economies

Article

Impact of the COVID-19 Pandemic on the Economic Development of the Mining and Construction Industry: Case Study in Slovakia

Beátka Stehlíková, Marcela Taušová and Katarína Čulková *

Faculty BERG, Technical University of Košice, Letná 9, 042 00 Košice, Slovakia; beata.stehlikova@tuke.sk (B.S.); marcela.tausova@tuke.sk (M.T.)
* Correspondence: katarina.culkova@tuke.sk

Abstract: Due to the present worldwide economic development, there is an increasing need to follow the financial health of companies in individual sectors to avoid possible decline and bankruptcy. The goal of this contribution is to find out the influence of the pandemic on the economic situation in the mining industry as the primary sector, in connection with the construction industry as the secondary sector. The research is carried out through economic and financial indicators, which mostly influence the potential crisis of companies. The results show that the mining industry and construction sectors managed to avoid the heavy decline and bankruptcy of certain organizations in the industries. Such results can be used for forecasting and modeling the socio-economic development of regions and countries. The growth of the analyzed industries could contribute to the sustainable development in the country.

Keywords: economic indicators; financial health; primary and secondary sector; Slovakia

check for updates

Citation: Stehlíková, Beátka, Marcela Taušová, and Katarína Čulková. 2024. Impact of the COVID-19 Pandemic on the Economic Development of the Mining and Construction Industry: Case Study in Slovakia. *Economies* 12: 119. https://doi.org/10.3390/economies12050119

Academic Editor: Sergio Scicchitano

Received: 12 March 2024
Revised: 16 April 2024
Accepted: 8 May 2024
Published: 15 May 2024

1. Introduction

The financial health of a company can be seen as the ability to hold a balance against the changing conditions of the environment in relation to everyone participating in the business. For the evaluation of financial health and the prediction of financial problems of companies, various indexes are used for the prediction of financial situation development. A financial healthy company means a company that is able to evaluate invested capital to the measure, demanded by shareholders.

In recent years, the mining industry has achieved an important position in the national economy due to its increasing productivity. However, since 2000, there have been signs of a slowdown, resulting from the national and local conditions of the mining industry. Moreover, the COVID-19 pandemic worldwide situation influenced the development of the mining industry, as well as any other industrial sectors, causing many companies to decline or face bankruptcy.

The goal of this contribution is to find out the influence of the pandemic on the economic situation of the mining industry as the primary sector through chosen financial indexes, determining the possible crisis of a company. The development in the primary mining industry is consequently followed up with development in the connected construction sector as a representative of the secondary sectors. The mining industry generally forms a basic platform for the sustainable development of countries, directly determining the development of other national economic sectors. Therefore, this paper is orientated to the mining industry, which has to be assessed especially after the post-pandemic situation from economic perspectives and influences on other industries. The aim of the research was to verify the viability of organizations impacted by the extraordinary situations such as the pandemic or energy crises. It could help to identify sectors that react sensibly to the situation in their financial indicators and sectors that are relatively stable. The results of

the research could help to form the state policy of Slovakia or any other country hoping to define supportive measurements for companies. Such measurements could relieve the negative social dimension caused by unemployment. Due to the aforementioned, this research is important for the macro- and micro-economic level. However, the research is limited to the analysis of chosen financial indexes of mining and the construction industry that are heterogeneous, disregarding the heterogeneity between sectors and only considering the reaction of the sectors to the present crisis.

The first part of the paper consists of a literature review, dealing with the present state of the problem that requires solving, as well as previous research in the area. This chapter shows the gap in the study of the financial indicators in the post-COVID period in Slovakia, and the results can be used for evaluation in any other sector and for comparison to other countries. The second part of the paper is dedicated to the data, their processing, and the main methodological approach during the research that helped to achieve its main goal. The Results Section consists of an analysis of return on capital and quick liquidity in the selected mining and construction sectors. In the Discussion Section, the main results are discussed together with other research and common measurements for financial indexes improvement.

2. Literature Review

The various literature deals with the development of the financial situation in individual sectors, mainly due to the pandemic situation worldwide. The results of the financial analysis are different in companies from various sectors, since companies have different properties and financial structures and therefore a different economic result structure. Financial health demands the achievement of sufficient profit, as well as long-term liquidity. Bankruptcy means a situation when the organization has no possibility of overcoming bad financial health (Csikosova et al. 2019). Chen and Yeh (2021) compared the crisis due to COVID-19 in industries with the global financial crisis in 2008 and found that the effect of quantitative easing in 2020 was more significant for the industries that were more affected by the pandemic. He et al. (2020) found that, except for basic industry which was less affected by the epidemic, the rest of the industries were significantly affected by the epidemic and the costs for various industries have increased differently.

The mining industry is not immune to COVID-19's impacts. The crisis in the mining industry due to the pandemic has the potential to have severe consequences in the short-, medium-, and long-term for the industry (Laing 2020). There is, therefore, a task to understand the impacts and analyze their significance for the industry, and in this way contribute to the consequent economic development of industries. The COVID-19 pandemic affected the demand for metals and the global mining sector (Jowitt 2020), causing variations in metal and commodity prices and stocks during the crisis. Also, Kekec et al. (2022) investigated the impact of the pandemic on the global and Turkish mining sectors with the aim to suggest measures for the limitation of the spread of COVID-19 and to conduct mining operations safely and efficiently; they found that the mining industry was affected more than others were by the COVID-19 crisis.

The importance of studying COVID-19's influence on the mining sector results from the fact that the mining industry is characterized as a labor-intensive sector with high worker mobility; thus, this mobile workforce increases the transmission risk of COVID-19 (Susanto et al. 2022). This is found in the case of the Brazilian mining sector, studied by De Castro et al. (2022), in connection with municipalities where mining activity is prevalent. The impact of COVID-19 is higher in larger mining localities. Marimuthu et al. (2022) evaluated the impact of COVID-19 on India's mining activities and found that a large group of workers, a collapse of demand and disruption, and suffering contractual workers are the top three factors that need to be considered. Bernauer and Slowey (2020) reported a case study from Canada and found that the pandemic caused struggles between Indigenous peoples and mining, oil, and gas companies. This again results from the fact that the mining and construction sectors need to consider human resources, which are impacted by the

pandemic the most. Susanto et al. (2022) conducted a study of mining organization in Indonesia, finding critical factors that could decrease impact of the pandemic, which could contribute to the sustainable development of the mining organizations in crisis. Paz-Barzola et al. (2023) evaluated the impact of COVID-19 on the Ecuadorian mining industry and found the Ecuadorian scenario is different from the one abroad; companies presented more social and economic information and less health and safety information than international companies. Atif et al. (2020) explored the application of digital technologies for the detection and prevention of COVID-19 in the mining industry.

