



ORIGINAL ARTICLE


Citation: Valaskova, K., Gajdosikova, D., & Lazaroiu, G. (2023). Has the COVID-19 pandemic affected the corporate financial performance? A case study of Slovak enterprises. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 18(4), 1133–1178. doi: 10.24136/eq.2023.036

Contact to corresponding author: Katarina Valaskova, katarina.valaskova@uniza.sk

Article history: Received: 3.04.2023; Accepted: 5.11.2023; Published online: 30.12.2023


Katarina Valaskova

University of Zilina, Slovakia

 orcid.org/0000-0003-4223-7519

Dominika Gajdosikova

University of Zilina, Slovakia

 orcid.org/0000-0001-7705-3264


George Lazaroiu

Curtin University, Australia

Toronto Metropolitan University, Canada

Cardiff Metropolitan University, United Kingdom

Spiru Haret University, Romania

 orcid.org/0000-0002-3422-6310

Has the COVID-19 pandemic affected the corporate financial performance? A case study of Slovak enterprises

JEL Classification: G01; G30; O16

Keywords: *financial performance; indebtedness; COVID-19 pandemic; Slovak enterprises*

Abstract

Research background: The corporate debt situation can be considered a crucial factor influencing the future development of the financial performance of the firm. It is essential for every business entity to know its financial health, its strengths and weaknesses, and how its business has been affected by the COVID-19 pandemic and all the changes it has brought.

Copyright © Instytut Badań Gospodarczych / Institute of Economic Research (Poland)

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Purpose of the article: The main aim of this paper is to explain and quantify the consequences of the COVID-19 pandemic, analyze changes in the growth of crucial determinants, and identify new trends in Slovak enterprises throughout the monitored period of 2018–2021.

Methods: Hence, a statistically significant difference between the individual indicators due to the period in which the firms achieved these values was determined using the Friedman test. It determined whether the average values of the financial indicators remained constant over the period under review (the years 2018 and 2019 are considered pre- COVID-19 years, while 2020 and 2021 are years when the globe was already being impacted by the outbreak of the COVID-19 pandemic) or whether the individual values of the indicators differed significantly.

Findings & value added: Considering that there are statistically significant differences in the indicators of self-financing ratio, current indebtedness ratio, and equity leverage ratio in all monitored periods except for the years 2020 and 2021, where the average values of these debt indicators are the same, the results indicate that the COVID-19 pandemic also negatively impacted the indebtedness of Slovak enterprises. Although this research paper, focusing on the financial performance of the firms in the post-pandemic period, is pioneering in Slovakia, the biggest contribution of the study is the application of the latest information, which could help in more precise monitoring of corporate financial stability and debt policy during the current challenging period. The obtained results provide important universal guidelines for building financial strategies improving long-term financial resilience of enterprises.

Introduction

The COVID-19 pandemic has significantly affected the financial health of enterprises in most countries, and also the worldwide economy (Michulek *et al.*, 2023; Kinnunen *et al.*, 2021). In addition to the approach of employers (Adamowicz, 2022) and the economic environment of individual markets (Hartmann *et al.*, 2022), it also had a slight but noticeable impact on consumer behavior (Horodnic *et al.*, 2022; Waliszewski & Warchlewska, 2021). The pandemic is an external factor that affects firms differently, depending on their focus (Głodowska *et al.*, 2023). In order to avoid the spread of the COVID-19 pandemic, many governments implemented measures worldwide (Labidi, 2023). In Slovakia, many types of interventions were presented. One of the most challenging measures was the lockdown of the economy, which involved restricting or outright prohibiting the functioning of some particular enterprises while isolating individual people (Harantova *et al.*, 2022). Depending on the type of enterprise, the impact of the COVID-19 pandemic on individual firms was significantly different (Žur & Wałęga, 2023). Some firms took advantage of the circumstances and improved sales (Chen & Wu, 2022), while others were negatively impacted by the COVID-19 pandemic (Xu & Jin, 2022). However, many enterprises were forced to stop their business and thus faced existential problems. Globally, business

entities operating in the fields of gastronomy (Ciołek, 2021), the hotel industry (García-Gómez *et al.*, 2021), and tourism (Kaczmarek *et al.*, 2021), as well as many manufacturing enterprises, suffered the most and were forced to completely stop their production due to production restrictions during the lockdown (He *et al.*, 2020; Valaskova *et al.*, 2022). With the suspension of business operations, the government of the Slovak Republic also accepted several types of financial subsidies, the purpose of which was to eliminate the negative consequences of the COVID-19 pandemic whose devastating effects on production, operations, and sales are reflected in a negative rate of return. Zhao *et al.* (2023) claim that its effects are significantly worse than those of the previous financial crisis. In these unfavourable circumstances, firms try to use limited sources of funds, which the authors argue will also have a negative effect on their performance. According to Sajnog and Rogozinska-Pawelczyk (2022), a company should always try to maximize its value for the benefit of shareholders by making investments that generate cash flow. Many financial resources that support the assets that this cash flow generates for the firm configure the corporate capital structure. The question of whether the financial resources that represent the capital structure with which the firm finances its business activity may influence its financial performance persists (Kristof & Virag, 2022). The arrival of the COVID-19 pandemic also caused significant difficulties in cash flows for companies. According to Brunnermeier and Krishnamurthy (2020), production and service delivery of enterprises stopped under the impact of several restrictive measures, which led to difficulties with the maturity of receivables. The effect of the gradual emergence of insolvency was caused by this phenomenon, which was typical of many enterprises (Pulawska, 2021). Reduced production caused a decrease in activity and turnover of individual property goods. The management results gradually decreased, which was reflected not only in the performance of the firm (Krasteva & Nagy, 2022), but also in its profitability (Miskufova *et al.*, 2022). Enterprises were compelled to request additional funding during the COVID-19 pandemic due to the demanding management of cash flows, which significantly impacted the capital structure and level of debt held by the company (Kovacova *et al.*, 2022) and had an impact on its financial performance (Gajdosikova & Valaskova, 2022).

Many authors worldwide, as previously mentioned, discuss financial success as one of the fundamental requirements for the long-term survival of a firm. Businesses must first identify the factors that can influence them

to be successful, and then determine the indicators that can be used to measure financial performance and, subsequently, manage it proactively. Nagy *et al.* (2022) highlighted that the financial success of an enterprise, which can be measured by its ratio of liquidity, solvency, or profitability, determines its financial performance. Individual governments also implemented aid packages to alleviate the poor economic situation in order to reduce the negative impacts of measures on businesses and prevent the business environment from collapsing. The COVID-19 pandemic is a milestone that significantly affected not only people's lives, but also the functioning of enterprises (Blazek *et al.*, 2023). The ability of companies to adapt to sudden changes comes to the fore, and for some types of companies this can mean avoiding bankruptcy (Korol & Fodadis, 2022), while for others it means the possibility of development and new opportunities (Nagy & Lazaroiu, 2022). The ability to adapt is related to the management's ability to react quickly and modify its plans and strategies. Making the appropriate choice depends on understanding the financial health of the firm, its strengths and weaknesses, and its operational predictions. In the case of significant global external effects, such as a pandemic, it is crucial to understand how and to what extent it can affect a firm. Due to this, financial analysis is becoming increasingly important as a tool for assessing financial health and monitoring the consequences of the pandemic, which have a direct impact on financial performance.

In general, the effects of the COVID-19 pandemic are observed from different perspectives, and it is interesting to monitor and quantify the related changes and how it has affected the lives of people in all its aspects. The main aim of this paper is to describe and quantify the COVID-19 pandemic's effects, evaluate changes in the growth of critical debt determinants, and simultaneously identify new trends in Slovak enterprises in the monitored period of 2018–2021 (the pre- COVID-19 years are 2018 and 2019, while the years of the globe being hit by the COVID-19 pandemic are 2020 and 2021).

Derco (2022) analysed the changes on the Slovak market (2018–2020) in conditions of market concentration and insolvency issues. He identified a decline in profitability indicators and an increase in the liability-to-assets ratio, and recommended the protection of enterprises against insolvency. Nemeč and Spacek (2020) debated on the consequences of the COVID-19 pandemic on macro-level financial aspects based on the qualitative research approach, but the same outputs were confirmed by Cajkova *et al.*

(2021) who added also quantitative methods to analyse the shortfalls caused by the COVID-19 pandemic. Tobisova *et al.* (2022) studied the way of re-evaluation and re-consideration of an effective financial policy in the context of various changes and restrictions brought by the COVID-19 pandemic, and they proposed a very specific simulation method. Moreover, the effect of the COVID-19 pandemic on financial problems of small and medium-sized enterprises in specific sectors was inspected also by Civelek *et al.* (2022), Sedliacikova *et al.* (2021), Dziwok and Karas (2021) or Szustak *et al.* (2021). However, none of these studies evaluated changes in the increase or decrease of critical determinants of financial stability and did not identify new trends in Slovak enterprises.

Thus, the biggest contribution of the study is the application of the latest data, which could help in more precise monitoring of corporate financial stability during the current challenging period. This research paper, focusing on the financial performance of the firms in the post- COVID-19-pandemic period, is also a pioneering one in Slovakia. Enterprises are under constant pressure to discover innovative methods and assess relevant indicators to grow and survive in the ever-changing business climate. In this situation, businesses need to build and strengthen their financial resilience in order to survive unforeseen circumstances and attain long-term sustainability. It is therefore important to analyse changes and identify trends, capabilities and strategies to enhance enterprise elasticity in specific national or local environments and so the outputs of the research may help enterprises to adjust quickly to changes in the environment by providing relevant and latest information to minimize vulnerabilities, prevent high-cost activities, and continue in business operation. The importance of one-country studies has arisen during the last COVID-19 pandemic, as each national economy has been affected differently based on the overall industrial orientation of the country.

The paper is divided into the following sections. The first part of the paper is focused on the main theoretical background of the issue as well as the most relevant and recent studies in the field. The methods for meeting the objective of this paper, which include describing and quantifying the COVID-19 pandemic's effects, assessing changes in the growth of crucial determinants, and simultaneously identifying new trends in Slovak enterprises for the monitored period of 2018–2021, are described in the second section. The third part describes the results obtained by the previous calculation of selected debt indicators and their subsequent statistical verifica-

tion with a description of the obtained results, which are compared in the context of other relevant studies published worldwide. The most important results of this research are summarized at the end of this paper, along with the limitations and future research on this issue.

Literature review

Crises generally occur relatively unexpectedly, despite the efforts of economists around the world to forecast the development of economies. The COVID-19 pandemic paralyzed the world, almost stopping the developed economies for a time. The COVID-19 pandemic hit the world unexpectedly, and scientists and analysts worldwide are attempting to quantify its impacts on a variety of factors, including employment (Privara, 2022; Kozak & Wierzbowska, 2022; Svabova *et al.*, 2021; Kramarova *et al.*, 2022) and GDP (Syarifuddin & Setiawan, 2022), via evaluations of the business environment (Bayramov *et al.*, 2023) or firms in various sectors (Cui *et al.*, 2021), to the investigation of changes in purchasing behaviour (Tesarova & Krizanova, 2022), among others.

Not only the development of the economy but also of the company itself depends on several factors, which primarily include the state of demand and supply on world markets, directly affecting the demand and supply of domestic products (Svabova *et al.*, 2022). Even before the arrival of the COVID-19 pandemic, the global economy was experiencing a decline in global demand (Moorhouse *et al.*, 2021; Durana & Valaskova, 2022), which gradually began to manifest itself towards the end of 2019 (Gunalan *et al.*, 2020). Gross domestic product (Burger & Slampiaková, 2021,) is a crucial indicator for assessing economic performance since its development reveals how the monitored economy has changed over time. According to Ciravegna and Michailova (2022), the first unfavorable consequences of deteriorated economic development may have been seen as recently as 2019, when Coccia (2021) reported that the global economy grew by just 2.9%. To reliably forecast quarterly GDP data for 8 major economies, the United States, Mexico, Germany, Italy, Spain, France, India, and Japan, Jena *et al.* (2021) developed a multilayer artificial neural networks model that can predict the consequences of a pandemic. Asian nations saw modest development from January to March. Compared to the prior quarter, India's GDP increased by 2.38%. Similar to the other nations, India imposed

a nationwide lockdown, as confirmed by Joshi *et al.* (2020). According to Sahoo and Ashwani (2020), as the economy was already slowing when the COVID-19 pandemic broke out, the growth rate from January to March 2020 does not accurately represent the effects of the lockdown. The Japanese economy decreased by 0.5% during that period compared to the previous quarter; that was the second straight quarter in which economic growth declined. Even Iwamoto *et al.* (2021) stated that the Japanese economy has been severely impacted by decreased exports due to a trade war between the US and China, followed by a drop in consumer expenditure. There was a slowdown in the national economy in a few countries, principally caused by the development of the external environment and the implementation of first measures in particular economies.

The industrial sector is typically regarded as the most crucial domain of the economy from the perspective of its structure in numerous countries (Szczygielski *et al.*, 2022), as industry development directly affects the growth of the GDP. At the end of 2019, the first restrictive measures appeared in China, which had already begun to appear in the rest of the developed world during that period. Despite the above, economies have not yet collapsed, as was the case the following year, when restrictive measures predominantly impacted global demand. According to Medlock *et al.* (2021), the resulting trade balance deficit varied depending on the GDP of the individual countries. The measures introduced as part of the fight against the spread of COVID-19 mainly affected tourism (Sigala, 2020) and the service sector (Zayed *et al.*, 2022). Jena *et al.* (2021) indicate that, in contrast to Germany, nations with a greater dependence on tourism and the service sector include France and Spain, where the largest impact is shown. The drop in GDP in connection with the COVID-19 pandemic can thus be considered a global problem.

