far East. Table 1 presents an analysis of the financial data collected by country. A grand total of 20,832,825 legitimate firm-year observations (corporate data records) were gathered.

Table 1. Country breakdown of corporate financial data.

Country	Available Corporate Financial Data									
	2013	2014	2015	2016	2017	2018	2019	2020	2021	Total
AL	90	257	251	218	196	1147	6866	7517	5504	22,046
BA	19,954	20,264	21,072	20,475	18,744	18,102	17,410	18,730	18,013	172,764
BG	225,422	241,147	257,229	270,427	285,723	298,340	304,499	308,263	313,644	2,504,694
BY	1523	1621	1646	1511	1552	1687	2568	1384	12,587	26,079
CZ	118,531	119,317	129,230	141,541	143,282	139,564	127,664	115,469	126,650	1,161,248
EE	75,504	83,748	97,735	108,780	118,461	129,165	137,215	145,158	141,839	1,037,605
GR	25,868	28,177	29,175	30,857	33,840	35,900	36,184	34,363	8258	262,622
HR	55,273	65,189	74,910	80,867	88,984	97,351	101,988	111,117	108,438	784,117
HU	219,342	234,312	251,101	264,049	276,913	289,914	289,871	318,273	329,863	2,473,638
KV	153	231	263	299	332	317	171	281	269	2316
LT	9052	9658	9514	10,861	12,519	19,202	63,977	69,629	71,463	275,875
LV	49,042	53,532	59,000	63,606	67,786	70,968	74,132	78,124	37,343	553,533
MD	438	392	338	270	4886	4957	4895	5287	5540	27,003
ME	1262	8977	10,525	10,633	10,148	10,273	10,651	10,760	10,253	83,482
MK	30,756	34,558	38,871	40,005	42,200	43,986	44,317	46,977	47,034	368,704
PL	81,129	90,544	101,433	97,168	184,337	204,845	213,586	222,910	221,814	1,417,766
RO	360,312	378,707	425,768	455,789	496,722	530,944	559,552	619,823	656,423	4,484,040
RS	59,285	51,248	51,866	68,705	87,843	91,913	162,493	173,950	167,288	914,591
SI	63,202	69,690	73,397	74,408	78,988	83,276	83,608	91,462	93,410	711,441
SK	119,801	135,486	147,006	158,714	169,692	178,089	182,432	196,483	203,881	1,491,584
UA	235,244	218,279	232,361	240,523	255,308	269,072	263,251	322,866	20,773	2,057,677
Total	1,753,196	1,847,348	2,014,706	2,141,722	2,380,473	2,521,030	2,689,349	2,900,846	2,602,308	20,832,825

The number of firm-year observations per country that were obtained from Moody's Analytics Orbis and used in this study is shown in Table 1.

The picture of financial data accessibility is not uniform. While corporate financial data from more developed nations are more thoroughly compiled and arranged in Moody's Analytics database, access to data is more challenging in other countries (like Albania, Belarus, Kosovo, and Moldova). Furthermore, it is evident that the quantity of data that was available grew annually, with the exception of 2021, when data availability in Ukraine

sharply declined. Reduced data accessibility may also result from the conflict between Russia and Ukraine, which broke out in February 2022.

The Bureau van Dijk (BVD) sector classification method was applied in order to provide sectoral analysis. When it was unclear which industry the downloaded records belonged to, they were discarded. This practice was also applied to companies in the "Banking, Insurance & Financial Services" and "Public Administration, Education, Health, Social Services" sectors because the different financial ratios applied to these sectors have different business meanings (which were already filtered out before the completion of Table 1).

There were only a few companies in each of the four information-technology (IT)-related sectors: "Communications", "Computer Hardware", "Computer Software", and "Information Services". These were later combined into an aggregated sector called "Information Technology and Communications". The financial data analysis breakdown by aggregated sector is presented in Table 2.

Table 2. Sectoral breakdown of corporate financial data.