During the pandemic, SMEs in the mining sectors encountered more financial problems. This trend was observed in Czech Republic, Slovakia, and Hungary (Civilek et al. 2022). The financial situation of the mining sector in Slovakia compared to the EU and worldwide was evaluated by Pavolova et al. (2022), who found that the mining industry is directly influenced by mineral deposits and the structure of other industries. Muthuri et al. (2021) highlighted the increased vulnerability of the mining organizations, especially in small-scale mining, in the pandemic (Muthuri et al. 2021).

Similarly, studying the influence of COVID-19 on the construction sector is crucial due to its high labor-intensity and its connection to the mining industry. Therefore, it can hinder sustainable development connected with construction (such as in study of Ebekozien et al. 2023 in Nigeria). Tanaka et al. (2017) introduced a novel framework for building company bankruptcy models and a methodology for assessing the vulnerability of industry economic activities, considering industry-specific differences. In the area of the construction sector, Gajdosikova et al. (2022) quantified the impacts of the COVID-19 pandemic on the construction sector as a crucial sector of the Slovak economy. The study found that since the construction sector is characterized by slower reactions to changes in the economy, the most significant impacts will be even more noticeable in the future. Alsharef et al. (2021) investigated the early impacts of the COVID-19 pandemic on the U.S. construction industry, identifying significant challenges, such as a delay in material procurement, reduced productivity rates, material price escalations, etc. Kubenka Michal (2013) studied the construction industry as a key sector of the national economy, finding higher bankruptcy indicators compared to other sectors, suggesting that the construction sector situation is better than the national economy as a whole.

There is limited research on the mutual relations of industries, especially during and after a pandemic, influencing the development of the other industries. Therefore, the aim of the study is to remove the gap in the literature by exploring the relations between the mining industry as the primary sector with the construction industry, as the secondary sector, which is dependent on the mining industry. The research results from previous research studies, orientated to the area of industries insolvency in Slovakia, are compared with other similar countries (Csikósová et al. 2016), as well as to the area of mining contribution to the socio-economic growth of the country (Taušová et al. 2017), to the area of activity indexes in industries, analyzed by the country (Čulková et al. 2018a), and to the area of indebtedness in chosen industrial sectors (Čulková et al. 2018b). The research uses results of the previous research, orientated and limited to the chosen financial indicators, highlighting the reactions to the crisis in the chosen Slovakian industries.

3. Methodology

The research aims to investigate the impact of the pandemic on both the primary and selected secondary business sectors in Slovakia. At the same time, the aim is to find out whether there are differences between industries in the financial indicators' development before, during, and after the pandemic.

We analyzed the primary sector, represented by the mining and quarrying industry, having a profound impact on the secondary sector, particularly the construction industry. The selection of sectors aligns with the sectorial structure of the national economy, which categorizes economic activities based on the output nature. The following sectors of the

national economy are divided according to output as goods or service (Kucharčíková and Tokarčíková 2010):

- The primary sector, consisting of agriculture, forestry, and fishing, and the mining industry;
- The secondary sector, including the processing industry and construction;
- The tertiary sector, consisting of other activities, i.e., services;
- The quaternary sector, integrating rapidly developing services, e.g., information and communication technologies.

We chose to analyze the primary sector because it serves as the cornerstone of the economy, consisting of industries producing essential raw materials and materials, thus shaping the state and development of subsequent sectors. For the secondary sector, we selected construction due to its significant influence on economic development and the population standard of living.

The research concentrated on selected financial indicators within the mining and construction industries with an aim to compare and detect the possible decline of businesses due to the pandemic.

The research followed the process below:

1. Selection of the representative indexes sample;
2. Selection of the representative organizations sample;
3. Data adjustment;
4. Formulation of research hypothesis;
5. Statistical analysis and hypothesis verification.

The research process is outlined in Table 1 below.

Table 1. Process of the research.

No.	Activity
1.	Selection of the representative sample of indexes
2.	Selection of the representative sample of organizations
3.	Data adjustment
4.	Defining of research hypothesis
5.	Statistical analysis and hypothesis verification

This procedure outlines the individual steps of the analytical model employed in the research and their basic characteristics: In our analytical model, we first used descriptive statistics and boxplots for data exploration and the identification of outliers or trends. Subsequently, we employed an analysis of variance (ANOVA) to test differences among multiple groups. Tukey's honestly significant difference (HSD) test was then applied for pairwise comparisons, offering a robust post-hoc analysis (Tukey 1949).

In cases where the assumptions for ANOVA are not provided, we employed the Kruskal–Wallis test, an appropriate non-parametric alternative (Kruskal and Wallis 1952). For pairwise comparisons in these instances, we applied the Wilcoxon rank sum test with continuity correction (Wilcoxon 1945).

For testing Research Hypothesis 3, we utilized data for the years 2019, 2020, and 2021. We employed the F-test and Mann–Whitney U-test (Mann and Whitney 1947) methods. We analyzed 80 enterprises in the mining industry and 84 construction enterprises spanning the period from 2015 to 2021. The outcomes of research will facilitate comparisons of the situation in other related industries from the perspective of selected financial indicators. Data processing was conducted using the R programming language (R Core Team 2022). R is a language and environment for statistical computing developed by the R Foundation for Statistical Computing, headquartered in Vienna, Austria (https://www.R-project.org/ (accessed on 3 December 2023)).

All analyses were conducted at a significance level of $\alpha = 0.05$, and the results were interpreted using p-values, compared to the predetermined α level (Cumming 2014).

The analytical model is structured as follows:

1. For Research Hypotheses 1 and 2:
   a. Statistical hypothesis test: Testing whether there is statistically significant difference between the mean values of all populations. If the null hypothesis is rejected, a pairwise comparison follows.
   b. Research Hypothesis 1 files: The return on capital indicator in the mining industry 2015 to 2021; Quick liquidity in the mining industry 2015 to 2021.
   c. Research Hypothesis 2 files: The return on capital indicator in the construction industry 2015 to 2021; Quick liquidity in the construction industry 2015 to 2021.
   d. Graphic presentation of results: Boxplot and crisis management and economic indicators.
2. For Research Hypothesis 3:
   a. Statistical test on the agreement of the variability of two populations and the agreement of the mean value of two populations.
   b. Pair of files for Return on Capital indicator: One file created from Return on Capital indicator in the mining industry 209 to 2021; Second file created from Return on Capital indicator in the construction industry 2019 to 2021; For Quick liquidity: One file created from Quick liquidity in the mining industry 2019 to 2021; Second file created from Quick liquidity in the construction industry 2019 to 2021;
   c. Graphic presentation of results: Boxplot and histogram.