The destructive spread of the COVID-19 pandemic, along with the expansion of restrictions in several countries, has resulted in a sharp decrease in economic growth and led to recession (IMF, 2020). Whereas previous recessions were caused by an inherent economic or financial shock, the current recession is driven on by a public health crisis (Zhou & Zhou, 2022). The decrease in aggregate demand resulted in more layoffs, which led to higher unemployment. According to Tan *et al.* (2022), all industrial sectors saw a decline in consumer demand as a result of COVID-19, which led to a serious unemployment crisis that affected not just hourly workers but also professionals who were paid salaries. Rojas *et al.* (2020) examine

how COVID-19 cases and school closings affect state job markets and discover that these two variables partially explain for the difference in unemployment patterns across states. Their findings are related to the health economics literature on population health and economic activity, demonstrating that negative public health shocks can have massive consequences on labor markets that dwarf the effects of interventions aimed to alleviate the COVID-19 pandemic itself. Using exogenous regional variation in Korea, Aum *et al.* (2021) quantify the causal impact of COVID-19 outbreaks on the labor market. The main finding, which states that a one in 1,000 increase in confirmed infections corresponds to a 2.7% decrease in employment, is roughly half as large as non-causal estimates from the US or the UK, which confuse the direct consequences of COVID-19 with lockdown effects. Lukacova *et al.* (2022), Svabova *et al.* (2021) or Kramarova *et al.* (2022) investigated how labor relations influenced the COVID-19 pandemic benefit regimes in the Visegrad Group countries. The regulatory framework of the jobless benefits programs in Czechia, Hungary, Poland, and Slovakia is different from that of their European counterparts because of their relatively low value, strict qualifying requirements, and shorter period of support. The COVID-19 pandemic caused a sharp increase in unemployment in Germany as well. Bauer and Weber (2021) examined how the COVID-19 containment measures in Germany would affect the labor market over the short term. By evaluating the treatment effect on unemployment using difference-in-difference estimation, the authors found that 60% of the considerably greater inflows from employment into unemployment in April 2020 were brought on by the shutdown actions. Monitoring the impact of the COVID-19 pandemic on unemployment in Romania was dealt with by Radulescu *et al.* (2021), which determined its effect on the Romanian labor market, and Davidescu *et al.* (2021), whose study is intended to anticipate the unemployment rate for the years 2020 through 2023 using the Box-Jenkins approach based on ARIMA models, examining also the uncertainty based on fan charts.

Based on the previous literature review, the first hypothesis was developed, that *there are statistically significant differences in the corporate financial performance across the years caused by the COVID-19 pandemic (i.e. the COVID-19 pandemic and changes in the macroeconomic development have significantly affected the corporate financial stability of enterprises)*

The COVID-19 pandemic caused several restrictive measures to be implemented by the governments of individual countries to stop the spread of

the virus, significantly impacting the financial performance of business entities. To assess the overall financial performance, the financial statement analysis uses a variety of tools and techniques (Qin *et al.*, 2022). Ratio analysis is the main instrument in financial analysis, and it expresses the connection between financial data in various financial statements (Linares-Mustaros *et al.*, 2022). This assessment also includes investigating the causes of the changes in these ratios. The most frequently used ratios, according to Ghenimi *et al.* (2020), are liquidity ratios, solvency and leverage ratios, profitability ratios, investors' ratios, and cash flow ratios. These ratios were widely used in earlier studies to measure and evaluate financial performance, particularly during national or worldwide crises and difficulties. According to Ahmad *et al.* (2020), these indicators enable a synthesis of the information obtained from the statements and give a wide range of important information about the firm that may help them make financial decisions. Such financial analysis is especially relevant during times of crisis as the COVID-19 pandemic (Bhavani *et al.*, 2021; Kitowski, 2022; Rutkowska-Tomaszewska *et al.*, 2022). According to specific research on COVID-19, different variables have varying effects on the corporate performance (Heyden & Heyden, 2021). Additionally, the latter authors noted that businesses with higher level of tangibility and liquidity had the best market results. The findings on profitability were inconclusive. The decline in corporate profitability might indicate issues with companies' capacity to fulfill their obligations in general, including paying employees, suppliers, taxes, etc. Due to this consequence, businesses may turn to loans and funding (Derco, 2022). Therefore, it was expected that corporate debt would rise as the COVID-19 pandemic developed. According to several sources (Ellis, 2021; Mirza *et al.*, 2023), companies' capacity to fulfill all their debts is in doubt given the current operating cycle and growth in debt.

Corporate financial performance is negatively impacted by national or global economic, political, and general health difficulties. Many of these crises, including the Asian financial crisis of 1997–1998 (Ha, 2022), the global financial crisis of 2008 (Tran & Tran, 2023), and many diseases like the SARS virus (Kung *et al.*, 2022), had a significant negative impact on the global economy. In the past, financial ratios have been extensively used to analyse how enterprises performed during worldwide crises. Tan (2012) examined, in 277 Asian enterprises, the impact of the Asian financial crisis on corporate performance using leverage and profitability indicators. The impact of the global financial crisis on the Greek dairy enterprises was

studied by Notta and Vlachvei (2014) using leverage, profitability, and liquidity ratios, and they concluded that corporate financial performance was significantly impacted by that crisis. Demirhan and Anwar (2014) used eleven financial ratios to analyse the performance of Turkish companies during the global financial crisis. Generally, the performance of firms was shown to be negatively impacted by the financial crisis.

Research results of the COVID-19 pandemic and its impact on corporate performance have been conducted in various contexts, including developed countries (Chen *et al.*, 2022), emerging economies (Ben Hssain *et al.*, 2022; Ghosh & Bhattacharya, 2022; Nguyen *et al.*, 2022; Shear & Ashraf, 2022; Wang *et al.*, 2022), and specific regions, such as G20 countries (Atayah *et al.*, 2022; El Khoury *et al.*, 2022), the ASEAN-5 (Ardiyono, 2022), and the Gulf Cooperation Council (Mzoughi *et al.*, 2022). Some studies evaluated the effect on the financial performance of particular sectors, such as hospitality or tourism (Boto-Garcia & Mayor, 2022; Ghosh & Bhattacharya, 2022), construction (Sang *et al.*, 2022; Alsamhi *et al.*, 2022), logistics (Nguyen, 2022; Atayah *et al.*, 2022), telecommunications (Muftiasa *et al.*, 2023), health care (Vrontis *et al.*, 2022), banking (El-Charani *et al.*, 2022a; Nguyen *et al.*, 2022), or airlines (Chen *et al.*, 2022; Fontanet-Perez *et al.*, 2022).

Taking the previous international studies into consideration, the changes in the development of crucial financial ratios should be examined also in the Slovak environment. Thus the second hypothesis *tests statistically significant changes in the development of critical financial ratios (indebtedness ratios) caused by the COVID-19 pandemic across the years.*

The worldwide outbreak of the COVID-19 pandemic significantly highlighted the financial performance of firms. Many authors (e.g., Albuquerque *et al.*, 2020; Khatib & Nour, 2021; El-Charani *et al.*, 2022b; Gazi *et al.*, 2022) pointed out that companies that regularly monitored and regularly increased their financial performance overcame the crisis times caused by the outbreak of the COVID-19 pandemic significantly more easily and with less loss than companies that neglected such issue. Even though economy in Slovakia is primarily driven by the industrial and construction sectors, which went through lockdowns and quarantines, only a few studies have examined the impact of the COVID-19 pandemic on corporate performance there. Businesses are always under pressure to find new ways to operate and evaluate pertinent metrics in order to thrive in the dynamic business environment. To improve enterprise resilience in particular national or local environments, it is crucial to investigate changes

and identify trends and corporate capabilities. The findings of the study may assist enterprises in quickly adapting to environmental changes by offering pertinent and up-to-date information to reduce vulnerabilities, avoid costly activities, and run ongoing business operations.

Research methods

The COVID-19 pandemic highlighted the financial performance of businesses, as companies that regularly monitored and improved their financial performance overcame these crisis times significantly easier than enterprises that did not focus on such issue. According to Bouri *et al.* (2020), a financially stable company can operate simpler during recessions because it has enough financial resources and can more easily deal with a drop in market demand. Thus, financial stability may be considered a measure of how well a business can respond to changes not only in the microeconomic (Alamsyah *et al.*, 2022), but also in the macroeconomic environment of the company (Radovic-Markovic *et al.*, 2022; Ha Hong, 2022).

Individual financial data from the ORBIS database, was the basis for the financial analysis. The search for firms operating in Slovakia indicated 30,130 enterprises. The acquired database of financial data had to be adjusted before calculating the most crucial financial indicators. Enterprises were removed from the generated dataset if they did not provide all the required data for financial analysis throughout the monitored period of 2018–2021 (the pre- COVID-19 years are 2018 and 2019, while the years of the globe being hit by the COVID-19 pandemic are 2020 and 2021). Any outliers that would have reduced the usefulness of the conclusions drawn from the realized financial analysis were also removed using Z-Score method. Using this approach, it is possible to determine the difference between each received signal strength observation and the time-series mean received signal strength observation. Following that, the result is divided by the standard deviation of the observation. When the Z-Score is 0, the mean of the time-series observation and the received signal strength observation are equal. A positive and a negative Z-Score indicate that the received signal strength measurement is above and below the mean. A received signal strength observation is regarded as an outlier if its Z-Score value is higher than an established threshold. In general, the most used threshold for detecting outliers is ± 3 (Yaro *et al.*, 2023). Accordingly, when

the Z-score value of a received signal strength observation was higher than ± 3 in this research, we regarded it as an outlier. After this adjustment, the database now contains 1,618 firms, whose essential identification data are shown in Table 1.

The complete dataset necessary for the debt analysis of firms operating in Slovakia is included in the final data. To evaluate the firm size characteristics, the following conditions were considered: a very large enterprise fulfils at least one of the following conditions: operating revenue ≥ 100 million EUR, total assets ≥ 200 million EUR, and employees $\geq 1,000$. A large enterprise is regarded as one with an operating revenue of ≥ 10 million EUR, total assets ≥ 20 million EUR, and employees ≥ 150 . An enterprise is considered medium-sized if it satisfies at least one of the following requirements: operating revenue ≥ 1 million EUR, total assets ≥ 2 million, and employees ≥ 15 . Small enterprises are defined as those that do not meet these criteria. The final dataset contains the most enterprises operating in the medium-sized enterprise category. On the contrary, the category that is least represented is that of very large enterprises.

Three types of ownership structures that enterprises operating in Slovakia implement are partnerships, private limited companies, and public limited companies. A private limited company has been legally incorporated into supplementary legal identities. In this legal form, the shareholders are only partially liable for any debts incurred by the enterprise (Ferlie & Trenholm, 2019). Many firms in Slovakia have the legal form of a private limited company. A public limited company, which is sometimes mistaken for a private limited company, differs in that it can offer the sale of the shares of the enterprise to the general public. According to Haloub *et al.* (2022), the enterprise might benefit financially from this approach. Another type of legal form established by a few individuals who are involved in the ownership and decision-making of the business and its earnings is a partnership. According to Kusio *et al.* (2022), each individual may provide a distinctive field of specialization to the firm in order to improve its marketability.

The information about the number of years on the market was also considered. It is evident that enterprises operating the longest in the market have the least share (more than 50 years). Many enterprises in Slovakia are those that have been there for 10 to 20 years. Because they dominate and have been in the market for more than 10 years, these firms are sufficiently stable and will give the research the appropriate data.

In Slovakia, most enterprises operate in the category Wholesale and retail trade, including NACE G. Because the Slovak Republic is well-known for its automobile manufacturing, this category took first place. Their subsequent sale and provision of service are closely related to the production of cars. The category Manufacturing, comprised of NACE B, C, D, and E, can be considered also an important economic sector. Today, manufacturing is still paramount in Slovakia. On the contrary, the fewest enterprises in the sample operate in category Agriculture, including NACE A (Table 1). The simplified version of sectoral classification was chosen (following the standards of the Statistical Office) to obtain relevant, consistent and comparable information on production economic activities necessary for the decision-making process at all levels of management and satisfying the needs of users at the corporate, national and international level.

Less debt being used by the firm currently is often an indication that the enterprise is financially healthy. Riskier, higher debt often results in less cash available for general operations and supplier payments since the firm must pay interest expenses. The financial analysis of enterprises operating in the Slovak Republic was performed using 10 crucial debt ratios, their formulas are provided in Table 2. These indicators are the most frequently used financial ratios used to measure the level on indebtedness and they also reflect the level of financial stability and insolvency of enterprises.

Individual financial indicators were calculated using financial data (in thousands of euros), and basic descriptive statistics such as mean, median, standard deviation, minimum, maximum, and coefficient of variation (CV) are included in Table 3.