Sector	Available Corporate Financial Data									
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**Total**
Agriculture, Horticulture & Livestock	91,339	95,882	102,326	106,116	115,249	119,302	117,827	125,402	87,882	961,325
Biotechnology and Life Sciences	5533	5686	6136	6462	7342	7726	7968	8723	7211	62,787
Business Services	342,224	365,080	398,559	429,240	483,108	514,154	553,554	612,371	557,676	4,255,966
Chemicals, Petroleum, Rubber & Plastic	18,678	19,295	20,584	21,357	23,480	24,384	25,160	26,900	22,327	202,165
Construction	163,661	172,015	190,127	205,395	233,639	252,895	271,890	298,650	282,747	2,071,019
Food & Tobacco Manufacturing	31,672	33,710	36,595	39,002	44,243	46,942	51,855	55,534	48,441	387,994
Industrial, Electric & Electronic Machinery	26,145	27,267	28,767	30,215	32,891	34,224	34,885	36,761	32,023	283,178
Information Technology and Communications	47,182	51,198	56,901	62,649	73,543	80,740	87,481	97,582	93,959	651,235
Leather, Stone, Clay & Glass products	10,539	10,882	11,558	11,910	13,062	13,603	14,389	15,373	12,377	113,693
Media & Broadcasting	13,886	14,895	16,459	17,902	21,039	22,842	24,387	26,254	24,186	181,850
Metals & Metal Products	33,693	35,515	37,841	40,163	44,168	46,765	48,758	51,934	47,661	386,498
Mining & Extraction	4690	4726	5076	5233	5760	5984	6076	6505	4884	48,934
Miscellaneous Manufacturing	4764	4973	5491	5931	6840	7382	8615	9259	8749	62,004
Printing & Publishing	18,556	19,199	20,218	20,849	22,675	23,335	23,981	25,095	20,889	194,797
Property Services	134,334	136,468	153,545	158,439	175,570	185,620	191,145	203,781	177,470	1,516,372
Retail	224,560	234,493	251,052	262,142	280,845	287,918	311,458	325,214	307,022	2,484,704
Textiles & Clothing Manufacturing	19,112	20,108	21,564	22,644	25,156	26,574	28,743	30,067	26,785	220,753
Transport Manufacturing	4442	4719	5153	5421	6052	6478	6705	7134	6270	52,374
Transport, Freight & Storage	96,688	104,458	114,924	125,216	140,654	150,899	163,496	178,428	167,056	1,241,819
Travel, Personal & Leisure	143,297	156,146	175,511	190,824	216,499	236,006	269,727	282,691	267,548	1,938,249
Utilities	14,712	15,408	16,942	17,446	20,281	21,454	22,893	26,627	22,840	178,603
Waste Management & Treatment	7350	7723	8427	8810	9985	10,439	10,613	11,341	9863	84,551
Wholesale	261,907	271,494	292,790	308,495	334,729	349,308	358,551	386,223	318,898	2,882,395
Wood, Furniture & Paper Manufacturing	32,219	33,994	36,145	37,845	41,646	44,038	47,173	50,977	45,523	369,560
Total	1,751,183	1,845,334	2,012,691	2,139,706	2,378,456	2,519,012	2,687,330	2,898,826	2,600,287	20,832,825

The sectoral breakdown of firm-year observations taken from Moody's Analytics Orbis is examined in Table 2. The Business Services sector had the greatest number of available corporate records, followed by the Wholesale and Retail sectors.

3.2. Variable Specification

The study's financial ratios are compliant with good practice in corporate finance. Nineteen financial ratios were considered in order to include indicators of profitability, margin, liquidity, capital structure, leverage, indebtedness, turnover, and efficiency. Table 3 compiles the definitions of the financial ratios.

Table 3. Definition of financial ratios.