Ad1.

The selection of financial indicators was based on the classic predictions of financial situation development, resulted from crisis management tools. A financial crisis of the company is defined as a state resulting from a failure in two levels of financial indicators:

- A failure caused by low liquidity, manifested by the inability of the company to pay its obligations on time. The liquidity crisis includes insufficient cash generation, the commitment of a large number of funds in less liquid forms of current assets, the implementation of risky investment projects, and excessive indebtedness. Liquidity refers to the efficiency with which an asset or security can be converted into ready cash without affecting its market price. The most liquid asset is cash itself. Consequently, the availability of cash to make such conversions is the biggest influence on whether a market can move efficiently. The quick liquidity formula is as follows:

$$Quick\ Liquidity = \frac{Quick\ Assets}{Current\ Liabilities} \tag{1}$$

$$Quick\ Assets = (Cash + Cash\ equivalents + Marketable\ securities + Accounts\ receivables) \tag{2}$$

- A failure caused by low profitability, caused by insufficient revenue from the company's business activities, resulting from the loss of production sales or a drop in prices and a cost increase. Profitability is measured by the return on capital (ROC) and return on equity (ROE). The return on equity (ROE) measures a corporation's profitability in relation to stockholders' equity. The return on capital (ROC) includes debt financing in addition to equity. We selected to analyze ROC development, calculated as follows:

$$Return\ on\ Capital = \frac{Net\ Income}{(Debt + Equity)} \tag{3}$$

The mutual relation between liquidity and return on capital determines the possible crisis of the organization, as illustrated by Figure 1.

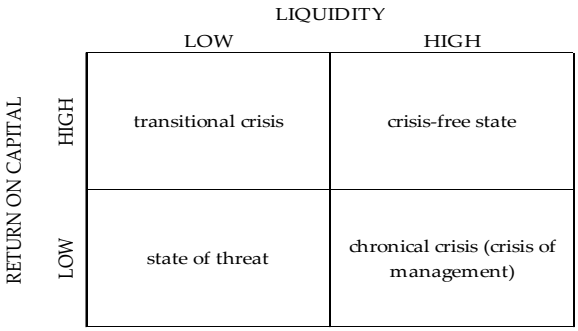

Figure 1. Crisis management and economic indicators (Campello et al. 2011).

These indicators most closely indicate a potential crisis within companies and a subsequent decline.

Ad2.

The criterion for filtering enterprises into groups based on the sector was their area of business. Enterprises were included in the sample only if their other areas of business were related to the sector under consideration, rather than diversification. Additionally, the "return on sales" indicator for products and services had to exceed EUR 6000 in the observed year 2015, from which the data were analyzed.

Ad3.

Given the aim of evaluating the industry as a whole, we sought robust data. We aggregated data from financial statements published in the Finstat database for the period 2015–2021, covering years before, during, and after the COVID pandemic. The indicator values from one year and one industry form one statistical set. For example, a file might be "year indicator, mining industry year 2015". The data were adjusted as described; obtained statistical files can be used in different groups to confirm research hypotheses. The data for each used indicator were adjusted in such a way that the data for each used indicator remained in the range: ME $\pm$ 1.5*IQR, median $\pm$ 1.5 $\times$ Interquartile range in the file for further evaluation. Values of indicators outside the specified range were replaced with the sign "NA" in order not to lose comprehensive information about the companies.

Ad4.

The research proceeded sequentially. The hypothesis for each step of the investigation was defined, confirmed, or rejected based on statistical results. The result of each partial investigation formed the basis for establishing the next hypothesis. Four hypotheses were established:

Research Hypothesis 1. *Financial health indicators in Slovak mining companies were worse in 2020 and 2021 than in the years preceding the COVID pandemic.*

Research Hypothesis 2. *Financial health indicators in construction companies, closely related to the mining industry, were worse in 2020 and 2021 than in the years preceding the COVID pandemic.*

Research Hypothesis 3. *The financial indicators of quick liquidity and return on capital for a pair of industries (construction and mining) exhibit different variability and mean values.*

Ad5.

Descriptive statistics and boxplots were employed for statistical evaluation. Statistical hypotheses were tested using the ANOVA test with the Tukey HSD criterion for pairwise comparison. When ANOVA assumptions are not provided, its non-parametric alternative the Kruskal–Wallis chi-squared test was used. For pairwise comparisons, the Wilcoxon rank sum test with continuity correction and the *p*-value adjustment method was employed: BH (Benjamini–Hochberg adjustment).

The evaluation of statistical tests is carried out at the level of significance $\alpha = 0.05$. In the description of the tests, the *p*-value is indicated, which is compared with the α value, set at 0.05.

For Research Hypothesis 3, data from the years 2019, 2020, and 2012 were used, and the F-test and Mann–Whitney U-test methods were employed.

The analysis covered 80 enterprises in the mining industry and 84 construction enterprises for the period 2015 to 2021. The results of the research will facilitate comparison of the related industries based on the selected financial indicators. Data processing was conducted, using R Core Team (2022). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria (https://www.R-project.org/ (accessed on 3 December 2023)).

4. Results

4.1. Research Hypothesis 1

"Financial health indicators in Slovak mining companies were worse in 2020 and 2021 than in the years preceding the COVID pandemic."

To verify Hypothesis 1, data on solely mining companies were employed. Data were obtained from a profit and loss statement and balance sheet. From the data, the return on capital and quick liquidity indicators were calculated. The analysis was carried out for the period 2015 to 2021 to evaluate development before, during, and after the pandemic situation.

4.1.1. Return on Capital

Figure 2 displays boxplots of the return on capital (ROC) indicator for mining companies. The red line represents the bank's interest rate, indicating that the ROC value of all companies that evaluate their finances better is above the line.

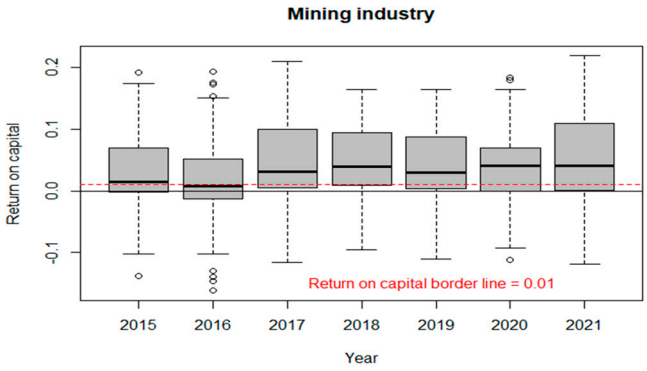

Figure 2. Return on capital indicator in the mining industry.