The following methodological steps were used to perform the overall financial analysis:

1. Firstly, for each firm operating in Slovakia throughout the monitored time horizon, which was defined for the years 2018 to 2021, crucial financial ratios were determined. Using the methods of analysis, exploration, and explanation, individually calculated financial parameters impacting business performance were subsequently examined.
2. Subsequently, the normality tests were used to confirm whether a dataset is well-modeled by a normal distribution. In addition to the graphical assessment of normality, the statistical test of normality can also determine whether a population proportion uses a non-normal distribution (Bishara *et al.*, 2021), and is useful since it can be difficult to discern whether any deviation from linearity is systematic or the result of sam-

ple variation (Kolkiewicz *et al.*, 2021). The null hypothesis states that the population proportion comes from a normal distribution, while the alternative indicates that the population proportion is from a non-normal distribution. The original sample size limitation for the Shapiro and Wilk (1965) test was 50. This test was the first to be able to detect deviations from normality, using either skewness, kurtosis, or both, and, due to its strong power characteristics, it has become the recommended test (Avram & Marusteri, 2022). The Shapiro-Wilk test covers the composite hypothesis that the data are independent, identically distributed, and normal given a sample X_1, X_2, \dots, X_n of n real-valued observations, i.e. $N(\mu, \sigma^2)$ for some unknown real μ and some $\sigma > 0$. It is unlikely to lose any information while getting the order statistics $X_{(1)} \leq X_{(2)} \leq \dots \leq X_{(n)}$ if the data X_1, X_2, \dots, X_n are arranged in order (Hanusz *et al.*, 2016). It is required to consider the expectations of Z_j as well as the correlation of $X_{(1)}, X_{(2)}, \dots, X_{(n)}$ to determine if the order statistics of X_j are well connected with expected standard normative order statistics. A correlation less than 1 would suggest non-normality, but a correlation close to 1 would represent a considerable fit to normality. According to Demir (2022), if a constant is added to all the X_j , it is then added to their order statistics, as well as to \bar{X} , leaving $X_{(j)} - \bar{X}$ and s_x unchanged. If all X_j are multiplied by a positive constant, the ratios $\frac{(X_{(j)} - \bar{X})}{s_x}$ and correlation remain constant. Therefore, if the X_j are independent and identically distributed normal, the correlation will have the same distribution regardless of location μ or scale σ of the X_j . The $Z_{(j)}$ and its expectations m_j have several symmetry properties. The more well-known Shapiro-Wilk statistic uses both the means and covariances of the normal order statistics $Z_{(j)}$, whereas the Shapiro-Francia statistic (Shapiro & Francia, 1972, pp. 215-216) uses the squared correlation of $X_{(j)}$ with m_j . The original Shapiro-Wilk test statistic is defined by

$$W = \frac{\sum_{j=1}^n a_j X_{(j)}^2}{\sum_{j=1}^n (X_j - \bar{X})^2} \quad (1)$$

as in Shapiro and Wilk (1965). According to Yap and Sim (2011), the value of W is between zero and one. However, one indicates that the data are normally distributed, whereas smaller values of W result in the rejection of normality. To test for normality, many other commonly

used normality tests exist, such as Anderson-Darling test (Anderson & Darling, 1954), Cramer-von Mises test (Cramer, 1928), and Kolmogorov-Smirnov test (Kolmogorov, 1933; Smirnov, 1936). The Kolmogorov-Smirnov test statistic is the maximum absolute difference between the cumulative distribution function and normal cumulative distribution function, compared to the Anderson-Darling and Cramer-von Mises tests, which are based on a weighted integral of the squared difference. The output of statistical software typically includes the normality test p-values, and a small p-value is interpreted as indicating that the sample does not come from a normally distributed population. This test of a parametric hypothesis is typically related to nonparametric since many statistical methods (such as t-tests and analysis of variance) assume that variables are normally distributed. If not, nonparametric methods might be required.

3. In the next step, to identify treatment differences in multiple test trials, the Friedman test, a nonparametric alternative for one-way ANOVA with repeated measures analysis of variance by levels, was performed. The Friedman test ranks the K algorithms considered on each dataset independently (Lopez-Vazquez & Hochsztain, 2019). The data can be grouped into a table with n rows and K columns, where the rows represent the blocks, and the columns typically reflect the various conditions. Ranks ($R_{ik}, i = 1, \dots, n; k = 1, \dots, K$) of the conditions by blocks are used as the data of the test, thus $1 \leq R_{ik} \leq K, i = 1, \dots, n$ (Xu *et al.*, 2017). The data must adhere to two assumptions: (i) the variables must be mutually independent, so that the findings in one block do not impact the results in another, and (ii) the observations in each row may be ordered individually based on some criteria (Sayyareh, 2017). Friedman's test examines if the rank totals for each condition deviate noticeably from the expected values, according to Benavoli *et al.* (2016). The test statistic created by Friedman is

$$F_r = \frac{12}{nK(k+1)} \sum_{k=1}^K R_{.k}^2 - 3n(K + 1) \quad (2)$$

where $R_{.k} = \sum_{i=1}^n R_{ik}$ is the sum of the ranks for each condition k over the n blocks. Under the null hypothesis, this statistic F_r has an asymptotic Chi-square distribution with $K - 1$ degrees of freedom as n tends to infinity. Generally, the null hypothesis is rejected at the level of significance if $F_r \geq \chi_{K-1;1-\alpha}^2$, where $\chi_{K-1;1-\alpha}^2$ is the $(1 - \alpha)$ quantile of the

Chi-square distribution with $K-1$ degrees of freedom (Lopez-Vazquez & Hochsztain, 2019).

4. Friedman's test results indicate a considerable difference between groups but do not identify which pairs of groups are different. Consequently, it is generally necessary to apply a post hoc procedure for pairwise comparison once these multiple comparison tests have rejected the null hypothesis (Sayyareh, 2017). In order to investigate differences between pairs of medians, there are multiple comparison techniques available in the literature. However, the Bonferroni correction was used in this study to reduce the likelihood of obtaining a statistically significant result and to identify the problem of multiple comparisons. According to Xu *et al.* (2017), the Bonferroni-Dunn test is adjustable and can be applied to examine if differences exist between two conditions as well as among all conditions. Previously, Dunn (1961) discussed how to handle this issue using a Bonferroni adjustment, which may change the rejection level for any test by dividing α by the total number of tests and requires a significantly lower p-value to reject any test. The Bonferroni-Dunn test, according to Lopez-Vazquez and Hochsztain (2019), uses an adjustment to the critical value used to reject the null hypothesis in order to lower the familywise Type I error rate, i.e. $1 - (1 - \alpha)^c$, where $c = K(K - 1)/2$ is the number of comparisons and α is the per comparison Type I error rate. The overall probability of committing at least one Type I error in the set of comparisons is adjusted to ensure that it does not exceed a predetermined α (Liu & Xu, 2022). The conditions k and j are considerably different if

$$|R_{.k} - R_{.j}| \geq z_1 - \frac{\alpha}{K(K-1)} \sqrt{\frac{nK(K+1)}{6}} \quad (3)$$

where $z_1 - \frac{\alpha}{K(K-1)}$ is the $\left(1 - \frac{\alpha}{K(K-1)}\right)$ quantiles of the standard normal distribution (Xu *et al.*, 2017).

Results and discussion

The evaluation of corporate debt is often based on a variety of debt indicators. In order to achieve the aim of this research paper, the following 10

debt ratios were chosen. Table 4 summarizes their average values during the observed time horizon of 4 years.

The most important indicator is the total indebtedness ratio, which characterizes the share of debt in total assets. Before the outbreak of the COVID-19 pandemic, the level of indebtedness of companies operating in Slovakia reached an average value of over 60%, while during the COVID-19 pandemic, the value of this indicator gradually decreased. In 2021, the average debt ratio was the lowest, at 57.1%. According to Johnson and Yushkov (2022), this indicator can also be interpreted as a measure of the debt burden on total assets. The recommended value of the total indebtedness ratio ranges from 30 to 60% (Zhao & Fang, 2022). According to Yazdanfar and Ohman (2015), the optimal value differs depending on the association of the company with the industry. Manufacturing firms need to have more own financial sources, where a value of up to 70% is often stated. On the contrary, companies operating in the service sector usually tie up a significantly lower share. According to Kramolis and Dobes (2020), high debt levels might be justified by substantial reserves, which, while derived from internal resources, are reported on the balance sheet as a foreign source of the firm. From the perspective of creditors, it is preferable to create a sizable financial reserve in the case of corporate bankruptcy, which is related to the fact that, if the value of the ratio is higher than the industry average value, it will be harder for the company to obtain foreign capital because creditors will demand that they participate as risk owners to a greater extent (Gajdosikova *et al.*, 2023b).

The self-financing ratio indicates how independent the company is or how much of its business activities are financed by equity. Since this indicator complements the total indebtedness ratio, its growth during the monitored period was exactly the opposite. Because the level of the self-financing ratio steadily rose over time until it reached an average level of 40.6% in 2021, enterprises started to finance their operations primarily using equity after the outbreak of the COVID-19 pandemic. This indicator evaluates the overall stability of the company (Svidronova & Vacekova, 2012), while it should not fall below the level of 20–30% (Mazanec & Bartosova, 2021). In general, the level of the indicator depends primarily on the area of operation of the firm, industry classification according to NACE, interest policy, availability of credit and other factors. Monitoring the self-financing ratio in addition to the return on equity is recommended, (Dinh & Pham, 2020). If the company mainly uses foreign resources to fi-

nance its business activity, it is recommended to monitor the level of current indebtedness ratio and non-current indebtedness ratio.

The current indebtedness ratio indicates the ratio of short-term debt to the total assets of the firm. Conversely, the non-current indebtedness ratio shows how much corporate assets are financed through long-term debt. From the financial analysis results, which were focused on corporate indebtedness, it is clear that the share of the corporate short-term or long-term debt in its total assets gradually decreased from year to year, which is also related to the gradual reduction of the total indebtedness ratio. Enterprises use short-term debt to a greater extent, which, according to Chen *et al.* (2021) is essential not only for the creditors of the firm, but also for its investors, as it determines whether the company is liquid enough to repay its short-term obligations.

The debt-to-equity ratio is comparable to the total indebtedness ratio in that both indicators increase when the use of debt in the capital structure of the firm increases (Flor *et al.*, 2023). According to Batrancea (2021), this indicator is closely related to liquidity since it reveals the ability to repay debts. Ghardallou (2022) claims that the Central European countries are in a beneficial condition if the value of the indicator is at the level of 1 to 2. The optimal debt-to-equity ratio is considered to be between 0.5 and 1.5 in most industries, according to Zhu (2022), while Nukala and Rao (2021) suggest that the proper range is between 0 and 2.5. Values greater than 2 are typically considered riskier by creditors and owners, yet even in this situation the most appropriate value depends on the industry in which the enterprise operates (Herciu & Ogrean, 2017).

In 2018, which represents the year with the highest average level of debt, the average value of the indicator in the conditions of Slovak enterprises is slightly over the optimal level, according to the computed data. The average value of the monitored ratio gradually decreased after the COVID-19 pandemic outbreak, which is beneficial for firms because, according to Batrancea (2021), the lower the ratio, the better, because a high value of the monitored indicator is frequently related to high risk.

The interest coverage ratio, which identifies the ability of the firm to cover the cost of debt, is primarily used to monitor the adequacy of debt bearing. According to Chadha and Sharma (2015), this measure reveals how corporate revenues cover its interest payments. The lower the value of the indicator, the more the company is burdened with interest costs. The ratio reached an average value of 9.951 in 2018, which gradually increased

during the monitored period, with the exception of 2019, when there was a slight decrease. Lee and Hu (2018) point to the fact that this indicator informs creditors about the level of the created financial reserve in case of bankruptcy, and shareholders about how much of the corporate profit will remain after paying the price of the debt. Gul and Cho (2019) consider a value greater than 3 to be optimal, but, according to Zulkipli *et al.* (2019), even a value of 4 is considered risky, and the optimal value is in the range of 6 to 8. Generally, the higher the value of the interest coverage indicator, the more desirable it is for the company.

The interest burden ratio, which represents the share of interest payments made by the firm on profits earned, is the reversed indicator of the interest coverage ratio. In comparison to the interest coverage indicator, the average value in the conditions of Slovak companies gradually decreased from year to year, while, after the outbreak of the COVID-19 pandemic, 1€ of earnings before interest and taxes accounted for 0.132€ of interest paid in 2020, and the value of the ratio decreased to 0.122€ in 2021. A high value indicates a significant amount of profit available to cover the debt, but the ratio may also suggest that the firm is not using its debt effectively. According to Jeppson *et al.* (2021), in the long term, the value of the indicator must be lower than 100%.

The equity leverage ratio, which reflects the amount of assets made up of equity and is the inverse value of the self-financing coefficient (Michalkova *et al.*, 2021), also has a significant impact on corporate efficiency. The value of the monitored indicator significantly decreased from year to year during the observed period. Before the outbreak of the COVID-19 pandemic, the equity leverage ratio reached an average value above 3, while after the beginning of the COVID-19 pandemic, the average value of the indicator in the conditions of Slovakia gradually decreased below this level. In general, if the ratio has a downward tendency, the company is tying up excess capital from its own resources (Pekarek, 2022). According to Istok and Kanderova (2019), a higher indicator value denotes a lower percentage of owned resources and a higher share of debt in the overall financing. Eisdorfer *et al.* (2013) found that the optimal level fluctuates about 1.5, whereas Tousek *et al.* (2021) stated that a desired level of 4 is reached when 75% of the business activity is financed by debt. Similar to the self-financing ratio, this indicator needs to be related to profitability indicators, primarily the profitability of equity capital, due to the effect of financial leverage, which is positive if the profitability of invested capital is

higher than the price of interest-bearing foreign resources (Pal & Nandy, 2019).

The financial independence ratio is the next indicator to determine the financial stability of the firm. Following the outbreak of the COVID-19 pandemic, the average value of the monitored ratio in enterprises operating in Slovakia in the years 2018–2021 steadily increased, indicating a rise in the use of own resources to fund business needs. According to Melnik *et al.* (2020), this indicator reveals how much a firm can finance its business activity using its own resources, which indicates how high the level of financial independence is.

The last calculated indicator is the insolvency ratio, which can be used to interpret the proportion of liabilities to corporate receivables. The average value expanded in the period before the COVID-19 pandemic, and, within the monitored period, it reached its highest level during 2020, when many negative effects that the COVID-19 pandemic brought with it were observed. In 2020, 1€ in receivables accounted for 3.011€ in total liabilities. The insolvency indicator, which, according to Mirmozaffari *et al.* (2022), represents the overall financial stability of the firm, must be constantly monitored by the company. However, the average value decreased again in 2021. According to Schonfeld (2020), primary insolvency results when the liabilities of the firm exceed its receivables and the indicator value is higher than 1. On the contrary, the firm is in secondary insolvency if the ratio value is less than 1, which occurs when its claims exceed its liabilities. This indicator consequently provides a financial health evaluation by indicating whether the cash flow is sufficient to pay for its long-term obligations (Michalkova *et al.*, 2022). As the changes were not considerable, and more or less merely reflected trends from previous years before the COVID-19 pandemic, it was determined that the beginning of the COVID-19 pandemic in 2020 had little impact on the financial situation of the examined firms in the area of solvency based on the results of the analysis.

The corporate indebtedness is related to the fact that the firm uses debt to finance its business activities. Generally, it relates directly to the capital structure, with the share of equity and debt providing information on the financing structure. According to Al Amosh *et al.* (2022), debt financing can be primarily subsequently specified into short-term and long-term debt, while currently, in practice, short-term debt is mainly used because it represents a lower risk from the point of view of creditors.