Financial Ratio	Calculation Formula	References
ROA using Net income %	(Net income/Total assets) × 100	Kurniawandi (2021)
ROE using Net income %	(Net income/Shareholders' funds) × 100	Manimannan and Lakshmi (2020)
Profit margin %	(Profit (loss) before tax/Turnover) × 100	Wira (2021)
Gross margin %	(Gross profit/Turnover) × 100	Kristóf and Virág (2022)
EBIT margin %	(Operating profit/Turnover) × 100	Vijayakumaran and Vijayakumaran (2019)
EBITDA margin %	((Operating profit + Depreciation + Total amortization and impairment)/Turnover) × 100	Kristóf and Virág (2022)
Cash flow/Operating revenue %	((Net income + Depreciation + Total amortization and impairment)/Turnover) × 100	Muthu and Wesson (2023)
Net assets turnover	Turnover/Total assets less Current liabilities	Wira (2021)
Interest cover	Profit (loss) before interest/Interest paid	Kliestik et al. (2020)
Stock turnover	Turnover/Stock and work in progress	Kovacova et al. (2019)
Collection period days	(Trade debtors/Turnover) × 365	Wira (2021)
Credit period days	(Trade creditors/Turnover) × 365	Kristóf and Virág (2022)
Current ratio	Current assets/Current liabilities	Kurniawandi (2021)
Liquidity ratio	(Current assets − Stock and work in progress)/Current liabilities	Muthu and Wesson (2023)
Shareholders liquidity ratio	Shareholders' funds/Long-term liabilities	Kliestik et al. (2020)
Solvency ratio assets based %	(Shareholders' funds/Total assets) × 100	Manimannan and Lakshmi (2020)
Solvency ratio liability based %	(Shareholders' funds/Liabilities) × 100	Rahman and Sharma (2020)
Gearing %	((Short-term loans and overdrafts + Long-term liabilities)/Shareholders' funds) × 100	Kristóf and Virág (2022)
Cost of employees/Operating revenue %	(Remuneration/Turnover) × 100	Kristóf and Virág (2022)

The computation formulas for the financial ratios used in this study are shown in Table 3. These ratios, which express financial performance from various angles, are frequently used in corporate financial analysis.

3.3. Data Preparation and Aggregation

Financial ratio means were then determined for each year's sectors within each country. Twenty-one countries, twenty-four sectors, and a nine-year observation period were taken into account, yielding an aggregated unit of observation of 4536 records. Financial ratio means were computed without considering company-level missing values per year, country, sector, or financial ratio values.

Nevertheless, in some years, despite the enormous volume of data, there was absolutely no data available for specific sectors in particular countries for certain financial ratios. Imputation based on nearest neighbors was used to solve this problem. The country with the closest overall financial ratio mean for the year under review was the closest neighbor, as opposed to the nation with a missing value for a particular sector during the year under review.

3.4. Applied Multivariate Cluster Analysis Method

Because mixed feature types were prevalent, exploratory data analysis could not be conducted using traditional k-means cluster analysis. In order to handle both continuous and categorical variables, this study used two-step cluster analysis (TSCA) (Rundle-Thiele et al. 2015). TSCA is widely used to find patterns in a set of input variables by clustering records so that those in one group are more likely to be similar to one another than those in other groups (Popa et al. 2022). The two processes are pre-clustering and clustering, in that order.

During the pre-clustering phase, all records were examined, and their log-likelihood distances were measured to determine whether they could reasonably form pre-clusters based on the preset threshold criteria. The reduction in log-likelihood as two clusters merge to form a single cluster is correlated with the distance between them (Li and Sun 2011). The distance between the two clusters, *j* and *i*, assuming they exist, can be expressed as follows:

$$d(j,i) = \varepsilon_j + \varepsilon_i - \varepsilon_{<j,i>} \qquad (1)$$

where

$$\varepsilon_j = -N_j \left[\sum_{k=1}^{K^A} \frac{\log\left(\sigma_k^2 + \sigma_{jk}^2\right)}{2} + \sum_{k=1}^{K^B} E_{jk} \right] \tag{2}$$

$$E_{jk} = -\sum_{l=1}^{L_k} \frac{N_{jkl}}{N_j} log \frac{N_{jkl}}{N_j} \tag{3}$$

In which $d(j,i)$ denotes the distance between clusters j and i, $<j,i>$ is the index representing the combination of clusters j and i. N_j is the number of records in cluster j, K^A is the number of considered continuous variables, K^B is the number of considered categorical variables, σ_k^2 is the variance of the k-th continuous variable in the original dataset, σ_{jk}^2 is the variance of the k-th continuous variable in cluster j, L_k is the number of categories for the k-th categorical variable, N_{jkl} is the number of records in cluster j, of which the k-th categorical variable takes the l-th level.

In the second phase, the formulated pre-clusters were integrated into the optimal number of clusters using a hierarchical algorithm to satisfy the minimum distance in (1). If a desired cluster number could not be predicted in advance, Schwarz's Bayesian information criterion (*BIC*) automatically determines the optimal number of clusters using the following formula (Harantová et al. 2023):

$$BIC(J) = -2\sum_{j=1}^{J} \varepsilon_j + m_J \log(N) \tag{4}$$

where J is the number of clusters, K is the total number of continuous variable clusters, N is the total number of records, $m_J = 2KJ$.