The ROC value = 0.0 is delineated by a black line.

From the graph, it is evident 2016 was the most challenging year for mining companies, when more than half of the companies had a ROC of less than 0.01.

In 2018, exactly a quarter of businesses fell below the ROC 0.01 level. During the COVID-19 period, in 2020 and 2021, there was a slight increase in the rate of businesses with a ROC of less than 0.01.

To access the statistical significance of differences in the average ROC values across the years, an ANOVA test was conducted. The null hypothesis stated that the average ROC values from 2015 to 2021 are not statistically different, while the alternative hypothesis stated that there are at least two periods in 2015–2021 with statistically significant differences in the ROC indicators.

The test result was as follows: The test criterion F = 1.905 and *p* value = 0.07834, indicating that the null hypothesis cannot be rejected.

Assumptions: the homoscedasticity of the data of all periods was confirmed by Bartlett's test of homogeneity of variances (p-value = 0.3723); the normality of the residuals was verified by the QQ plot, respectively. The residuals can be considered to approximate a normal distribution.

In terms of profitability, analyzed by ROC, the research hypothesis that the financial health of mining companies deteriorated in 2019, 2020, and 2021 was not confirmed (see Figure 2).

4.1.2. Quick Liquidity

Figure 3 depicts boxplots illustrating the quick liquidity indicator. From 2015 to 2018, more than half of the enterprises had quick liquidity below one. However, during the COVID-19 period from 2019 to 2021, the median (representing the threshold of 50% of enterprises) exceeded a value of one, indicating that more than 50% of enterprises had quick liquidity above one. Additionally, in the analyzed years, an increase in variability is visible, as indicated by the width of the graph box. For instance, in 2021, a quarter of the enterprises exhibited quick liquidity values exceeding 3.86. Such high values are no longer optimal as they unnecessarily ties up funds that could otherwise be used to generate profit.

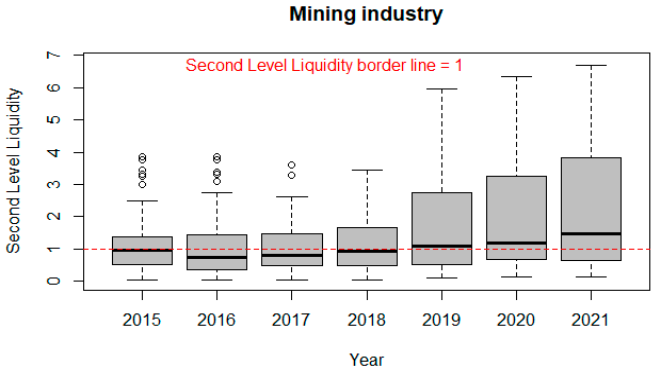

Figure 3. Quick liquidity in mining industry.

A non-parametric statistical test was employed to validate the visual assessment, as the null hypothesis of homoscedasticity of the data was rejected, with a p-value from Bartlett test of homogeneity of variances being less than 2.2×10^{-16}.

The test result was as follows: The Kruskal–Wallis rank sum test was conducted with the hypothesis that the medians of each group are the same, implying that all groups originate from the same distribution. The alternative hypothesis states that at least one group has a different median, indicating that at least one group stems from a different distribution distinct from the others. The Kruskal–Wallis chi-squared statistics yielded a value of 30.098, with a p-value of 3.765×10^{-5}. Consequently, the null hypothesis was rejected, confirming the visual finding that the difference between the medians of at least two groups is statistically significant.

Table 2 presents the p-values of the pairwise comparisons of group medians. All medians of the liquidity indicator for the years 2015, 2016, 2017, and 2018 are statistically significantly different from the medians of the liquidity indicator for the years 2020 and 2021.

The research hypothesis that in the years of the pandemic 2020 and 2021 there was a deterioration in the indicators of the financial health of companies in the industry is rejected. Figure 4 implies that the quick liquidity indicator in the pandemic years has better values than before the pandemic.

Looking at the economic sectors in terms of succession, the mining industry is considered primary. The construction industry was chosen as a secondary sector to examine the impact of COVID on the financial health of companies. The following hypothesis has been established.

Table 2. Pairwise comparison of group medians (*p*-value).

	taLi392015	taLi392016	taLi392017	taLi392018	taLi392019	taLi392020
taLi392016	0.5602	-		-	-	-
taLi392017	0.8944	0.7111	-		-	-
taLi392018	0.9601	0.5247	0.8317		-	-
taLi392019	0.1824	0.0471	0.1329	0.2217	-	-
taLi392020	0.0293	0.0054	0.0197	0.0293	0.4676	
taLi392021	0.0029	0.0017	0.0029	0.0036	0.1824	0.5602

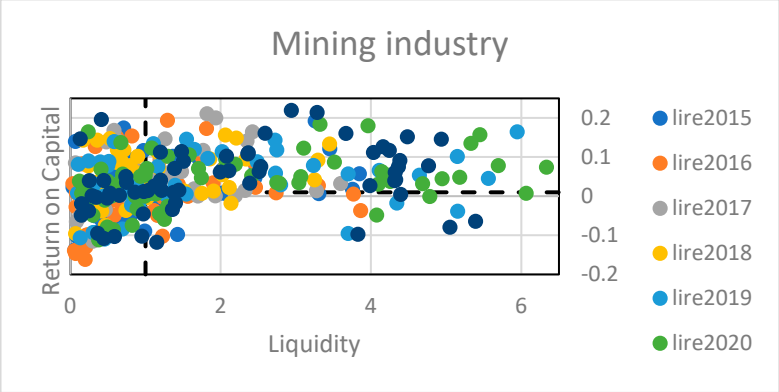

Figure 4. Development of return on capital and quick liquidity in mining industry in 2015–2021.

4.2. Research Hypothesis 2

"Financial health indicators in construction companies, closely related to the mining industry, were worse in 2020 and 2021 than in the years preceding the COVID pandemic."

To verify Hypothesis 2, data from companies engaged in construction activities, including construction of buildings, engineering works, and the specialized construction work, were utilized. Companies involved in consultancy or other activities were excluded. Financial statements, including profit and loss statement and balance sheet were employed to assess the return on capital and quick liquidity indicators. The analysis covered the period from 2015 to 2021, to enable comparison with the mining industry.

4.2.1. Return on Capital

Figure 5 illustrates boxplots of the return on capital (ROC) indicator for construction companies. The red line represents the bank's interest rate, with ROC values above the line indicating favorable financial evaluations of companies.