In addition to evaluating and monitoring the corporate capital structure, debt indicators assess the ability to repay obligations. Financial stability is determined by the ratio of equity and debt, and thus identifying the optimal proportion of financial resources is crucial (Kalusova & Badura, 2017). A higher share of equity contributes to corporate stability when the company becomes independent. On the contrary, it becomes unstable if it has a low proportion of equity. Although a higher level of indebtedness may not explicitly mean a negative, since the cost of equity capital is higher compared to the cost of foreign capital (Valaskova *et al.*, 2019), it is nevertheless true that the higher the indebtedness of the firm, the greater the risk of the business arises, which results in a more difficult acquisition of debt financing (Durana *et al.*, 2021). Another reason why high indebtedness does not necessarily mean a negative is that its growth contributes to increasing profitability or market value (Kovacova *et al.*, 2022), but only in financially stable companies (Ruckova & Skulanova, 2022). There is also no direct connection between indebtedness and the insolvency of a firm, because a higher level of corporate debt does not automatically lead to insolvency (Krabec & Cizinska, 2022), and therefore it is necessary to compare these indicators with liquidity indicators (Zaremba, 2016).

A statistically significant difference between the individual indicators throughout the period in which the firms achieved these values was monitored by the detailed financial analysis. The basic aim was to determine if the average values of the financial indicators remained constant in all years of the period under review (the years 2018 and 2019 are regarded as pre-COVID-19 years, while 2020 and 2021 are years when the globe was already being impacted by the breakout of the COVID-19 pandemic), or whether the individual values of the indicators differed widely from each other.

Using the Kolmogorov-Smirnov and Shapiro-Wilk tests, it was first essential to confirm the normality of the dataset, but the results rejected the null hypothesis that the data derived from a normal distribution. Nonparametric tests, which are statistical analysis techniques that do not require a distribution to fulfill the necessary assumptions to be analyzed, are usually applied if the data are not normally distributed. Hence, a statistically significant difference between the calculated indicators concerning the year was determined using the Friedman test, a non-parametric alternative to the one-way ANOVA with repeated measures. When the measured dependent variable is ordinal, the Friedman test examines if there are differ-

ences between groups. The Friedman test result is summarized in Table 5. For some financial ratios, the p-value of the test is less than the chosen level of significance, which indicates that the null hypothesis of equal median values of debt ratios is rejected. It is possible to conclude from the results that there are statistically significant differences between all indicators of indebtedness concerning the monitored year. Thus, the statistical tests confirm that the macroeconomic development (including the COVID-19 pandemic in 2020 and 2021) has significantly affected the corporate financial stability of enterprises.

As there are statistically significant differences in the monitored debt indicators, a post hoc analysis was used to determine between which monitored periods the differences in the individual indicators are the most significant. Table 6 contains the results of the pairwise comparison of the monitored years. The total indebtedness ratio, debt-to-equity ratio, and financial independence ratio indicate statistically significant differences between all monitored periods. However, the results indicate that the COVID-19 pandemic also adversely affected the indebtedness of Slovak companies because there are statistically significant differences in the indicators of self-financing ratio, current indebtedness ratio, and equity leverage ratio in all monitored periods, with the exception of 2021 and 2020, where the statistically significant differences were not confirmed, and the average values of these debt indicators are the same. However, the non-current indebtedness ratio and the insolvency ratio similarly reveal the same average values for 2020 and 2019, 2020 and 2018, and 2019 and 2018. Thus, based on the results of the post-hoc test, the second hypothesis was confirmed. as there are statistically significant changes in the development of critical debt determinants caused by the COVID-19 pandemic. In some cases (current indebtedness ratio, non-current indebtedness ratio, interest coverage ratio and insolvency ratio), the p-value (Sig.) equals 1, which means that there are no differences between the analysed pairs of years other than due to chance.

Financial performance monitoring is essential for companies operating in a challenging and competitive environment, especially during the COVID-19 pandemic. Using the financial data of listed Chinese companies, Shen *et al.* (2020) investigated the impact of the COVID-19 pandemic on corporate performance. The findings have showed that the COVID-19 crisis had a negative effect on business performance, and that this impact is more obvious when a corporate investment scale or sales revenue is smaller. The

same negative effect was declared on the sample of Slovak enterprises mapping the changes in indebtedness ratios, and thus influencing the overall financial stability of enterprises. A sample of 188 non-financial firms listed in Malaysia for 2019 and 2020 was used by Khatib and Nour (2021) to evaluate the effect of COVID-19 on firm and governance characteristics as well as the corporate performance association. The panel OLS regression between the variables was estimated using several governance and performance attributes. Based on the research results, all firm characteristics, including firm performance, corporate governance structure, dividend level, liquidity, and leverage, have been impacted by the COVID-19 crisis, but not significantly, as the difference between before and after the COVID-19 pandemic is not statistically significant. These outputs are in contrast with our findings which may be the consequence of the national economy orientation and focus. Pooled ordinary least square regression was used also by Rababah *et al.* (2020) as a baseline approach to assess the significantly serious negative consequences of the COVID-19 pandemic on the financial performance of Chinese listed firms. Overall revenue, profitability, and investment in firms across industries have all decreased as a result. However, businesses that largely depend on travel and tourism, transport, and other related industries for a significant portion of their revenue during the first quarter of 2020 are impacted particularly hard. Since the COVID-19 pandemic hit China, the overall financial performance of the Chinese firms has decreased across all industries, although this financial impact may be reduced by introducing new investments. The situation is very similar also in Slovak environment. The interest coverage ratio uses the level of earnings before interest and taxes, and it is evident (Table 4) that the development of this indicator worsened in the analysed period (the optimal value is 3–5) which was caused by significant changes in the profits (earnings) achieved.

Data from locally listed companies are used by Ren *et al.* (2021) to determine the impact on stock returns of regional COVID-19 in 31 Chinese provinces. The authors revealed cross-sectional differences in stock return based on a firm's geographical location and on the time of the COVID-19 outbreak. By adjusting culture and corporate social responsibility in the research model, Sun and Li (2021) described the relationship between COVID-19 and financial performance in China. The findings have showed that COVID-19 had a negative financial impact, particularly on travel and entertainment. The financial performance of the medical sector, in contrast,

remains unaffected. According to Wu *et al.* (2022), firm ranking is significant and important in financial performance evaluation since firms want to know their ranking among competitors in the same field or industry for benchmarking purposes. Depending on the present financial situation and ranking, companies can execute the appropriate strategies to enhance their financial performance (Abdel-Basset *et al.*, 2020). In general, multi-criteria decision making is a crucial step in the decision analysis process to determine the optimal alternative by considering a variety of decision criteria or factors (Rezaei, 2015). By using the entropy-fuzzy VIKOR model, Lam *et al.* (2021) aimed to propose a multi-criteria decision-making framework for assessing and comparing the financial performance of construction enterprises. The impact of the COVID-19 pandemic on corporate financial performance in the construction sector was addressed by Sang *et al.* (2022) and Alsamhi *et al.* (2022). Nguyen (2022) and Atayah *et al.* (2022) dealt with the consequences of the COVID-19 pandemic on the logistics sector, and Muftiasa *et al.* (2023) investigated the relationship between the telecommunications sector and the COVID-19 pandemic. The present research conducted among Slovak enterprises was not primarily focused on selected sectors or industries, as the main purpose was to quantify the consequences of the COVID-19 pandemic. Nonetheless, the negative impact of the pandemic on the financial performance was proven by the study; based on the national orientation of the country it can be claimed that some sectors of economy have been hit much harder than others (e.g., Gajdosikova *et al.*, 2023a; Gajdosikova *et al.*, 2023b; Hitka *et al.*, 2023a; Hitka *et al.*, 2023b; Gajdosikova *et al.*, 2022; Lukac *et al.*, 2022). Grancay (2020) also declared the impact of the COVID-19 pandemic on individual sectors in specific regions of the Central European area.

The outbreak of the COVID-19 pandemic harmed many aspects of business and affected corporate financial and economic situations. Although the total indebtedness of enterprises in individual studies steadily declined throughout the pre- COVID-19 period, the number of firms with an optimal level of debt started to decline after the COVID-19 pandemic outbreak. Previously published studies indicate that firms increase the amount of debt financing during periods of greater uncertainty and crises. Kucera and Ticha (2022) examined the impact of the COVID-19 pandemic on the Czech automotive industry, Gajdosikova *et al.* (2022) dealt with the indebtedness of Slovak companies with a focus on the construction industry, and Bartos *et al.* (2022) focused on the impact of the COVID pandemic on the tertiary

sector not only of Slovak and Czech companies but also of the whole of Central Europe. This is not the case of the analysed sample of Slovak enterprises, as the total indebtedness ratio (as well as the current and non-current indebtedness ratios) decreased in the analysed period and this trend is obvious also for debt-to-equity ratio (Table 4), which can be the consequence of worsen financial performance of enterprises and thus of their reduced ability to obtain a loan. Belas *et al.* (2021) investigated and quantified the impacts of the COVID-19 pandemic on several management aspects of small and medium-sized enterprises in the Czech Republic and the Slovak Republic. According to the authors, financial performance is an essential factor that may determine the consequences of an economic pandemic on the operations and ongoing existence of firms. Compared to the period before the COVID-19 pandemic, SMEs had a more negative perception of corporate financial performance at that time. Financial performance declined by 17.2% in the Czech Republic and by 20.3% in Slovakia, so the negative consequences of COVID-19 crisis were proven in both nations. Taking into consideration the results of the current study it is evident, that financial performance and stability of Slovak enterprises measured by selected indebtedness ratios worsened due to the COVID-19 pandemic which confirm the research findings of other authors in very similar economic conditions.

Thus, debt financing has increased significantly during the COVID-19 pandemic. In general, the increased need for debt in this period is primarily motivated by the preventive and strategic needs of firms. At the same time, it turned out that businesses reacted very quickly at the beginning of the COVID-19 pandemic because they created higher reserves, thus preparing for the new situation that the COVID-19 pandemic brought and which could bring them many potential damages, including bankruptcy.

Conclusions

Numerous studies have been conducted on the COVID-19 pandemic because of its range, impact on the global economy, and consequences on the economies of different countries. Macroeconomic or microeconomic analyses of COVID-19 pandemic consequences were carried out, focusing primarily on how the COVID-19 pandemic has influenced enterprises within a given industry. Studies on the effects of the COVID-19 pandemic on the

activities of SMEs or large enterprises are additionally included in the literature on the subject. There are studies that demonstrate the effects of the COVID-19 pandemic on the business activities of individual companies, but there is no study that reveals the impact of the COVID-19 pandemic on the financial performance of enterprises operating in Slovakia. Therefore, this research paper fills the existing research gap. The obtained results can be also especially interesting from international Central European perspective, as the whole region operates with the similar micro and macroeconomic conditions.

As each firm must be aware of its financial situation to compete in the market, the COVID-19 pandemic increased attention to the financial performance of enterprises. The worldwide outbreak of the COVID-19 pandemic significantly highlighted the financial performance of firms. The main objective of the study is more in-depth analysis was to ascertain whether the average values of the financial indicators were consistent throughout the period under review (the years 2018 and 2019 are regarded as pre- COVID-19 years, while 2020 and 2021 are years when the global impact of the COVID-19 pandemic was already being felt) or whether the individual values of the indicators differed significantly from each other. The comprehensive financial analysis tracked a statistically significant difference between particular indicators due to the period in which the enterprises obtained these values. Based on the results, the total indebtedness ratio, debt-to-equity ratio, and financial independence ratio indicate statistically significant differences between all monitored periods. However, considering that there are statistically significant differences in the indicators of self-financing ratio, current indebtedness ratio, and equity leverage ratio in all monitored periods with the exception of 2021 and 2020, where the statistically significant differences were not confirmed, and the average values of these debt indicators are the same, the results indicate that the COVID-19 pandemic also negatively impacted the indebtedness of Slovak companies. However, the non-current indebtedness ratio and the insolvency ratio similarly reveal the same average values for 2020 and 2019, 2020 and 2018, and 2019 and 2018. Only a few studies have examined the impact of the COVID-19 pandemic on corporate performance in Slovakia, despite the fact that the industrial and construction sectors are largely responsible for the economic growth of the country and were affected by lockdowns and quarantines. The biggest contribution of the study is the application of

the latest information, which could help in more precise monitoring of corporate financial stability during the current challenging period.

The research presented in this paper extends the literature on corporate finance in several ways; i) it offers an analysis of the COVID-19 pandemic's effects on the various economic and financial performance aspects of Slovak enterprises; ii) it measures the pandemic's effects using the internal data from the enterprises and iii) it concentrates on both pandemic years (and also the pre-pandemic ones) that have hardly affected the business operation of enterprises and thus enables the investigation of the pandemic over that time.

This study is useful in helping governments, shareholders, and company owners understand how COVID-19 affects financial performance, particularly in those industries that have made significant contributions to the nation's growth. To evaluate the performance of enterprises, the data from the most recent years were collected, which span from 2018 to 2021. There are many more factors that affect markets during pandemics; however, this study concentrated solely at the COVID-19 pandemic. Additionally, the research may be used to evaluate how well the business performs in respect to other factors, such as managerial and decision-making techniques during the pandemic. However, as this study only looked at one nation, further research looking at different countries will be necessary to draw more broadly applicable results as the scope of the paper limits the generalization of the findings. To ascertain if there might be differences in the findings and to allow for greater generalization and applicability, future research should analyse this phenomenon across various national economies or over a longer time horizon than established for this research.

References

- Abdel-Basset, M., Ding, W., Mohamed, R., & Metawa, N. (2020). An integrated plithogenic MCDM approach for financial performance evaluation of manufacturing industries. *Risk Management*, 22(3), 192–218. doi: 10.1057/s41283-020-00061-4.
- Adamowicz, M. (2022). COVID-19 pandemic as a change factor in the labour market in Poland. *Sustainability*, 14(15), 9197. doi: 10.3390/su14159197.
- Ahmad, N., Naveed, A., Ahmad, S., & Butt, I. (2020). Banking sector performance, profitability, and efficiency: A citation-based systematic literature review. *Journal of Economic Surveys*, 34(1), 185–218. doi: 10.1111/joes.12346.