4. Results and Discussion

4.1. Results of Sectoral Performance Trend Analysis

Trends in sectoral performance can be evaluated by examining the evolution of the financial ratio means for the region (Table 4). Beginning in 2013, financial ratios improved across the board, pointing to an important general trend: the effects of the previous global financial crisis had diminished, and substantial progress had been made. Furthermore, patterns in the data indicate that COVID-19 contributed to this trend's brief decline in 2020, especially in terms of profitability, margin, and solvency ratios. By 2021, financial ratio means, however, began to further strengthen the trend and advance. It should be noted that this study only included active companies. The COVID-19 pandemic may have claimed the lives of companies that were dissolved, liquidated, or declared bankrupt; however, there was insufficient data to include these companies in the study. Moreover, it is probable that these businesses faced more significant problems during the COVID-19 pandemic than trying to provide official data collection agencies with financial information.

The financial ratio trend analysis is shown in Appendix A. The logarithmic, polynomial, exponential, and linear trend functions can be used to effectively estimate the financial ratio time-series. The best fitting curve was selected for each ratio, and the trend fit was evaluated using the R-squared statistical measure.

It is important to keep in mind that the evolution of financial ratio means was examined using bottom-up average computations from particular corporate records. Consequently, countries that had access to more corporate data contributed more to the total numbers than those that had fewer observations. However, each country was given equal weight when clusters were created in the sectoral performance difference analysis that is subsequently presented because, in contrast, the sectoral average financial ratios for each country and year were formed by aggregating observations.

Table 4. Evolution of financial ratio means for the Balkan and Eastern European region.

Financial Ratio	2013	2014	2015	2016	2017	2018	2019	2020	2021
ROA using Net income %	3.967	4.618	6.264	7.715	7.972	8.555	9.416	7.778	9.822
ROE using Net income %	10.813	11.851	15.766	19.032	21.008	21.588	22.737	21.839	24.442
Profit margin %	6.886	8.445	8.875	9.980	10.081	10.725	11.794	10.727	12.999
Gross margin %	34.163	38.395	40.797	42.786	43.965	44.559	46.465	43.051	47.136
EBIT margin %	6.444	8.013	9.592	10.590	10.707	11.253	11.598	11.348	12.195
EBITDA margin %	11.647	12.554	13.935	14.613	14.389	14.966	15.389	15.129	16.790
Cash flow/Operating revenue %	8.258	9.193	10.640	11.456	11.564	12.313	12.663	12.239	13.824
Net assets turnover	9.364	9.497	8.909	8.834	8.888	8.819	9.148	8.862	9.299
Interest cover	36.635	33.131	36.807	41.070	41.050	41.977	43.122	44.135	47.828
Stock turnover	38.727	38.932	47.390	41.687	42.041	43.587	45.542	44.317	42.349
Collection period days	72.588	75.877	67.996	65.305	66.555	65.827	64.977	67.554	67.308
Credit period days	51.889	49.105	45.874	44.500	45.221	43.914	44.247	47.884	46.365
Current ratio	4.797	4.906	5.168	5.460	5.481	5.776	6.054	6.136	6.303
Liquidity ratio	3.782	3.898	4.135	4.276	4.375	4.565	4.838	5.029	5.276
Shareholders liquidity ratio	25.048	23.483	26.287	24.858	24.860	25.009	24.411	22.303	23.570
Solvency ratio assets based %	43.633	44.447	45.917	46.781	47.820	51.401	52.181	49.615	51.961
Solvency ratio liability based %	36.427	36.975	37.307	37.293	37.389	37.561	37.789	36.599	37.671
Gearing %	44.444	42.725	42.372	41.029	42.036	42.169	42.031	41.739	41.944
Cost of employees/Operating revenue %	22.176	22.224	22.213	22.889	23.439	23.778	24.395	25.605	24.704

Table 4 examines average financial ratio values at the regional level from 2013 to 2021. Table 3 displays the financial ratios' calculation formulas.

4.2. Results of Sectoral Performance Difference Analysis

The log-likelihood distance measure was employed in conjunction with the BIC method to select variables and establish clusters. Cluster solutions ranging from two to six were considered. Ultimately, it was discovered that a three-cluster solution struck the best balance between the cohesiveness of the model and the number of clusters.