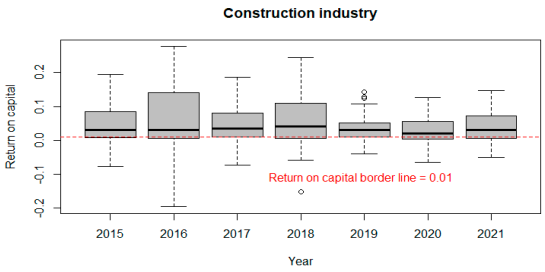

Figure 5. Return on capital indicator in the construction industry.

The value ROC = 0.0 is indicated by a black line.

From the graph, it can be concluded that the most challenging period for construction companies was 2020, with over a quarter of the companies below ROC values of less than 0.01.

In the year preceding the COVID-19 period (2018), exactly a quarter of the companies fell below the ROC equal to 0.01. During the COVID-19 period (2019–2021), there was a slight increase in the proportion of businesses with ROC values of less than 0.01.

The Kruskal–Wallis chi-squared test was employed to verify the statistical significance of differences between the average ROC values in individual years. The null hypothesis posited that the median values of the ROC indicator from 2015 to 2021 are not statistically different, while the alternative hypothesis suggested that there are at least two periods between 2015 and 2021 in which the ROC medians differ significantly.

The test result: The Kruskal–Wallis test criterion chi-squared = 8.1434 and p-value = 0.2278, indicating that the null hypothesis cannot be rejected.

From the profitability perspective, the research hypothesis asserting that the financial health indicators of construction companies deteriorated during the COVID-19 years of 2019, 2020, and 2021, was not confirmed (see Figure 5).

4.2.2. Quick Liquidity

Figure 6 displays boxplots representing the quick liquidity indicator. It is evident from the figure that the median of the liquidity indicator remains around the value of one throughout the observed period. In 2021, an increase in variability is noticeable. However, based on the graph, it is apparent that there is no statistically significant difference between the distributions of the liquidity indicator in the individual years of the observed period.

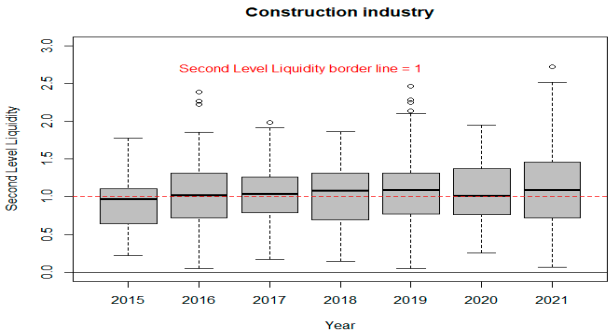

Figure 6. Quick liquidity development in the construction industry.

A non-parametric statistical test was employed to confirm the visual assessment since the null hypothesis of homoscedasticity of the data was rejected, with the p-value from the Bartlett test of homogeneity of variances being less than 2.2×10^{-16}.

The test result: The Kruskal–Wallis rank sum test was conducted with the hypothesis that the medians of each group are the same, implying that all groups originate from the same distribution. The alternative hypothesis states that at least one of the groups has a different median, meaning that at least one comes from a different distribution than the others. The Kruskal–Wallis chi-squared statistics yielded a value of 7.16, with a p-value of 0.268. Thus, the null hypothesis cannot be rejected, confirming that the visual finding suggests the lack of statistically significant differences between the medians of at least two groups. The hypothesis is confirmed.

The research hypothesis suggesting deterioration in the financial health indicators of companies in the industry during the pandemic years is rejected (see Figure 7).

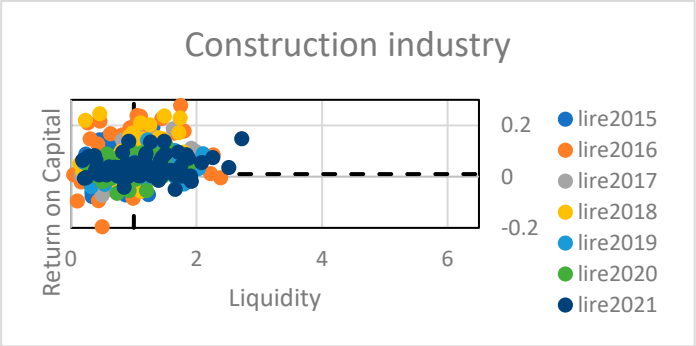

Figure 7. Development of return on capital and quick liquidity in the construction industry in 2015–2021.

4.3. Research Hypothesis 3

"The financial indicators of quick liquidity and return on capital for a pairs of industries (construction and mining) exhibit different variability and mean values."

A detailed assessment of the differences between the financial indicators for the construction and mining industries is employed resulting in the following graphs and tables.

4.3.1. Return on Capital

The value of the indicator for Slovakia is 0.01, which signifies the interest rate for deposited money. Approximately 25% of enterprises in the construction and mining industries fall below this value.

Both the box and bar charts (see Figure 8) display the interquartile range, as well as the difference between the minimum and maximum, which is higher for the mining industry. A statistically significant difference was also confirmed by the F-test of variance matching, F = 3.1801 with a p-value < 2.2×10^{-16}. The mean values for the industries do not differ statistically significantly, as also confirmed by the Mann–Whitney U-test, W = 30185, p-value = 0.9724.

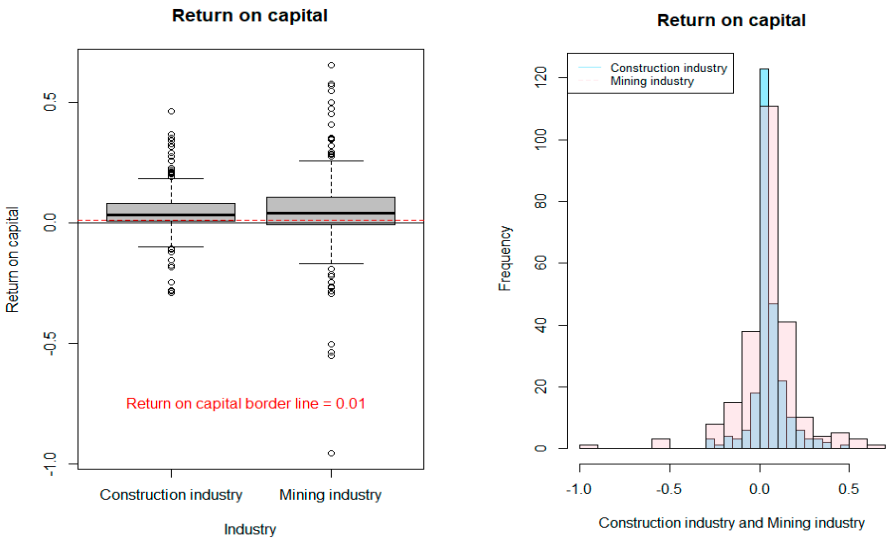

Figure 8. Boxplot and histogram of return on capital indicator.