- Al Amosh, H., Khatib, S. F., Alkurdi, A., & Bazhair, A. H. (2022). Capital structure decisions and environmental, social and governance performance: Insights from Jordan. *Journal of Financial Reporting and Accounting*. Advance online publication. doi: 10.1108/JFRA-12-2021-0453.
- Alamsyah, A., Ramadhani, D. P., Kristanti, F. T., & Khairunnisa, K. (2022). Transaction network structural shift under crisis: Macro and micro perspectives. *Economies*, 10(3), 56. doi: 10.3390/economies10030056.
- Albuquerque, R., Koskinen, Y., Yang, S., & Zhang, C. (2020). Resiliency of environmental and social stocks: An analysis of the exogenous COVID-19 market crash. *Review of Corporate Finance Studies*, 9(3), 593–621. doi: 10.1093/rcfs/cfaa011.
- Alsamhi, M. H., Al-Ofairi, F. A., Farhan, N. H., Al-Ahdal, W. M., & Siddiqui, A. (2022). Impact of Covid-19 on firms' performance: Empirical evidence from India. *Cogent Business & Management*, 9(1), 2044593. doi: 10.1080/23311975.2022.2044593.
- Anderson, T. W., & Darling, D. A. (1954). A test of goodness of fit. *Journal of the American Statistical Association*, 49(268), 765–769. doi: 10.2307/2281537.
- Ardiyono, S. K. (2022). Covid-19 pandemic, firms' responses, and unemployment in the ASEAN-5. *Economic Analysis and Policy*, 76, 337–372. doi: 10.1016/j.eap.2022.08.021.
- Atayah, O. F., Dhiaf, M. M., Najaf, K., & Frederico, G. F. (2022). Impact of COVID-19 on financial performance of logistics firms: Evidence from G-20 countries. *Journal of Global Operations and Strategic Sourcing*, 15(2), 172–196. doi: 10.1108/JGOS-03-2021-0028.
- Aum, S., Lee, S. Y. T., & Shin, Y. (2021). COVID-19 doesn't need lockdowns to destroy jobs: The effect of local outbreaks in Korea. *Labour Economics*, 70, 101993. doi: 10.1016/j.labeco.2021.101993.
- Avram, C., & Marușteri, M. (2022). Normality assessment, few paradigms and use cases. *Revista Romana de Medicina de Laborator*, 30(3), 251–260. doi: 10.2478/rrlm-2022-0030.
- Bartos, V., Vochozka, M., & Skopkova, K. (2022). Assessment of financial health of service sector companies in the Central European region. *Entrepreneurship and Sustainability Issues*, 10(2), 375–393. doi: 10.9770/jesi.2022.10.2(23).
- Batrancea, L. (2021). The influence of liquidity and solvency on performance within the healthcare industry: Evidence from publicly listed companies. *Mathematics*, 9(18), 2231. doi: 10.3390/math9182231.
- Bauer, A., & Weber, E. (2021). COVID-19: how much unemployment was caused by the shutdown in Germany? *Applied Economics Letters*, 28(12), 1053–1058. doi: 10.1080/13504851.2020.1789544.
- Bayramov, S. V., Kookueva, V., Kolobov, A., & Tsvetkova, L. (2023). Innovative business models in the context of organizational culture transformation in the COVID-19 pandemic. *Public Organization Review*, 23(1), 365–387. doi: 10.1007/s11115-022-00688-9.

- Belas, J., Gavurova, B., Dvorsky, J., Cepel, M., & Durana, P. (2022). The impact of the COVID-19 pandemic on selected areas of a management system in SMEs. *Economic Research-Ekonomska Istrazivanja*, 35(1), 3754–3777. doi: 10.1080/1331677X.2021.2004187.
- Ben Hssain, B., Agouram, J., & Lakhnati, G. (2022). Impact of COVID-19 pandemic on Moroccan sectoral stocks indices. *Scientific African*, 17, e01321. doi: 10.1016/j.sciaf.2022.e01321.
- Benavoli, A., Corani, G., & Mangili, F. (2016). Should we really use post-hoc tests based on mean-ranks?. *Journal of Machine Learning Research*, 5, 1–10.
- Bhavani, G., Agrawal, R., Mendon, S., Spulbar, C., & Birau, R. (2021). An empirical investigation into alarming signals ignored by the US multi-brand retailer J. Crew Incorporation during COVID-19 pandemic. *Journal of Risk and Financial Management*, 14(11), 539. doi: 10.3390/jrfm14110539.
- Bishara, A. J., Li, J., & Conley, C. (2021). Informal versus formal judgment of statistical models: The case of normality assumptions. *Psychonomic Bulletin & Review*, 28, 1164–1182. doi: 10.3758/s13423-021-01879-z.
- Blazek, R., Durana, P., & Michulek, J. (2023). Renaissance of accounting due to the pandemic: New patterns explored by correspondence analysis. *Stats*, 6(1), 411–430. doi: 10.3390/stats6010025.
- Boto-Garcia, D., & Mayor, M. (2022). Domestic tourism and the resilience of hotel demand. *Annals of Tourism Research*, 93, 103352. doi: 10.1016/j.annals.2022.103352.
- Bouri, E., Cepin, O., Gabauer, D., & Gupta, R. (2020). Return connectedness cross asset classes around the COVID-19 outbreak. *International Review of Financial Analysis*, 73(1), 101646. doi: 10.1016/j.irfa.2020.101646.
- Brunnermeier, M., & Krishnamurthy, A. (2020). Corporate debt overhang and credit policy. *Brookings Papers on Economic Activity*, Summer, 447–502. doi: 10.1353/eca.2020.0014.
- Burger, P., & Slampiaková, L. (2021). The effect of sectoral division on GDP per capita in the Slovak republic. *E & M Ekonomie a Management*, 24(1), 21–37. doi: 10.15240/tul/001/2021-1-002.
- Cajkova, A., Butoracova Sindleryova, A., & Garaj, M. (2021). The COVID-19 pandemic and budget shortfalls in the local governments in Slovakia. *Scientific Papers of the University of Pardubice, Series D: Faculty of Economics and Administration*, 29(1), 1243. doi: 10.46585/sp29011243.
- Chadha, S., & Sharma, A. K. (2015). Determinants of capital structure: An empirical evaluation from India. *Journal of Advances in Management Research*, 12(1), 3–14. doi: 10.1108/JAMR-08-2014-0051t.
- Chen, C. D., Su, C. H. J., & Chen, M. H. (2022). Understanding how ESG-focused airlines reduce the impact of the COVID-19 pandemic on stock returns. *Journal of Air Transport Management*, 102, 102229. doi: 10.1016/j.jairtraman.2022.102229.

- Chen, H., Xu, Y., & Yang, J. (2021). Systematic risk, debt maturity, and the term structure of credit spreads. *Journal of Financial Economics*, 139(3), 770–799. doi: 10.1016/j.jfineco.2020.09.002.
- Chen, Y., & Wu, Z. (2022). Taking risks to make profit during COVID-19. *Sustainability*, 14(23), 15750. doi: 10.3390/su142315750.
- Ciołek, D. (2021). Changes in the labour market during the COVID-19 pandemic and their spatial interactions—evidence from monthly data for Polish LAU. *Geographia Polonica*, 94(4), 523–538. doi: 10.7163/GPol.0218.
- Ciravegna, L., & Michailova, S. (2022). Why the world economy needs, but will not get, more globalization in the post-COVID-19 decade. *Journal of International Business Studies*, 53(1), 1–15. doi: 10.1057/s41267-021-00467-6.
- Civelek, M., Kasarda, M., Hajduk, L., & Szomolányi, A. (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(4), 982–993. doi: 10.46544/AMS.v27i4.12.
- Coccia, M. (2021). The relation between length of lockdown, numbers of infected people and deaths of Covid-19, and economic growth of countries: Lessons learned to cope with future pandemics similar to Covid-19 and to constrain the deterioration of economic system. *Science of The Total Environment*, 775, 145801. doi: 10.1016/j.scitotenv.2021.145801.
- Cramer, H. (1928). On the composition of elementary errors. *Scandinavian Actuarial Journal*, 1928(1), 141–180. doi: 10.1080/03461238.1928.10416872.
- Cui, Q., He, L., Liu, Y., Zheng, Y., Wei, W., Yang, B., & Zhou, M. (2021). The impacts of COVID-19 pandemic on China's transport sectors based on the CGE model coupled with a decomposition analysis approach. *Transport Policy*, 103, 103–115. doi: 10.1016/j.tranpol.2021.01.017.
- Davidescu, A. A., Apostu, S. A., & Stoica, L. A. (2021). Socioeconomic effects of COVID-19 pandemic: Exploring uncertainty in the forecast of the Romanian unemployment rate for the period 2020–2023. *Sustainability*, 13(13), 7078. doi: 10.3390/su13137078.
- Demir, S. (2022). Comparison of normality tests in terms of sample sizes under different skewness and Kurtosis coefficients. *International Journal of Assessment Tools in Education*, 9(2), 397–409. doi: 10.21449/ijate.1101295.
- Demirhan, H. G., & Anwar, W. (2014). Factors affecting the financial performance of the firms during the financial crisis: evidence from Turkey. *Ege Strategic Research Journal*, 5(2), 65–80. doi: 10.18354/esam.70099.
- Derco, J. (2022). The impacts of the COVID-19 pandemic on the tour operator market: The case of Slovakia. *Journal of Risk and Financial Management*, 15(10), 466. doi: 10.3390/jrfm15100446.
- Dinh, H. T., & Pham, C. D. (2020). The effect of capital structure on financial performance of Vietnamese listing pharmaceutical enterprises. *Journal of Asian Finance, Economics and Business*, 7(9), 329–340. doi: 10.13106/jafeb.2020.vol7.no9

- Dunn, O. J. (1961). Multiple comparisons among means. *Journal of the American Statistical Association*, 56(293), 52–64. doi: 10.2307/2282330.
- Durana, P., & Valaskova, K. (2022). The nexus between smart sensors and the bankruptcy protection of SMEs. *Sensors*, 22(22), 8671. doi: 10.3390/s22228671.
- Durana, P., Michalkova, L., Privara, A., Marousek, J., & Tumpach, M. (2021). Does the life cycle affect earnings management and bankruptcy?. *Oeconomia Copernicana*, 12(2), 425–461. doi: 10.24136/oc.2021.015.
- Dziwok E., & Karaś, M.A. (2021). Systemic illiquidity noise-based measure—a solution for systemic liquidity monitoring in frontier and emerging markets. *Risks*, 9(7), 124. doi: 10.3390/risks9070124.
- Eisdorfer, A., Giaccotto, C., & White, R. (2013). Capital structure, executive compensation, and investment efficiency. *Journal of Banking & Finance*, 37(2), 549–562. doi: 10.1016/j.jbankfin.2012.09.011.
- El Khoury, R., Nasrallah, N., Harb, E., & Hussainey, K. (2022). Exploring the performance of responsible companies in G20 during the COVID-19 outbreak. *Journal of Cleaner Production*, 354, 131693. doi: 10.1016/j.jclepro.2022.131693.
- El-Chaarani, H., Abraham, R., & Skaf, Y. (2022a). The impact of corporate governance on the financial performance of the banking sector in the MENA (Middle Eastern and North African) region: An immunity test of banks for COVID-19. *Journal of Risk and Financial Management*, 15(2), 82. doi: 10.3390/jrfm15020082.
- El-Chaarani, H., Ismail, T. H., El-Abiad, Z., & El-Deeb, M. S. (2022b). The impact of COVID-19 on financial structure and performance of Islamic banks: A comparative study with conventional banks in the GCC countries. *Journal of Economic and Administrative Sciences*. Advance online publication. doi: 10.1108/JEAS-07-2021-0138.
- Ellis, C. (2021). How should risk professionals think about the rise in corporate indebtedness? *Journal of Risk Management in Financial Institutions*, 14(2), 161–172.
- Ferlie, E., & Trenholm, S. (2019). Exploring new organisational forms in English higher education: A think piece. *Higher Education*, 77(2), 229–245. doi: 10.1007/s10734-018-0269-7.
- Flor, C. R., Petersen, K. B., & Schandlbauer, A. (2023). Callable or convertible debt? The role of debt overhang and covenants. *Journal of Corporate Finance*, 78, 102346. doi: 10.1016/j.jcorpfin.2022.102346.
- Fontanet-Perez, P., Vazquez, X. H., & Carou, D. (2022). The impact of the COVID-19 crisis on the US airline market: Are current business models equipped for upcoming changes in the air transport sector?. *Case Studies on Transport Policy*, 10(1), 647–656. doi: 10.1016/j.cstp.2022.01.025.
- Gajdosikova, D., & Valaskova, K. (2022). A systematic review of literature and comprehensive bibliometric analysis of capital structure issue. *Management Dynamics in the Knowledge Economy*, 10(3), 210–224. doi: 10.2478/mdke-2022-0014.
- Gajdosikova, D., Lazaroiu, G., & Valaskova, K. (2023b). How particular firm-specific features influence corporate debt level: A case study of Slovak enterprises. *Axioms*, 12(2), 183. doi: 10.3390/axioms12020183.