Since the shareholder liquidity ratio did not meet the adaptive feature selection criteria, it demonstrated little to no potential to improve the model's overall goodness. As such, this variable was left out of any further analysis. The distribution of observations within the created clusters is shown in Table 5.
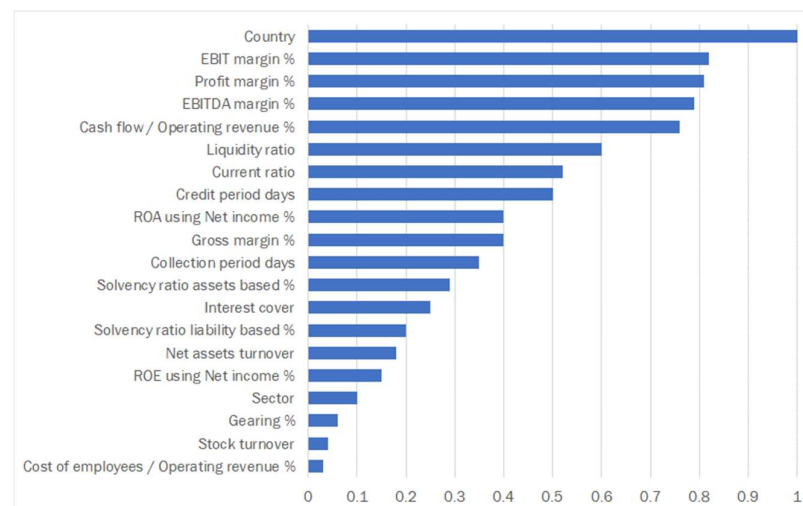
Table 5. The main features of the clusters.

Cluster	Number of Records	Share of Cluster (Percent)	Cluster Cohesion *
Cluster-1	1822	0.40	0.73
Cluster-2	1240	0.27	0.52
Cluster-3	1474	0.33	1.00

* 0.0 to 0.2 Poor | 0.2 to 0.6 Fair | 0.6 to 1.0 Good.

The 2542.0 chi-squared statistics with $p = 0.000$, which resulted from the chi-squared testing of the cluster formulation, demonstrated significant clustering. Each variable was assessed for its significance in relation to cluster formation using normalized across-cluster feature importance statistics. In Figure 1, the clustering variables of the study are ranked. The results indicate that country classification forms the strongest clustering variable, followed by four margin indicators (Cash flow/Operating revenue is also regarded as a margin variable), the two liquidity indicators, and the credit period. The feature importance of the other variables is less than 0.5. It is also noteworthy that the formation of clusters is largely unaffected by sector classification.

Based on the ranking of input variables according to the significance of within-cluster features, cluster profiles can be created. The traits of the three clusters are summed up as follows based on the strongest feature importance statistics.

Figure 1. Across-cluster feature importance values. Figure 1 shows the rank of across-cluster feature importance when formulating clusters. This represents the importance of an input variable to the overall clustering solution. The calculation formulas of the financial ratios are located in Table 3.

Belarus, Montenegro, Kosovo, Bosnia and Herzegovina, Serbia, Albania, and Moldova have significantly overrepresented sectoral average financial ratios in Cluster-1. The highest within-cluster feature importance values are assigned to the credit period (0.63), profit margin (0.52), and EBIT margin (0.51), after the country classification (1.00). Sector membership is not important within this cluster. Thus, compared to the other clusters, Cluster-1 exhibits less favorable profitability and income margin indicators, lower liquidity, longer credit and collection periods, the highest leverage, and significantly lower interest cover. Nonetheless, compared to Cluster-2, gross margin and the ability to generate cash flow from operating revenue are more accurately represented. The lowest net asset and stock turnover period is observed in this cluster. The average sector-level financial ratios for each of the three clusters are shown in Table 6.

Table 6. Sector-level financial ratio means in the three clusters.