The research hypothesis is rejected for the mean value and confirmed for the variability.

4.3.2. Quick Liquidity

The difference between sectors was validating concerning the quick liquidity indicator. Significant statistical disparities were observed in both the mean value, evidenced by the

Mann–Whitney U-test: W = 18,723, p-value = 0.001444, and in the variability, as indicated by the F-test has the result: F = 11.07, p-value < 2.2×10^{-16}. This difference is evident in both the box and bar charts (refer to Figure 9).

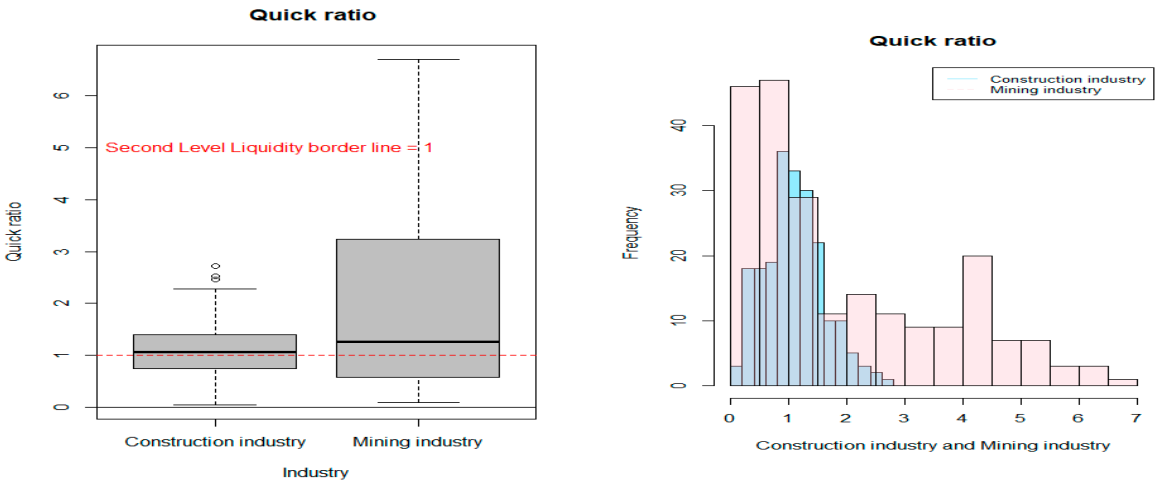

Figure 9. Boxplot and histogram of the quick liquidity indicator.

In neither industry can the distribution of the indicator be considered normal. While the construction industry has a median indicator around one, the mining industry has a median of around 1.2. Regarding variability, the construction industry's box is symmetrical on both sides of the median, whereas for the mining industry, there is visible asymmetry with data concentrated below the median value. The research hypothesis is confirmed for both the mean value and the variability.

To mitigate the risk of a crisis, companies must address issues related to profitability and liquidity. In the area of liquidity, companies should:

- Prefer advance payment arrangement;
- Adjust invoice due dates;
- Motivate small buyers with cash discount;
- Monitor and assess liquidity levels using a payment calendar.

In terms of profitability, companies should:

- Monitor all profitability indicators, especially when company costs impact profitability;
- Analyze the company's highest costs;
- Analyze external services;
- Consider establishing a dedicated profitability management team.

Companies should implement a range of financial crisis resolution tools, including both strategic and tactical approaches (Wodak 2021). Strategic tools may involve debt restructuring, securities issuance, asset divestment, equity adjustment, new production program selection, strategic partnerships, and production diversification. Tactical tools could include debt restructuring, the implementation of strategic planning, controls and total quality management (TQM), the adoption of a marketing management system, new human resources management systems, and enhanced internal communication. Utilizing such tools can assist companies in overcoming the crisis via the following steps:

1. Identifying of the root causes of the crisis;
2. Establishing crisis management protocols;
3. Temporarily centralizing management functions;
4. Implementing a comprehensive business recovery plan;
5. Strategically combining the appropriate tools for maximum efficiency.

5. Discussion and Conclusions

The focus of the paper lies in the mining and construction industries, given their primary sector influence on the secondary sector. The results of the analysis indicate that despite the crisis caused by COVID-19 pandemic, both sectors show relative stability in their financial indexes. This stability could potentially enhance overall state stabilization in the economic and social spheres. Additionally, the research underscores the exceptional economic impact of the construction sector in Slovakia and globally, with interconnections not only to the mining industry but also to other sectors like manufacturing (Alaloul et al. 2021). The study employs two specific economic indicators to underline the crisis impact on the companies. However, Strahl (2020) highlights the importance of considering macroeconomic indicators such as GDP per capita and the employment structure. The mining and construction sectors, along with manufacturing, are identified as pivotal sectors contributing to the socio-economic development of regions, as emphasized by Sorokozherdyev and Efímov (2023). Amidst the COVID-19 pandemic, these industries faced various challenges. Here is an overview of their performance during this period:

1. Mining industry:
    - The extractive industry, particularly oil and natural gas, has suffered from a decline in energy demand due to decreased economic activity and mobility;
    - The OPEC+ agreement to reduce production, implemented in response to the oil surplus and declining prices, has impacted production levels and profits within the mining industry;
    - Many mining companies have had to adjust to lower demand and reduced energy prices, resulting in production restrictions and austerity measures.
2. Construction industry:
    - The construction industry experienced closures of construction sites and the project interruptions due to labor movement restrictions and suspension of certain projects;
    - Labor movement restrictions and material shortages may have caused construction delays and increased project costs;
    - Increased economic uncertainty could lead to decreased investment in new construction projects, influencing the industry over the long term.

In both cases, the situation may have varied depending on specific factors such as the region, type of business, and resources availability. The return to normal operations of these industries may depend on various factors, including the speed of vaccination, measures to limit virus spread, and economic recovery (Majumder and Biswas 2021; Gałaś et al. 2021).

According to general findings and studies, the impact of COVID-19 on the mining and construction industries has been described as significant. The fastest detectable indicators of a company's financial health are the second degree of liquidity and total capital profitability. Hence, we chose to use these two indicators. Detailed analyses of these indicators will be the subject of another study. The authors Bellovary et al. (2003) and Pangaribuan et al. (2023) also support their utilization. Based on this literature, we believe that our chosen financial ratios are well-supported and commonly accepted in the analytical environment.