- Gajdosikova, D., Valaskova, K., Kliestik, T., & Kovacova, M. (2023a). Research on corporate indebtedness determinants: A case study of Visegrad group countries. *Mathematics*, 11(2), 299. doi: 10.3360/math11020299.
- Gajdosikova, D., Valaskova, K., Kliestik, T., & Machova, V. (2022). COVID-19 pandemic and its impact on challenges in the construction sector: A case study of Slovak enterprises. *Mathematics*, 10(17), 3130. doi: 10.3390/math10173130.
- García-Gómez, C. D., Demir, E., Díez-Esteban, J. M., & Bilan, Y. (2021). The impact of COVID-19 outbreak on hotels' value compared to previous diseases: The role of ALFO strategy. *Heliyon*, 7(8). doi: 10.1016/j.heliyon.2021.e07836.
- Gazi, M. A. I., Nahiduzzaman, M., Harymawan, I., Masud, A. A., & Dhar, B. K. (2022). Impact of COVID-19 on financial performance and profitability of banking sector in special reference to private commercial banks: Empirical evidence from Bangladesh. *Sustainability*, 14(10), 6260. doi: 10.3390/su14106260.
- Ghardallou, W. (2022). Capital structure decisions and corporate performance: Does firm's profitability matter?. *Journal of Scientific & Industrial Research*, 81(8), 859–865. doi: 10.56042/jsir.v81i08.59697.
- Ghenimi, A., Chaibi, H., & Lajmi, A. (2020). The liquidity risk-credit risk-profitability trilogy: A comparative study between Islamic and conventional banks. *Economics Bulletin*, 40(3), 1900–1913.
- Ghosh, S., & Bhattacharya, M. (2022). Analyzing the impact of COVID-19 on the financial performance of the hospitality and tourism industries: An ensemble MCDM approach in the Indian context. *International Journal of Contemporary Hospitality Management*, 34(8), 3113–3142. doi: 10.1108/IJCHM-11-2021-1328.
- Glodowska, A., Maciejewski, M., & Wach, K. (2023). Navigating the digital landscape: A conceptual framework for understanding digital entrepreneurship and business transformation. *International Entrepreneurship Review*, 9(4), 7–20. doi: 10.15678/IER.2023.0904.01
- Grancay, M. (2020). COVID-19 and Central European tourism: The competitiveness of Slovak tourist guides. *Central European Business Review*, 9(5), 81–98. doi: 10.18267/j.cebr.259.
- Gul, S., & Cho, H. R. (2019). Capital structure and default risk: Evidence from Korean stock market. *Journal of Asian Finance, Economics and Business*, 6(2), 15–24. doi: 10.13106/jafeb.2019.vol6.no2.15.
- Gunalan, A., Sarumathi, D., Madigubba, H., & Sastry, A. S. (2020). Intellectual use of personal protective equipment in the view of COVID-19 global demand crises. *Journal of Clinical & Diagnostic Research*, 14(10), DE01–DE05. doi: 10.7860/JCDR/2020/45271.14091.
- Ha Hong, T. R. A. N. (2022). The impact of global uncertainty shocks on macroeconomics: The case of Vietnam. *Journal of Asian Finance, Economics and Business*, 9(9), 263–269. doi: 10.13106/jafeb.2022.vol9.no9.0263.
- Ha, T. (2022). Economic crises and fiscal measures in South Korea: Asian financial crisis, global financial crisis, and COVID-19. *Journal of Asian Public Policy*. Advance online publication. doi: 10.1080/17516234.2022.2075220.

- Haloub, R., Khoury, G., & Masri, A. (2022). Resilience through entrepreneurial storytelling in extreme contexts: A Case study of a pharmaceutical company in the Palestinian territory. *International Journal of Entrepreneurship and Innovation*, 23(2), 111–127. doi: 10.1177/14657503221074576.
- Hanusz, Z., Tarasinska, J., & Zielinski, W. (2016). Shapiro–Wilk test with known mean. *REVSTAT-Statistical Journal*, 14(1), 89–100.
- Harantova, V., Kalasova, A., Skrivanek Kubiková, S., Mazanec, J., & Jordova, R. (2022). The impact of mobility on shopping preferences during the COVID-19 Pandemic: The evidence from the Slovak Republic. *Mathematics*, 10(9), 1394. doi: 10.3390/math10091394.
- Hartmann, A. J., Gangl, K., Kasper, M., Kirchler, E., Kocher, M. G., Mueller, M., & Sonntag, A. (2022). The economic crisis during the COVID-19 pandemic has a negative effect on tax compliance: Results from a scenario study in Austria. *Journal of Economic Psychology*, 93, 102572. doi: 10.1016/j.joep.2022.102572.
- He, P., Sun, Y., Zhang, Y., & Li, T. (2020). COVID–19’s impact on stock prices across different sectors—An event study based on the Chinese stock market. *Emerging Markets Finance and Trade*, 56(10), 2198–2212. doi: 10.1080/1540496X.2020.1785865.
- Herciu, M., & Ogorean, C. (2017). Does capital structure influence company profitability?. *Studies in Business and Economics*, 12(3), 50–62. doi: 10.1515/sbe-2017-0036.
- Heyden, K. J., & Heyden, T. (2021). Market reactions to the arrival and containment of COVID-19: An event study. *Finance Research Letters*, 38, 101745. doi: 10.1016/j.frl.2020.101745.
- Hitka, M., Durian, J., Lizbetinova, L., & Nedeliakova, E. (2023a). Crisis COVID-19 and changes in motivation in the public administration sector. *Scientific Papers of the University of Pardubice – Series D – Faculty of Economics and Administration*, 31(1), 1711. doi: 10.46585/sp31011711.
- Hitka, M., Lorincova, S., Lizbetinova, L., Vrabcova, P., Urbancova, H., & Lipoldova, M. (2023b). The effect of the COVID-19 crisis on the employee motivations in the enterprises in forest-based sector in Slovakia. *Acta Facultatis Xylologiae Zvolen*, 65(1), 135–146. doi: 10.17423/afx.2023.65.1.12.
- Horodnic, I. A., Williams, C. C., Tugulea, O., & Stoian Bobalca, I. C. (2022). Exploring the demand-side of the informal economy during the COVID-19 restrictions: Lessons from Iasi, Romania. *Sustainability*, 14(12), 7228. doi: 10.3390/su14127228.
- IMF (2022). *World economic outlook update: A Crisis like no other, an uncertain recovery*. Retrieved from <https://www.imf.org/en/Publications/WEO/Issues/2020/06/24/WEOUpdateJune2020> (28.05.2023).
- Istok, M., & Kanderova, M. (2019). Debt/asset ratio as evidence of profit-shifting behaviour in the Slovak Republic. *Technological and Economic Development of Economy*, 25(6), 1293–1308. doi: 10.3846/tede.2019.11338.
- Iwamoto, Y., Miyakawa, D., & Ohtake, F. (2021). Introduction to the special issue “The Impacts of COVID-19 on the Japanese Economy”. *Japanese Economic Review*, 72, 329–331. doi: 10.1007/s42973-021-00082-y.

- Jena, P. R., Majhi, R., Kalli, R., Managi, S., & Majhi, B. (2021). Impact of COVID-19 on GDP of major economies: Application of the artificial neural network forecaster. *Economic Analysis and Policy*, 69, 324–339. doi: 10.1016/j.eap.2020.12.013.
- Jeppson, N. H., Ruddy, J. A., & Salerno, D. F. (2021). The influence of social media usage on the DuPont method of analysis. *Journal of Corporate Accounting & Finance*, 32(4), 31–44. doi: 10.1002/jcaf.22507.
- Johnson, C. L., & Yushkov, A. (2022). On the determinants of regional government debt in Russia. *Eurasian Geography and Economics*, 64(4), 484–522. doi: 10.1080/15387216.2022.2042350.
- Joshi, A., Bhaskar, P., & Gupta, P. K. (2020). Indian economy amid COVID-19 lockdown: A prespective. *Journal of Pure and Applied Microbiology*, 14, 957–961. doi: 10.22207/JPAM.14.SPL1.33.
- Kaczmarek, T., Perez, K., Demir, E., & Zaremba, A. (2021). How to survive a pandemic: The corporate resiliency of travel and leisure companies to the COVID-19 outbreak. *Tourism Management*, 84, 104281. doi: 10.1016/j.tourman.2020.104281.
- Kalusova, L., & Badura, P. (2017). Factors determining the financial structure of Czech and Slovak agricultural enterprises. *Agricultural Economics*, 63(1), 24–33. doi: 10.17221/325/2015-AGRICECON.
- Khatib, S. F., & Nour, A. (2021). The impact of corporate governance on firm performance during the COVID-19 pandemic: Evidence from Malaysia. *Journal of Asian Finance, Economics and Business*, 8(2), 943–952. doi: 10.13106/jafeb.2021.vol8.no2.0943.
- Kitowski, J., Kowal-Pawul, A., & Lichota, W. (2022). Identifying symptoms of bankruptcy risk based on bankruptcy prediction models: A case study of Poland. *Sustainability*, 14(3), 1416. doi: 10.3390/su14031416.
- Kinnunen, J., Georgescu, I., Hosseini, Z., & Androniceanu, A.-M. (2021). Dynamic indexing and clustering of government strategies to mitigate Covid-19. *Entrepreneurial Business and Economics Review*, 9(2), 7–20. doi: 10.15678/EBER.2021.090201.
- Kolkiewicz, A., Rice, G., & Xie, Y. (2021). Projection pursuit-based tests of normality with functional data. *Journal of Statistical Planning and Inference*, 211, 326–339. doi: 10.1016/j.jspi.2020.07.001.
- Kolmogorov, A. N. (1933). Sulla determinazione empirica di una legge di distribuzione. *Giornale dell'Istituto Italiano degli Attuari*, 4, 83–91.
- Korol, T., & Fodadis, A. K. (2022). Implementing artificial intelligence in forecasting the risk of personal bankruptcies in Poland and Taiwan. *Oeconomia Copernicana*, 13(2), 407–438. doi: 10.24136/oc.2022.013.
- Kovacova, M., Krajcik, V., Michalkova, L., & Blazek, R. (2022). Valuing the interest tax shield in the central European economies: Panel data approach. *Journal of Competitiveness*, 14(2), 41–59. doi: 10.7441/joc.2022.02.03.

- Kozak, S., & Wierzbowska, A. (2022). Did the COVID-19 pandemic amplify the positive impact of income diversification on the profitability of European banks?. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 17(1), 11–29. doi: 10.24136/eq.2022.001.
- Krabec, T., & Cizinska, R. (2021). Measuring the impact of an administrative fine on a company and its future survival: A case study from the Czech Republic. *Financial Internet Quarterly*, 17(4), 34–49. doi: 10.2478/fiqf-2021-0026.
- Kramarova, K., Svabova, L., & Gabrikova, B. (2022). Impacts of the Covid-19 crisis on unemployment in Slovakia: A statistically created counterfactual approach using the time series analysis. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 17(2), 343–389. doi: 10.24136/eq.2022.012.
- Kramolis, J., & Dobes, K. (2020). Debt as a financial risk factor in SMEs in the Czech Republic. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 15(1), 87–105. doi: 10.24136/eq.2020.005.
- Krasteva, N., & Nagy, M. (2022). Evaluation of the financial standing of businesses in a certain sector of the national economy. *Ekonomicko-manazerske spektrum*, 16(2), 18–36. doi: 10.26552/ems.2022.2.18-36.
- Kristof, T., & Virag, M. (2022). What drives financial competitiveness of industrial sectors in Visegrad Four countries? Evidence by use of machine learning techniques. *Journal of Competitiveness*, 14(4), 117–136. doi: 10.7441/joc.2022.04.07.
- Kucera, J., & Ticha, S. (2022). Czech automotive industry and COVID-19. *Ad Alta-Journal of Interdisciplinary Research*, 12(1), 225–228.
- Kung, Y. A., Lee, K. M., Chiang, H. J., Huang, S. Y., Wu, C. J., & Shih, S. R. (2022). Molecular virology of SARS-CoV-2 and related coronaviruses. *Microbiology and Molecular Biology Reviews*, 86(2), e0002621. doi: 10.1128/mmbr.00026-21.
- Kusio, T., Rosiek, J., & Conto, F. (2022). Urban–rural partnership perspectives in the conceptualization of innovative activities in rural development: An example of three-case study analysis. *Sustainability*, 14(12), 7309. doi: 10.3390/su14127309.
- Labidi, M. A. (2023). How the COVID-19 pandemic affected developing countries: The Tunisian investigation. *Journal of the Knowledge Economy*, 14(1), 20–34. doi: 10.1007/s13132-021-00875-x.
- Lam, W. S., Lam, W. H., Jaaman, S. H., & Liew, K. F. (2021). Performance evaluation of construction companies using integrated entropy–fuzzy VIKOR model. *Entropy*, 23(3), 320. doi: 10.3390/e23030320.
- Lee, Y. M., & Hu, J. L. (2018). Integrated approaches for business sustainability: The perspective of corporate social responsibility. *Sustainability*, 10(7), 2318. doi: 10.3390/su10072318.
- Linares-Mustaros, S., Farreras-Noguer, M. A., Arimany-Serrat, N., & Coenders, G. (2022). New financial ratios based on the compositional data methodology. *Axioms*, 11(12), 694. doi: 10.3390/axioms11120694.
- Liu, J., & Xu, Y. (2022). T-Friedman test: A new statistical test for multiple comparison with an adjustable conservativeness measure. *International Journal of Computational Intelligence Systems*, 15(1), 29. doi: 10.1007/s44196-022-00083-8.