Financial Ratio	Cluster-1	Cluster-2	Cluster-3
ROA using Net income %	3.707	4.804	8.800
ROE using Net income %	12.939	16.978	21.664
Profit margin %	3.928	4.633	12.621
Gross margin %	39.090	34.343	55.858
EBIT margin %	4.087	4.808	13.085
EBITDA margin %	7.799	8.031	19.535
Cash flow/Operating revenue %	6.818	6.316	16.957
Net assets turnover	5.077	8.242	5.292
Interest cover	27.495	38.252	44.525
Stock turnover	39.438	50.398	57.633
Collection period days	119.145	60.740	71.583
Credit period days	99.315	54.886	49.894
Current ratio	2.987	4.286	6.358
Liquidity ratio	2.196	3.237	5.358
Solvency ratio assets based %	43.660	45.640	55.004
Solvency ratio liability based %	41.266	39.307	40.046
Gearing %	64.889	54.511	50.549
Cost of employees/Operating revenue %	26.718	22.777	25.849

The sector-level financial ratio means in each of the three clusters are assessed in Table 6. Interpreting the cluster profiles requires consideration of differences between financial ratio means in addition to the significance of within-cluster features. Table 3 contains the financial ratios' calculation formulas.

Sectoral average financial ratios from Latvia, Czechia, Ukraine, Poland, Slovakia, and Lithuania make up the majority of Cluster-2. Once again, the highest within-cluster feature importance in this instance is country classification (1.00), followed by cash flow/operating revenue (0.63), EBIT margin (0.60), EBITDA margin (0.57), profit margin (0.55), collection period (0.53), and credit period (0.52). Indicators of profitability, profit margin, liquidity, gearing, stock turnover, and interest cover are all higher in Cluster-2 than in Cluster-1, but they are lower than in Cluster-3. The best collection period and the most advantageous cost of employee efficiency indicators are found in this cluster. The net assets turnover period is by far the longest among the clusters, but gross margin, the ratio of shareholders' funds to liabilities, and the ability to generate cash flow from operating revenue all lag behind the other two.

Sectoral average financial ratios from Estonia, Romania, Slovenia, Hungary, Bulgaria, and North Macedonia are somewhat overrepresented in Cluster-3. The highest within-cluster feature importance in this instance is the EBIT margin (1.00), which is followed by the profit margin (0.99), the EBITDA margin (0.98), the cash flow/operating revenue (0.92), the country classification (0.58), and the liquidity ratio (0.55). Cluster-3 unequivocally shows the best profitability, margin, liquidity, and leverage profiles among the clusters. In contrast to Cluster-2, the indicators for asset turnover, collection time, shareholders' funds to liabilities, and employee cost efficiency are somewhat less favorable. In Cluster-3, the stock turnover period is the best among the clusters.

The financial ratios from Greece and Croatia are unclear in this research because it is difficult to categorize them into one of the three clusters. Although there are more Greek and Croatian observations in Cluster-1, which is the largest cluster a priori, it is impossible to determine which country group their sectoral financial performance is most similar to.

5. Conclusions

An identified research gap in the academic literature led to the decision to conduct this empirical study, since the majority of studies in the field of assessing sectoral performance in emerging markets concentrated on a relatively small number of observed sectors, companies, and countries. Moreover, in this field of study, multivariate clustering techniques have not been used as much in recent years. This served as the foundation for a thorough data collection effort that explored trends and variations in sectoral performance, as indicated by widely used financial ratios in corporate finance for twenty-one Balkan and Eastern European nations. Clusters were created using the TSCA method to handle mixed data types.

5.1. Results of Examining H1

H1 posited that the COVID-19 pandemic severely negatively influenced all financial ratios in the Balkan and Eastern European region in 2020. The study's conclusions lend credence to the idea that, as a whole, companies in the Balkan and Eastern European region saw an improvement in their financial performance between 2013 and 2021. Following the previous global financial crisis, the region enjoyed advantageous business and economic conditions, as evidenced by the majority of financial ratios that exhibit positive trends. The COVID-19 pandemic in 2020 appears to have caused a brief halt to the trends shown in Appendix A. This is especially notable in the case of profitability, margin, trade turnover, solvency, and leverage ratios, as also demonstrated by prior empirical studies inter alia, Muthu and Wesson (2023), Suman et al. (2022), and Wijayanto and Seno (2021).

However, the unfavorable impact of COVID-19 cannot be reported for stock turnover, interest cover, liquidity, and current ratios. The findings of this study indicate that the assumption made in H1, which posited that COVID-19 had a substantial adverse effect on all financial ratios in the region during 2020, was not supported. Consequently, H1 is rejected. Nevertheless, as results demonstrate, by 2021, financial ratios had returned to their historical trends.

5.2. Results of Examining H2

H2 investigated whether country and sector membership sufficiently explain differences in financial performance at the sector level in the Balkan and Eastern European region.