Zhang et al. (2016) confirmed prior to the pandemic situation that the mining industry contributes significantly to the economy, playing a vital role in accelerating economic development and infrastructure construction, thereby impacting people's livelihood. Similarly, the construction sector plays a crucial role in social and economic development. Therefore, the management of both mining and construction industries must prioritize enhancing management quality (El Khatib et al. 2023).

Due to the European Green Deal (2019), mining should be analyzed with carbon neutrality goals in mind. In this regard, Sun et al. (2022) demonstrated that aside from the unstable situation in the oil and natural gas mining industry, other mining sectors have achieved strong decoupling and stability, showing a consistent positive trend. Monitoring

these sectors must be conducted regularly in connection with any socio-economic changes in the world (Vanek et al. 2011), and new industry and sector management systems should be implemented.

The paper focuses exclusively on the mining and construction industries, reflecting the primary sector's influence on secondary sectors. The research findings will be utilized alongside other sectors' analyses to understand responses to mining industry development in both pandemic and post-pandemic situations. The research examines heterogeneous financial indexes. A future direction for the research could involve exploring the heterogeneity between the mining and construction sectors, as well as the periodicity of financial indexes across sectors. This approach would enable not only an assessment of sectoral responses to the COVID-19 situation but also an examination of intersectoral relationships. The results can serve as benchmark for other countries to achieve sustainable development. The significance of the study is to make the mining and construction sector into a sustainable sector after the pandemic and crisis. The study can become a basis for forecasting and modeling the socio-economic development of the mining and construction sector in the short and medium term. It can also be a tool for other industries aiming to achieve sustainable development.

Author Contributions: Conceptualization, B.S. and M.T.; methodology, B.S. and K.Č.; software, M.T.; validation, B.S. and M.T.; formal analysis, M.T. and B.S.; investigation, M.T. and B.S.; resources, K.Č.; data curation, B.S. and M.T.; writing—original draft preparation, K.Č.; writing—review and editing, K.Č.; visualization, B.S.; supervision, M.T.; project administration, K.Č.; funding acquisition, K.Č. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by VEGA 1/0430/22, KEGA 013TUKE-4/2023, ITMS 3131011T564.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study. Data sharing is not applicable to this article.

Conflicts of Interest: The authors declare no conflicts of interest.

References

Alaloul, Wesam Salah, Muhammad Ali Musarat, Muhammad Babar Ali Rabbani, Qaiser Iqbal, Ahsen Maqsoom, and Waqas Farooq. 2021. Construction sector contribution to economic stability: Malaysian GDP distribution. *Sustainability* 13: 5012. [CrossRef]

Alsharef, Abdullah, Siddharth Banerjee, S M Jamil Uddin, Alex Albert, and Edward Jaselskis. 2021. Early impacts of the COVID-19 pandemic on the US construction industry. *International Journal of Environment Research and Public Health* 18: 1559. [CrossRef] [PubMed]

Atif, Iqra, Frederick Thomas Cawood, and Muhammad Ahsan Mahboob. 2020. The Role of Digital Technologies that Could Be Applied for Prescreening in the Mining Industry during the COVID-19 Pandemic. *Transactions of the Indian National Academy of Engineering* 5: 663–74. [CrossRef]

Bellovary, R. S., R. L. Giacomino, and P. Akers. 2003. A Review of Bank Financial Ratios' Literature: 1990–2001. *Journal of Financial Services Research* 23: 177–235.

Bernauer, Warren, and Gabrielle Slowey. 2020. COVID-19, extractive industries, and indigenous communities in Canada: Notes towards a political economy research agenda. *The Extractive Industries and Society* 7: 844–46. [CrossRef]

Campello, Murillo, Erasmo Giambona, John R. Graham, and Campbell R. Harvey. 2011. Liquidity Management and Corporate Investment during a Financial Crisis. *The Review of Financial Studies* 24: 1944–79. [CrossRef]

Chen, Hsuan Chi, and Chia Wei Yeh. 2021. Global financial crisis and COVID-19: Industrial reactions. *Finance Research Letters* 42: 101940. [CrossRef]

Civilek, Mehmet, Martin Kasarda, Ludovit Hajduk, and Anton Szomolanyi. 2022. Social media usage as a solution for financial problems of European SMEs: International comparison of firms in iron and mining industries. *Acta Montanistica Slovaca* 27: 982–93. [CrossRef]

Csikosova, Adriana, Maria Janoskova, and Katarina Culkova. 2019. Limitation of financial health prediction in companies from post-communist countries. *Journal of Risk and Financial Management* 12: 15. [CrossRef]

Csikósová, Adriana, Katarína Čulková, and Mária Janošková. 2016. Insolvency proceedings of industrial companies in Czech Republic and Slovakia. *Actual Problems of Economics* 177: 210–18.

Cumming, Geoff. 2014. The New Statistics: Why and How. *Psychological Science* 25: 7–29. [CrossRef] [PubMed]