- Lopez-Vazquez, C., & Hochsztain, E. (2019). Extended and updated tables for the Friedman rank test. *Communications in Statistics-Theory and Methods*, 48(2), 268–281. doi: 10.1080/03610926.2017.1408829.
- Lukac, J., Oleova, C., & Kudlova, Z. (2022). Factors predicting companies' crisis in the engineering industry from the point of view of financial analysis. *Plos One*, 17(2), e0264016. doi: 10.1371/journal.pone.0264016.
- Lukacova, K., Kovacova, L., & Kahanec, M. (2022). Industrial relations and unemployment benefit schemes in the Visegrad countries during the COVID-19 pandemic. *Transfer: European Review of Labour and Research*, 28(2), 229–246. doi: 10.1177/10242589221099804.
- Mazanec, J., & Bartosova, V. (2021). Prediction model as sustainability tool for assessing financial status of non-profit organizations in the Slovak Republic. *Sustainability*, 13(17), 9721. doi: 10.3390/su13179721.
- Medlock, K. B., Temzelides, T., & Chung, W. (2021). Mercantilism's groundhog day: The US-China trade war and US energy exports to Northeast Asia. *Energy Strategy Reviews*, 38, 100741. doi: 10.1016/j.esr.2021.100741.
- Melnik, T. E., Lomakin, D. E., Lebedeva, E. V., Aygumov, T. G., & Pakhomova, A. I. (2020). Applying benchmarking tool in assessment financial safety of organization. *Amazonia Investiga*, 9(27), 72–81. doi: 10.34069/AI/2020.27.03.8.
- Michalkova, L. (2021). Corporate management: Capital structure and tax shields. *Marketing and Management of Innovations*, 3, 276–295. doi: 10.21272/mmi.2021.3-23.
- Michalkova, L., Kovacova, M., Cepel, M., & Belas, J. (2022). Insolvency prediction and corporate bankruptcy model in Visegrad group countries. *Transformations in Business & Economics*, 21(2A), 529–548.
- Michulek, J., Gajanova, L., Krizanova, A., & Nadanyiova, M. (2023). Determinants of improving the relationship between corporate culture and work performance: Illusion or reality of serial mediation of leadership and work engagement in a crisis period?. *Frontiers in Psychology*, 14, 1135199. doi: 10.3389/fpsyg.2023.1135199.
- Mirmozaffari, M., Yazdani, R., Shadkam, E., Khalili, S. M., Tavassoli, L. S., & Boskabadi, A. (2021). A novel hybrid parametric and non-parametric optimisation model for average technical efficiency assessment in public hospitals during and post-COVID-19 pandemic. *Bioengineering*, 9(1), 7. doi: 10.3390/bioengineering9010007.
- Mirza, N., Rahat, B., Naqvi, B., & Rizvi, S. K. A. (2020). Impact of COVID-19 on corporate solvency and possible policy responses in the EU. *Quarterly Review of Economics and Finance*, 87, 181–190. doi: 10.1016/j.qref.2020.09.002.
- Miskufova, M., Jencova, S., & Petruska, I. (2022). Dependence of ROS on financial indicators using threshold regression models. *Ekonomicko-manazerske spektrum*, 16(2), 49–0. doi: 10.26552/ems.2022.2.49-60.

- Moorhouse, T. P., D'Cruze, N. C., & Macdonald, D. W. (2021). The pandemic as a conservation marketing intervention: Could COVID-19 lower global demand for wildlife products? *Frontiers in Ecology and Evolution*, 9, 609558. doi: 10.3389/fevo.2021.609558.
- Muftiasa, A., Wibowo, L. A., & Rahayu, A. (2023). Is intellectual capital related to telecommunications industry financial performance during COVID-19? *International Journal of Learning and Intellectual Capital*, 20(1), 29–46. doi: 10.1504/IJLIC.2023.127696.
- Mzoughi, H., Amar, A. B., Belaid, F., & Guesmi, K. (2022). The impact of COVID-19 pandemic on Islamic and conventional financial markets: International empirical evidence. *Quarterly Review of Economics and Finance*, 85, 303–325. doi: 10.1016/j.qref.2022.04.007.
- Nagy, M., & Lazaroiu, G. (2022). Computer vision algorithms, remote sensing data fusion techniques, and mapping and navigation tools in the Industry 4.0-based Slovak automotive sector. *Mathematics*, 10(19), 3543. doi: 10.3390/math10193543.
- Nagy, M., Valaskova, K., & Durana, P. (2022). The effect of CSR policy on earnings management behavior: Evidence from Visegrad publicly listed enterprises. *Risks*, 10(11), 203. doi: 10.3390/risks10110203.
- Nemec, J., & Spacek, D. (2020). The Covid-19 pandemic and local government finance: Czechia and Slovakia. *Journal of Public Budgeting, Accounting & Financial Management*, 32(5), 837–846. doi: 10.1108/JPBAFM-07-2020-0109.
- Nguyen, H. T. X. (2022). The effect of COVID-19 pandemic on financial performance of firms: Empirical evidence from Vietnamese logistics enterprises. *Journal of Asian Finance, Economics and Business*, 9(2), 177–183. doi: 10.13106/jafeb.2022.vol9.no2.0177.
- Nguyen, N. T. H., Kim-Duc, N., & Freiburghaus, T. L. (2022). Effect of digital banking-related customer experience on banks' financial performance during Covid-19: A perspective from Vietnam. *Journal of Asia Business Studies*, 16(1), 200–222. doi: 10.1108/JABS-09-2020-0366.
- Notta, O., & Vlachvei, A. (2014). The impact of financial crisis on firm performance in case of Greek Food manufacturing firms. *Procedia Economics and Finance*, 14(14), 454–460. doi: 10.1016/j.jairtraman.2022.102229.
- Nukala, V. B., & Prasada Rao, S. S. (2021). Role of debt-to-equity ratio in project investment valuation, assessing risk and return in capital markets. *Future Business Journal*, 7(1), 1–23. doi: 10.1186/s43093-021-00058-9.
- Pal, B., & Nandy, M. (2019). Innovation and business sustainability (IBS): Empirical evidence from Indian pharmaceutical industry (IPI). *AI EDAM-Artificial Intelligence for Engineering Design Analysis and Manufacturing*, 33(2), 117–128. doi: 10.1017/S0890060419000040.
- Pekarek, S. (2022). Simulation of systemic risk as a consequence of fire sales: Application to EU banking sector. *Politická Ekonomie*, 70(4), 440–476. doi: 10.18267/j.polek.1361.

- Privara, A. (2022). Economic growth and labour market in the European Union: lessons from COVID-19. *Oeconomia Copernicana*, 13(2), 355–377. doi: 10.24136/oc.2022.011.
- Pulawska, K. (2021). Financial stability of European insurance companies during the COVID-19 pandemic. *Journal of Risk and Financial Management*, 14(6), 266. doi: 10.3390/jrfm14060266.
- Qin, Z., Hassan, A., & Adhikariparajuli, M. (2022). Direct and indirect implications of the COVID-19 pandemic on Amazon's financial situation. *Journal of Risk and Financial Management*, 15(9), 414. doi: 10.3390/jrfm15090414.
- Rababah, A., Al-Haddad, L., Sial, M. S., Chunmei, Z., & Cherian, J. (2020). Analyzing the effects of COVID-19 pandemic on the financial performance of Chinese listed companies. *Journal of Public Affairs*, 20(4), e2440. doi: 10.1002/pa.2440.
- Radovic-Markovic, M., Vesic, T., & Dekic, M. (2022). Monetary and financial cash flows as drivers of foreign direct investments at the global level. *International Review*, 1-2, 10–16. doi: 10.5937/intrev2202013R.
- Radulescu, C. V., Ladaru, G. R., Burlacu, S., Constantin, F., Ioanăș, C., & Petre, I. L. (2020). Impact of the COVID-19 pandemic on the Romanian labor market. *Sustainability*, 13(1), 271. doi: 10.3390/su13010271.
- Ren, Z., Zhang, X., & Zhang, Z. (2021). New evidence on COVID-19 and firm performance. *Economic Analysis and Policy*, 72, 213–225. doi: 10.1016/j.eap.2021.08.002.
- Rezaei, J. (2015). Best-worst multi-criteria decision-making method. *Omega-International Journal of Management Science*, 53, 49–57. doi: 10.1016/j.omega.2014.11.009.
- Rojas, F. L., Jiang, X., Montenovio, L., Simon, K. I., Weinberg, B. A., & Wing, C. (2020). Is the cure worse than the problem itself? Immediate labor market effects of COVID-19 case rates and school closures in the US. *NBER Working Paper Series*, 27127. doi: 10.3386/w27127.
- Ruckova, P., & Skulanova, N. (2022). The firm-specific and macroeconomic determinants of the financial structure of construction companies in selected European countries. *Review of Economic Perspectives*, 22(2), 117–136. doi: 10.2478/revecp-2022-0006.
- Rutkowska-Tomaszewska, E., Łakomiak, A., & Stanisławska, M. (2021). The economic effect of the pandemic in the energy sector on the example of listed energy companies. *Energies*, 15(1), 158. doi: 10.3390/en15010158.
- Sahoo, P., & Ashwani. (2020). COVID-19 and Indian economy: Impact on growth, manufacturing, trade and MSME sector. *Global Business Review*, 21(5), 1159–1183. doi: 10.1177/0972150920945687.
- Sajnog, A., & Rogozinska-Paweczyk, A. (2022). Executive compensation and the financial performance of Polish listed companies from the corporate governance perspective. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 17(2), 459–480. doi: 10.24136/eq.2022.016.

- Sang, M., Zhang, Y., Ye, K., & Jiang, W. (2022). Moderating effects of internationalization between corporate social responsibility and financial performance: The case of construction firms. *Buildings*, 12(2), 185. doi: 10.3390/buildings12020185.
- Sayyareh, A. (2017). Non-parametric multiple comparisons of non-nested rival models. *Communications in Statistics-Theory and Methods*, 46(17), 8369–8386. doi: 10.1080/03610926.2016.1179759.
- Schonfeld, J. (2020). Financial situation of pre-packed insolvencies. *Journal of Business Economics and Management*, 21(4), 1111–1127. doi: 10.3846/jbem.2020.12820.
- Sedliacikova, M., Moresova, M., Mala D., & Rowland, Z. (2021). Controlling – An empirical study and proposal of a relevant model for sustainable business and development in Slovakia. *Journal of Business Economics and Management*, 22(5), 1252–1268. doi: 10.3846/jbem.2021.15393.
- Shapiro, S. S., & Francia, R. S. (1972). An approximate analysis of variance test for normality. *Journal of the American Statistical Association*, 67(337), 215–216.
- Shapiro, S., & Wilk, M. B. J. B. (1965). An analysis of variance test for normality. *Biometrika*, 52(3), 591–611. doi: 10.2307/2333709.
- Shear, F., & Ashraf, B. N. (2022). The performance of Islamic versus conventional stocks during the COVID-19 shock: Evidence from firm-level data. *Research in International Business and Finance*, 60, 101622. doi: 10.1016/j.ribaf.2022.101622.
- Shen, H., Fu, M., Pan, H., Yu, Z., & Chen, Y. (2020). The impact of the COVID-19 pandemic on firm performance. *Emerging Markets Finance and Trade*, 56(10), 2213–2230. doi: 10.1080/1540496X.2020.1785863.
- Sigala, M. (2020). Tourism and COVID-19: Impacts and implications for advancing and resetting industry and research. *Journal of Business Research*, 117, 312–321. doi: 10.1016/j.jbusres.2020.06.015.
- Smirnov, N. V. (1936). Sui la distribution de w_2 . *Comptes Rendus*, 202, 449–452.
- Sun, Y., & Li, Y. (2021). COVID-19 outbreak and financial performance of Chinese listed firms: Evidence from corporate culture and corporate social responsibility. *Frontiers in Public Health*, 9, 710743. doi: 0.3389/fpubh.2021.710743.
- Svabova, L., Kramarova, K., & Chabadova, D. (2022). Impact of the COVID-19 pandemic on the business environment in Slovakia. *Economies*, 10(10), 244. doi: 10.3390/economies10100244.
- Svabova, L., Tesarova, E. N., Durica, M., & Strakova, L. (2021). Evaluation of the impacts of the COVID-19 pandemic on the development of the unemployment rate in Slovakia: Counterfactual before-after comparison. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 16(2), 261–284. doi: 10.24136/eq.2021.010.
- Svidronova, M., & Vacekova, G. (2012). Current state of self-financing of private non-profit organizations in the conditions of the Slovak Republic. *Technological and Economic Development of Economy*, 18(3), 438–451. doi: 10.3846/20294913.2012.702695.

- Syarifuddin, F., & Setiawan, M. (2022). The relationship between COVID-19 pandemic, foreign direct investment, and gross domestic product in Indonesia. *Sustainability*, 14(5), 2786. doi: 10.3390/su14052786.
- Szczygielski, J. J., Charteris, A., Bwanya, P. R., & Brzezczyski, J. (2022). The impact and role of COVID-19 uncertainty: A global industry analysis. *International Review of Financial Analysis*, 80, 101837. doi: 10.1016/j.irfa.2021.101837.
- Szustak G, Gradoń W, & Szewczyk Ł. (2021). Household financial situation during the COVID-19 pandemic with particular emphasis on savings—An evidence from Poland compared to other CEE states. *Risks*, 9(9), 166. doi: 10.3390/risks9090166.
- Tan, L., Wu, X., Guo, J., & Santibanez-Gonzalez, E. D. (2022). Assessing the impacts of COVID-19 on the industrial sectors and economy of China. *Risk Analysis*, 42(1), 21–39. doi: 10.1111/risa.13805.
- Tan, T. K. (2012). Financial distress and firm performance: Evidence from the Asian financial crisis. *Journal of Accountancy and Finance*, 11, 5–6.
- Tesarova, E. N., & Krizanova, A. (2022). The impact of COVID-19 on sustainability and changing consumer behavior in the textile industry. Is it significant?. *Management Dynamics in the Knowledge Economy*, 10(2), 95–105. doi: 10.2478/mdke-2022-0007.
- Tobisova A, Senova A, & Rozenberg R. (2022). Model for sustainable financial planning and investment financing using Monte Carlo method. *Sustainability*, 14(14), 8785. doi: 10.3390/su14148785.
- Tousek, Z., Hinke, J., Malinska, B., & Prokop, M. (2021). The performance determinants of trading companies: A stakeholder perspective. *Journal of Competitiveness*, 13(2), 152–170. doi: 10.7441/joc.2021.02.09.
- Tran, M. H., & Tran, M. (2023). Value-at-risk and the global financial crisis. *Journal of Risk Model Validarion*, 17(1), 41–83. doi: 10.21314/JRMV.2022.030.
- Valaskova, K., Kliestik, T., & Gajdosikova, D. (2021). Distinctive determinants of financial indebtedness: Evidence from Slovak and Czech enterprises. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 16(3), 639–659. doi: 10.24136/eq.2021.023.
- Valaskova, K., Lazaroiu, G., Olah, J., Siekelova, A., & Lancova, B. (2019). How capital affects business valuation: A case study of Slovakia. *Central European Business Review*, 8(3), 1–17. doi: 10.18267/j.cebr.218.
- Valaskova, K., Nagy, M., Zabochnik, S., & Lazaroiu, G. (2022). Industry 4.0 wireless networks and cyber-physical smart manufacturing systems as accelerators of value-added growth in Slovak exports. *Mathematics*, 10(14), 2452. doi: 10.3390/math10142452.
- Vrontis, D., El Chaarani, H., El Abiad, Z., El Nemar, S., & Yassine Haddad, A. (2022). Managerial innovative capabilities, competitive advantage and performance of healthcare sector during Covid-19 pandemic period. *Foresight*, 24(3/4), 504–526. doi: 10.1108/FS-02-2021-0045.