With a 100% normalized across-cluster feature importance, the country factor formed the strongest clustering variable according to sectoral performance difference analysis. It is interesting to note that, after country classification, four margin ratios were found to be the next most crucial variables for cluster creation.

Regarding sectoral performance, the three clusters exhibit notably disparate financial profiles across the region. Cluster-3 is generally considered to be the most favorable, followed by Cluster-2 and Cluster-1. Nineteen countries could be assigned to the clusters based on the relative overrepresentation of those countries in the clusters. However, because of the differences in the quality of their financial ratio profiles, Greece and Croatia could not be represented. Thus, it can be concluded that during the study period, both countries concurrently had more and less favorable sector-level financial ratios.

In relation to sector membership, the variable satisfied the criteria for adaptive feature selection based on the log-likelihood distance measure when choosing variables for cluster formation. However, the normalized across-cluster feature importance of the variable was found to be 10%, suggesting a relatively limited potential for enhancing the overall quality of the model.

The aforementioned findings indicate that country and sector membership are considered important factors that impact the financial performance at the sector level. As a result, H2 is accepted. The finding that country membership has a more significant influence than sector membership aligns with the previous research conducted by Vidal-Llana et al. (2023).

5.3. Results of Examining H3

H3 assumed that the variations in sectoral performance in the Balkan and Eastern European region can be adequately elucidated by leverage, profitability, liquidity, and margin indicators.

The findings indicate that the four margin ratios, as observed in the financial ratios, exhibited statistical significance and displayed the highest normalized across-cluster feature importance in the process of cluster formation. In a prior study, Kristóf and Virág (2022) obtained comparable findings within a narrower scope of analyzed time periods and nations. The ability and efficiency to achieve EBIT, profit, EBITDA, and cash flow from revenue are crucial factors in explaining the variance between sectoral financial ratio means and are the critical factors in performance differences. This characteristic is particularly prominent in Cluster-3, as depicted in Table 6.

The two traditional liquidity ratios follow the importance of margin ratios, emphasizing the necessity of possessing adequate current assets to meet short-term liabilities. The significance of these ratios has been acknowledged in several previous studies, including those conducted by Kurniawandi (2021) and Muthu and Wesson (2023).

The subsequent factors to consider are trade turnover, profitability, gross margin, and leverage ratios. The significance of their findings aligns with previous research conducted by Manimannan and Lakshmi (2020), Rahman and Sharma (2020), and Wira (2021), among others.

Based on the aforementioned narrative, the acceptance of H3 is justified due to the effective elucidation of variations in sectoral performance in the Balkan and Eastern European region through the utilization of leverage, profitability, liquidity, and margin indicators.

5.4. Implications

The findings indicate that, overall, a company's country membership is a more influential factor than its sector membership when evaluating financial performance. However, it is important to acknowledge and measure the significant variations at the company level in order to better predict important dependencies in specific countries or sectors.

The findings reveal significant disparities in the financial conduct of the businesses and economic sectors in the region. Margin, liquidity, profitability, and leverage account for a substantial amount of variation. However, the situation is not that clear when considering other variables that are considered less important.

The empirical research unequivocally demonstrates that the sector-level corporate financial profile of the least developed countries in the region (Belarus, Montenegro, Kosovo, Bosnia and Herzegovina, Serbia, Albania, and Moldova) is the least favorable, as indicated by the most significant variables (refer to Cluster-1). Nevertheless, this observation does not hold true for the countries that are more developed, as evidenced by Cluster-2 and Cluster-3. While this research successfully identified notable disparities in financial ratio profiles, it does not imply that companies in the most developed countries in the region achieve the most favorable financial performance.

Investors, creditors, corporate finance experts, risk managers, and economic policy analysts with an interest in the Balkan and Eastern European region should consider the implications of this study's findings. When it comes to sectoral performance and corporate financial effectiveness, this study can also be used as a benchmark study by policymakers in emerging markets. This makes the paper a noteworthy addition to the field of emerging markets finance research.

5.5. Limitations and Future Research Directions

A limitation of this study is that the financial ratios analyzed could not account for the actual impacts of the Russia–Ukraine war, the subsequent sanctions, or the subsequent energy and inflation crisis. A possible further limitation is the relatively limited accessibility of data from certain countries; ideally, this will improve in the future. One additional constraint of the study is the potential for bias in the results, which may arise from unobserved variables that could impact financial performance at the sector level. This limitation persists, despite the inclusion of a substantial number of observations and variables in the empirical research.