Čulková, Katarína, Henrieta Pavolová, Michal Cehlár, and Samer Khouri. 2018a. Influence of Crisis to Activity Indexes in Chosen Industrial Companies of the Country. *TEM Journal: Technology, Education, Management, Informatics* 7: 744–49.
Čulková, Katarína, Marcela Taušová, Mária Shejbalová-Muchová, Lucia Domaracká, and Peter Tauš. 2018b. Indebtedness in Chosen Industrial Sectors with Regard to the Economic Development in the World. *Ekonomický časopis* 66: 28–42.
De Castro, Ferreira Fernando, Geraldo Sandosal Goes, Jose Antonio Sena do Nascimento, and Monica Monnerat Tardin. 2022. Incidences of COVID-19 in major mining municipalities in the Brazilian Amazon. Economic impacts, risks and lessons. *The Exctractive Industries and Society* 9: 101033. [CrossRef] [PubMed]
Ebekozien, Andrew, Clinton Aigbavboa, and Marwelous Aigbedion. 2023. Construction industry post-COVID-19 recovery: Stakeholders perspective on achieving sustainable development goals. *International Journal of Construction Management* 23: 1376–86. [CrossRef]
El Khatib, Mounir, Haitham M. Alzoubi, Muhammad Turki Alshurideh, and Ali A. Alzoubi. 2023. Project Quality Management in the United Arab Emirates Mining and Construction Sector: A Literature Review. In *Effect of Information Technologz on Business and Marketing Intelligence Systems*. Cham: Springer, vol. 1056, pp. 1341–53. [CrossRef]
European Green Deal. 2019. Available online: https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en (accessed on 15 February 2024).
Gajdosikova, Dominika, Katarina Valaskova, Tomas Kliestik, and Veronika Machova. 2022. COVID-19 pandemic and its impact on challenges in the construction sector. A case study of Slovak enterprises. *Mathematics* 10: 3130. [CrossRef]
Gałaś, Andrzej, Alicja Kot-Niewiadomska, Hubert Czerw, Vladimir Simić, Michael Tost, Linda Wårell, and Slávka Gałaś. 2021. Impact of Covid-19 on the mining sector and raw materials security in selected European countries. *Resources* 10: 39. [CrossRef]
He, Pinglin, Hanlu Niu, Zhe Sun, and Tao Li. 2020. Accounting Index of COVID-19 Impact on Chinese Industries: A Case Study Using Big Data Portrait Analysis. *Emerging Markets Finance and Trade* 56: 2332–49. [CrossRef]
Jowitt, Simon M. 2020. COVID-19 and global mining industry. *SEG Discovery* 122: 33–41. [CrossRef]
Kekec, Bilgehan, Niyazi Bilim, and Dhikra Ghiloufi. 2022. An insight on the impact of COVID-19 on the global and Turkish mining industry. *Work* 72: 1163–74. [CrossRef]
Kruskal, William H., and W. Allen Wallis. 1952. Use of Ranks in One-Criterion Variance Analysis. *Journal of the American Statistical Association* 47: 583–621. [CrossRef]
Kubenka Michal, Kralova Veronika. 2013. Z Score in assessing the financial health in the construction sector. *E+M Ekonomie a Management* 1: 101–12.
Kucharčíková, Alžbeta, and Emese Tokarčíková. 2010. *Base of the Economic Theory*. Žilina: EDIS. 236p, ISBN 97-554-0179-9.
Laing, Timothy. 2020. The economic impact of the Coronavirus 2019 (COVID-19): Implications for the mining industry. *The Extractive Industries and Society* 7: 580–82. [CrossRef] [PubMed]
Majumder, Soumi, and Debasish Biswas. 2021. COVID-19 impacts construction industry: Now, then and Future. In *COVID-19: Prediction, Decision-Making and Its Impacts*. Berlin: Springer, p. 19. [CrossRef]
Mann, Henry B., and Donald R. Whitney. 1947. On a Test of Whether one of Two Random Variables is Stochastically Larger than the Other. *The Annals of Mathematical Statistics* 18: 50–60. [CrossRef]
Marimuthu, Ramaganesh, Bathrinath Sankaranarayanan, Syed Mithun Ali, and Koppiahraj Karuppiah. 2022. Green recovery strategies for the mining industry of India: Lessons learned from the COVID-19 pandemic. *Journal of Asian Business Studies* 16: 428–47. [CrossRef]
Muthuri, Judy, Aditya Jain, Arthur A. O. Ndegwa, Shadrack Mwakio Mwagandi, and Naa Dedei Tagoe. 2021. The impact of COVID-19 on gold and gemstone artisanal and small-scale mining in sub-Saharan Africa: The case of Ghana and Kenya. *Africa Journal of Management* 7: 121–47. [CrossRef]
Pangaribuan, Hisar, Denok Sunarsi, Aprih Santoso, Endah Sri Wahyuni, and Harsono Yoewono. 2023. Quality of Financial Statement and the Factors that influence it. *Jurnal Akuntansi* 27: 176–96. [CrossRef]
Pavolova, Henrieta, Katarina Culkova, Zuzana Simkova, Andrea Senova, and Dusan Kudelas. 2022. Contribution of Mining Industry in Chosen EU Countries to the Sustainability Issues. *Sustainability* 14: 4177. [CrossRef]
Paz-Barzola, Daniela, Daniel Elizalde-Pardo, Paola Romero-Crespo, Kenny Escobar-Segovia, Samantha Jimenez-Oyola, and Daniel Garces-Leon. 2023. The impact of COVID-19 for the Ecuadorian mining industry in 2020. *Risks and Opportunities* 36: 499–507. [CrossRef]
Sorokozherdyev, Kirill G., and Evgeniy A. Efímov. 2023. The influence of the regional sectoral structure on the socio-economic development of a region. *Economy of Regions* 19: 314–28. [CrossRef]
Strahl, Danuta. 2020. The Level and Dynamics of Economic Development Versus Employment Structures in Economic Sectors and Sections in EU Countries. In *Education Excellence and Innovation Managemnet: A 2025 Vision to Sustain Economic Development during Global Challenges, 35th International Business Information Management Association Conference (IBIMA), Seville, Spain, April 1–2*. Sewilla: International Business Information Management Association.
Sun, Wenjie, Shunli Ren, Kai Liu, and Chaoyao Zan. 2022. Decoupling China's mining carbon emissions from economic development: Analysis of influencing factors. *Frontiers in Environemtnal Science* 10: 944708. [CrossRef]
Susanto, Arif, Agra Mohamad Khaliwa, Muhamad Razif Iqbal, Edi Karyono Putro, and Asep Dian Abdilah. 2022. COVID-19 prevention and control: Mining industry responses to the pandemic. *National Public Health Journal* 17: 22–29. [CrossRef]

Tanaka, Katsuyuki, Takuo Higashide, Takuji Kinkyo, and Shigeyuki Hamori. 2017. Forecasting the vulnerability of industrial economic activities: Prediction the of bankruptcy companies. *Journal of Management Inforamtion and Decision Sciences* 20: 1–24. Available online: https://www.abacademies.org/articles/forecasting-the-vulnerability-of-industrial-economic-activities-predicting-the-bankruptcy-of-companies-6898.html (accessed on 5 March 2024).

Taušová, Marcela, Katarína Čulková, Lucia Domaracká, Mária Shejbalová-Muchová, Ján Koščo, Mária Drevková, and Barbora Benčoóvá. 2017. The importance of mining for socio-economic growth of the country. *Acta Montanistica Slovaca* 22: 359–67.

Tukey, John W. 1949. Comparing Individual Means in the Analysis of Variance. *Biometrics* 5: 99–114. [CrossRef] [PubMed]

Vanek, Michal, Milan Mikolás, Hana Rucková, and Jana Bartonová. 2011. Analysis of mining companies operating in the Czech Republic in the sector of non-metallic and construction minerals. *Mineral Resources Management* 27: 17–32.

Wilcoxon, Frank. 1945. Individual Comparisons by Ranking Methods. *Biometrics Bulletin* 1: 80–83. [CrossRef]

Wodak, Ruth. 2021. Crisis communication and crisis management during COVID-19. *Global Discourse* 11: 329–53. [CrossRef]

Zhang, Xi, Genhou Wang, and Nan Xiao. 2016. Research of mining industry of TAR amid construction of silk road economic belt. Paper presented at the 2015 International Conference on Economics, Social Science, Educytion and Management Engineering, Xi'an, China, December 12–13.