- Waliszewski, K., & Warchlewska, A. (2021). Comparative analysis of Poland and selected countries in terms of household financial behaviour during the COVID-19 pandemic. *Equilibrium. Quarterly Journal of Economics and Economic Policy*, 16(3), 577–615. doi: 10.24136/eq.2021.021.
- Wang, Z., Dong, Y., & Liu, A. (2022). How does China's stock market react to supply chain disruptions from COVID-19? *International Review of Financial Analysis*, 82, 102168. doi: 10.1016/j.irfa.2022.102168.
- Wu, Q., Liu, X., Qin, J., Zhou, L., Mardani, A., & Deveci, M. (2022). An integrated generalized TODIM model for portfolio selection based on financial performance of firms. *Knowledge-Based Systems*, 249, 108794. doi: 10.1016/j.knosys.2022.108794.
- Xu, J., & Jin, Z. (2022). Exploring the impact of the COVID-19 pandemic on firms' financial performance and cash holding: New evidence from China's agri-food sector. *Agronomy*, 12(8), 1951. doi: 10.3390/agronomy12081951.
- Xu, J., Shan, G., Amei, A., Zhao, J., Young, D., & Clark, S. (2017). A modified Friedman test for randomized complete block designs. *Communications in Statistics-Simulation and Computation*, 46(2), 1508–1519. doi: 10.1080/03610918.2015.1006777.
- Yap, B. W., & Sim, C. H. (2011). Comparisons of various types of normality tests. *Journal of Statistical Computation and Simulation*, 81(12), 2141–2155. doi: 10.1080/0949655.2010.520163.
- Yaro, A. S., Maly, F., & Prazak, P. (2023). Outlier detection in time-series receive signal strength observation Using Z-Score method with Sn scale estimator for indoor localization. *Applied Sciences*, 13(6), 3900. doi: 10.3390/app13063900.
- Yazdanfar, D., & Ohman, P. (2015). Debt financing and firm performance: An empirical study based on Swedish data. *Journal of Risk Finance*, 16(1), 102–118. doi: 10.1108/JRF-06-2014-0085.
- Zaremba, A. (2016). Quality investing and the cross-section of country returns. *Studies in Economics and Finance*, 33(2), 281–301. doi: 10.1108/SEF-06-2014-0119.
- Zayed, N. M., Edeh, F. O., Darwish, S., Islam, K. A., Kryshthal, H., Nitsenko, V., & Stanislavyk, O. (2022). Human resource skill adjustment in service sector: Predicting dynamic capability in post COVID-19 work eEnvironment. *Journal of Risk and Financial Management*, 15(9), 402. doi: 10.3390/jrfm15090402.
- Zhao, L., Rasoulinezhad, E., Sarker, T., & Taghizadeh-Hesary, F. (2023). Effects of COVID-19 on global financial markets: Evidence from qualitative research for developed and developing economies. *European Journal of Development Research*, 35(1), 148–166. doi: 10.1057/s41287-021-00494-x.
- Zhao, S., & Fang, L. (2023). Debt financing, first-mover advantage, and vertical product differentiation. *Managerial and Decision Economics*, 44(1), 502–514. doi: 10.1002/mde.3696.
- Zhou, D., & Zhou, R. (2021). ESG performance and stock price volatility in public health crisis: Evidence from COVID-19 pandemic. *International Journal of Environmental Research and Public Health*, 19(1), 202. doi: 10.3390/ijerph19010202.

- Zhu, J. Y. (2019). Anticipating disagreement in dynamic contracting. *Review of Finance*, 26(5), 1241–1265. doi: 10.1093/rof/rfac007.
- Zulkipli, M. A., Nik Abdullah, N. A. I., & Kamaluddin, A. (2019). The relationship between financial leverage and liquidity, and firms' profitability of the agricultural industry: Evidence from Malaysian listed firms. *Asia-Pacific Management Accounting Journal*, 14(3), 200–217.
- Żur, A., & Wałęga, A. (2023). Internationalization and innovation orientation as factors of employee learning and development adaptation during Covid-19: Evidence from Polish SMEs. *Entrepreneurial Business and Economics Review*, 11(1), 77–91. doi: 10.15678/EBER.2023.110104.

Acknowledgments

This research was financially supported by the Slovak Research and Development Agency Grant VEGA 1/0677/22: Quo Vadis, Bankruptcy Models? Prospective Longitudinal Cohort Study with Emphasis on Changes Determined by COVID 19 and faculty institutional research 1/KE/2023.



**Ministry of Education and Science
Republic of Poland**

The journal is co-financed in the years 2022–2024 by the Ministry of Education and Science of the Republic of Poland in the framework of the ministerial programme “Development of Scientific Journals” (RCN) on the basis of contract no. RCN/SN/0129/2021/1concluded on 29 September 2022 and being in force until 28 September 2024.

Annex

Table 1. Firm-specific features of the sampled enterprises

Firm size	%
Small enterprise	26.39
Medium sized enterprise	61.00
Large enterprise	10.26
Very large enterprise	2.35
Legal form and ownership structure	
Private limited companies	90.30
Public limited companies	8.22
Partnerships	1.48
Firm age	
<10	10.32
10-20	50.74
20-30	35.41
30-40	2.91
>40	0.62
Economic sector (NACE classification)	
Agriculture (NACE A)	3.03
Manufacturing (NACE B, C, D, E)	28.12
Construction (NACE F)	10.82
Wholesale and retail trade (NACE G)	30.28
Services (NACE H, I, J, K, L, M, N, O, P, Q, R, S)	27.75
Total	1,618

Table 2. Summarized formulas of indebtedness indicators

Ratio	Algorithm
Total indebtedness ratio (TI)	Current and non-current liabilities to total assets
Self-financing ratio (SF)	Shareholders funds to total assets
Current indebtedness ratio (CI)	Current liabilities to total assets
Non-current indebtedness ratio (NCI)	Non-current liabilities to total assets
Debt-to-equity ratio (DE)	Current and non-current liabilities to shareholders funds
Interest coverage ratio (IC)	Earnings before interest and taxes to interests paid
Interest burden ratio (IB)	Interests paid to earnings before interest and taxes
Equity leverage ratio (EL)	Total assets to shareholders funds
Financial independence ratio (FI)	Shareholders funds to current and non-current liabilities
Insolvency ratio (Ins)	Current and non-current liabilities to receivables

Source: Valaskova *et al.* (2021, 639–659).

Table 3. Descriptive statistics of selected indebtedness ratios (4-year average values)

	mean th. €	med. th. €	std. dev. th. €	min. th. €	max. th. €	CV dimensionless
TOAS	6,236.665	1,332.780	26,050.079	212.519	273,219.500	4.177
DEBT	1,626.154	340.711	8,787.359	15.459	281,655.250	5.404
SHFD	2,250.421	453.854	9,152.670	45.153	217,389.500	4.067
NCLI	1,005.199	116.541	5,612.349	-1.562	115,098.330	5.583
CULI	2,862.583	582.120	12,811.975	19.475	273,163.750	4.476
EBIT	281.875	73.311	1,025.442	-8,979.787	20,284.116	3.638
INTE	38.429	9.700	154.918	0.502	3,975.338	4.031

Note: TOAS Total Assets, DEBT Debtors, SHFD Shareholders Funds, NCLI Non-Current Liabilities, CULI Current Liabilities, EBIT Earnings Before Interest and Taxes, INTE Interest Paid

Table 4. Average values of indebtedness indicators in the monitored period

Ratio	2018	2019	2020	2021
Total indebtedness ratio	0.629	0.604	0.581	0.571
Self-financing ratio	0.355	0.372	0.398	0.406
Current indebtedness ratio	0.495	0.477	0.452	0.450
Non-current indebtedness ratio	0.134	0.128	0.128	0.121
Debt-to-equity ratio	2.222	1.992	1.776	1.712
Interest coverage ratio	9.951	9.045	10.464	13.280
Interest burden ratio	0.147	0.149	0.132	0.122
Equity leverage ratio	3.356	3.135	2.907	2.855
Financial independence ratio	0.652	0.710	0.795	0.837
Insolvency ratio	2.895	2.914	3.011	2.943

Table 5. The output of the Friedman test

		TI	SF	CI	NCI	DE
Mean Rank	2018	2.11	2.89	2.27	2.30	2.08
	2019	2.25	2.80	2.27	2.53	2.20
	2020	2.63	2.33	2.63	2.53	2.66
	2021	3.01	1.98	2.84	2.64	3.05
N		1618	1618	1618	1618	1618
Chi-Square		481.213	524.077	229.526	60.003	576.643
df		3	3	3	3	3
Asymp. Sig.		0.000	0.000	0.000	0.000	0.000
		IC	IB	EL	FI	Ins
Mean Rank	2018	2.79	2.19	2.11	2.92	2.38
	2019	2.50	2.44	2.20	2.80	2.54
	2020	2.26	2.74	2.67	2.34	2.55
	2021	2.45	2.63	3.02	1.95	2.53
N		1618	1618	1618	1618	1618
Chi-Square		137.643	169.087	524.077	576.643	18.688
df		3	3	3	3	3
Asymp. Sig.		0.000	0.000	0.000	0.000	0.000

Table 6. The output of the pairwise comparison of the monitored years

TI	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.140	0.045	-3.077	0.002	0.013
2021-2019	-0.519	0.045	-11.424	0.000	0.000
2021-2018	-0.904	0.045	-19.921	0.000	0.000
2020-2019	-0.379	0.045	-8.347	0.000	0.000
2020-2018	-0.765	0.045	-16.844	0.000	0.000
2019-2018	-0.386	0.045	-8.497	0.000	0.000
SF	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	0.091	0.045	2.015	0.044	0.263
2021-2019	0.559	0.045	12.309	0.000	0.000
2021-2018	0.910	0.045	20.044	0.000	0.000
2020-2019	0.467	0.045	10.294	0.000	0.000
2020-2018	0.818	0.045	18.028	0.000	0.000
2019-2018	0.351	0.045	7.734	0.000	0.000
CI	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.002	0.045	-0.054	0.957	1.000
2021-2019	-0.361	0.045	-7.952	0.000	0.000
2021-2018	-0.569	0.045	-12.527	0.000	0.000
2020-2019	-0.358	0.045	-7.898	0.000	0.000
2020-2018	-0.566	0.045	-12.473	0.000	0.000
2019-2018	-0.208	0.045	-4.575	0.000	0.000
NCI	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.232	0.045	-5.106	0.000	0.000
2021-2019	-0.233	0.045	-5.133	0.000	0.000
2021-2018	-0.337	0.045	-7.435	0.000	0.000
2020-2019	-0.001	0.045	-0.027	0.978	1.000
2020-2018	-0.106	0.045	-2.328	0.020	0.119
2019-2018	-0.104	0.045	-2.301	0.021	0.128
DE	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.123	0.045	-2.710	0.007	0.040
2021-2019	-0.583	0.045	-12.841	0.000	0.000
2021-2018	-0.970	0.045	-21.378	0.000	0.000
2020-2019	-0.460	0.045	-10.131	0.000	0.000
2020-2018	-0.847	0.045	-18.668	0.000	0.000
2019-2018	-0.388	0.045	-8.538	0.000	0.000
IC	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	0.286	0.045	6.305	0.000	0.000
2021-2019	0.525	0.045	11.574	0.000	0.000
2021-2018	0.338	0.045	7.448	0.000	0.000
2020-2019	0.239	0.045	5.270	0.000	0.000
2020-2018	0.052	0.045	1.144	0.253	1.000
2019-2018	-0.187	0.045	-4.126	0.000	0.000
IB	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.254	0.045	-5.596	0.000	0.000
2021-2019	-0.553	0.045	-12.173	0.000	0.000
2021-2018	-0.437	0.045	-9.627	0.000	0.000

Table 7. Continued

IB	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2020-2019	-0.299	0.045	-6.577	0.000	0.000
2020-2018	-0.183	0.045	-4.031	0.000	0.000
2019-2018	0.116	0.045	2.546	0.011	0.065
EL	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.091	0.045	-2.015	0.044	0.263
2021-2019	-0.559	0.045	-12.309	0.000	0.000
2021-2018	-0.910	0.045	-20.044	0.000	0.000
2020-2019	-0.467	0.045	-10.294	0.000	0.000
2020-2018	-0.818	0.045	-18.028	0.000	0.000
2019-2018	-0.351	0.045	-7.734	0.000	0.000
FI	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	0.123	0.045	2.710	0.007	0.040
2021-2019	0.583	0.045	12.841	0.000	0.000
2021-2018	0.970	0.045	21.378	0.000	0.000
2020-2019	0.460	0.045	10.131	0.000	0.000
2020-2018	0.847	0.045	18.668	0.000	0.000
2019-2018	0.388	0.045	8.538	0.000	0.000
Ins	Test Statistic	Std. Error	Std. Test Statistic	Sig.	Adj. Sig.
2021-2020	-0.155	0.045	-3.404	0.001	0.004
2021-2019	-0.172	0.045	-3.799	0.000	0.001
2021-2018	-0.150	0.045	-3.309	0.001	0.006
2020-2019	-0.018	0.045	-0.395	0.693	1.000
2020-2018	0.004	0.045	0.095	0.924	1.000
2019-2018	0.022	0.045	0.490	0.624	1.000