Potential avenues for future research in this particular field involve expanding the duration for data collection, exploring supplementary financial ratios, broadening the scope of countries under investigation, developing innovative research inquiries, and implementing diverse research methodologies.
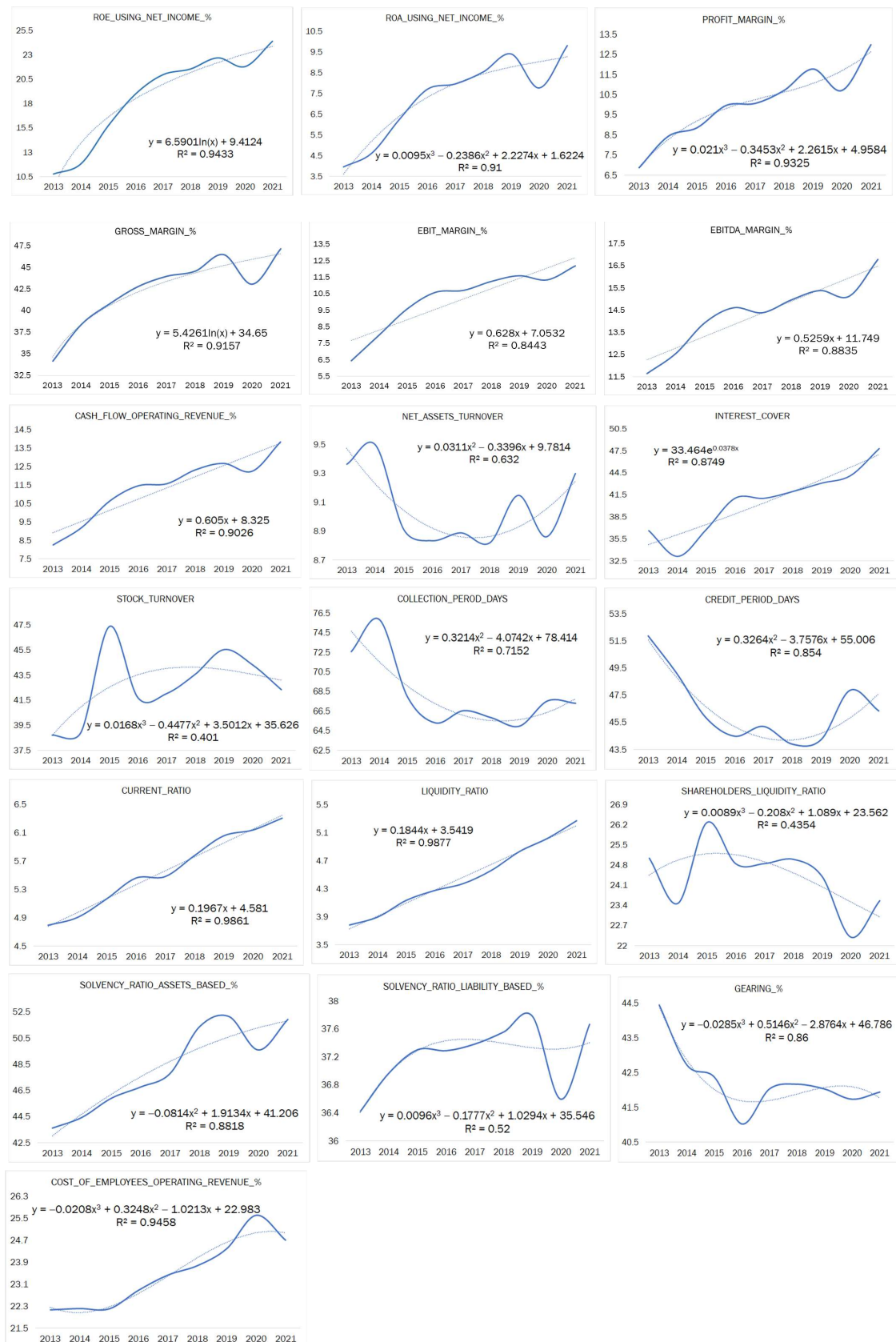
Appendix A

Figure A1. Trend analysis of financial ratio means in the Balkan and Eastern European region.

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