Credit risk analysis of Serbian luxury hotels: Impact of COVID-19

Ana Jovancai Stakić[1*], Vule Mizdraković[1], Maja Kljajić[2]

[1] Singidunum University, Faculty of Tourism and Hospitality Management, Belgrade, Serbia
[2] Singidunum University, Faculty of Business in Belgrade, Belgrade, Serbia

Abstract: The aim of this research is to analyse credit risk levels of Serbian luxury hotels, before, and during the COVID-19 pandemic. The purpose is to highlight the need for state-supported measures and proactive strategies to ensure financial sustainability and resilience in the luxury hotel industry. A dataset of 192 observations from 2019 to 2021 is employed, using predictive models including the Altman Z'-score, Altman Z"-score, Kralicek DF score, Springate S-score, and Zmijewski X-score, to assess creditworthiness of 64 selected mostly 4-star hotels. Data analysis involved the use of statistical tests such as the Kolmogorov-Smirnov test, Shapiro-Wilk test, and Wilcoxon signed-rank test. All models, except Zmijewski, show statistically significant results. The findings reveal a significant impact of the pandemic on credit risk levels in 2020, followed by positive trends in 2021, indicating successful adaptation and resilience. Policymakers, financial institutions, and hoteliers can use these insights to navigate the post-pandemic era effectively.

Keywords: hotel industry, pandemic, financial statements, financial sustainability, predictive models.
JEL classification: M21, M41

Analiza kreditnog rizika srpskih luksuznih hotela: Uticaj COVID-19 pandemije

Sažetak: Cilj ovog istraživanja jeste analiza nivoa kreditnog rizika luksuznih hotela iz Srbije, pre i tokom COVID-19 pandemije. Istraživanje ukazuje na potrebu za merama podrške države i proaktivnim strategijama kako bi se osigurala finansijska održivost i otpornost u ovoj industriji. Korišćen je uzorak od 192 jedinice posmatranja u periodu od 2019. do 2021. godine. Upotrebljeni su sledeći prediktivni modeli: Altman Z'-score, Altman Z"-score, Kralicek DF score, Springate S-score i Zmijewski X-score, kako bi se procenila kreditna sposobnost 64 uzorkovana hotela sa uglavnom 4 zvezdice. Za analizu podataka korišćeni su statistički testovi Kolmogorov-Smirnov test, Shapiro-Wilk i Wilcoxonov test. Svi modeli, osim Zmijewski modela, pokazali su statistički značajne rezultate. Rezultati potvrđuju značajan uticaj pandemije na nivoe kreditnog rizika u 2020. godini, koji su praćeni pozitivnim trendom u 2021. godini, što ukazuje na uspešno prilagođavanje uprave hotela i otpornost poslovanja. Rezultate istraživanja mogu koristiti različiti donosioci politika, finansijske institucije i hotelijeri kako bi se efikasno nosili sa postpandemijskom erom.

Ključne reči: hotelijerstvo, pandemija, finansijski izveštaji, finansijska održivost, modeli predviđanja
JEL klasifikacija: M21, M41

---

* ajovancaistakic@singidunum.ac.rs

1. Introduction

In today's intricate and interconnected financial landscape, credit analysis has emerged as a crucial discipline for assessing the viability and stability of borrowers. Credit analysis plays a pivotal role in enabling financial institutions to make informed lending decisions and manage credit risk effectively. At its core, credit analysis involves evaluating the creditworthiness of individuals, businesses, or industries by examining their financial health, past repayment behavior, and overall capacity to fulfill their debt obligations (Gootkind, 2023). Credit risk refers to the potential of financial loss arising from the failure of a borrower to repay a debt or meet their contractual obligations (Brown & Moles, 2014). It encompasses the probability of default, delayed payments, or inadequate collateral, which can lead to significant financial consequences for lenders. Therefore, understanding and managing credit risk is paramount to the sustainability and profitability of financial institutions, as well as the broader economic ecosystem (Gootkind, 2023). Recent global events, primarily COVID-19, affected all industries in the world and the financial health of businesses, making it challenging to meet their financial obligations (Ghorbani et al., 2023; Mijailović et al., 2023). Due to travel and many other restrictions, the tourism and hospitality industry suffered the most (Nagaj & Žuromskaitė, 2021; Nicola et al., 2020; Skare et al., 2021). The COVID-19 pandemic has dealt a severe blow to the global tourism and leisure sector, including the hospitality subsector, as well as the hotel industry, and its entire value chain (Duro et al., 2021). Over the past few decades, tourism represented one of the world's largest and fastest-growing industries and is widely recognized as a significant contributor to employment growth for numerous countries (Vasilakakis et al., 2023). Prior to the pandemic, from 2014 to 2019, the travel and tourism sector along with its direct, indirect, and induced effects had been responsible for generating 20% of the new jobs worldwide. In 2019, the sector contributed to 10.3% of total employment (equivalent to 334 million jobs) and 10.4% of global GDP (equivalent to US$ 10 trillion) (WTTC, 2023). The outlook for tourism development was exceptional and tourism was given a lot of official attention in the country until the COVID-19 crisis. In 2020, the travel and tourism sector suffered a significant blow from the COVID-19 pandemic, resulting in a significant GDP decrease of approximately USD 4.9 trillion and 62 million job losses (WTTC, 2022). In 2019, the global market size of the hotel and resort subsector reached its highest point at 1.52 trillion U.S. dollars. However, due to the impact of the COVID-19 pandemic, the market size fell under 1 trillion in 2020 and 2021. Projections for 2023 indicated a forecast market size of 1.21 trillion U.S. dollars (Statista, 2023). The unparalleled characteristics and subsequent consequences of the pandemic, followed by geopolitical instability, have created a significant economic and financial impact on global tourism and hospitality, underlying that hotels have been particularly exposed to negative consequences. Within the hotel industry, credit risk assumes a distinct significance due to the unique characteristics and inherent vulnerabilities of this sector Clark et al. (2021), such as high leverage ratios, and a significant portion of property, plant, and equipment (PP&E) in their total asset structure, as well. Hotels heavily rely on credit facilities to finance their operations, expansion projects, and infrastructure development. The financial stability of a hotel is significantly influenced by factors such as seasonality, market concentration, and proximity to the tourist destination centre. "Other factors related to hotel characteristics that prove significant are diversification, liquidity, indebtedness, operational efficiency, and profitability" (Vivel-Búa, et al., 2018, p. 110). Therefore, it is not only essential to focus on fast recovery but also to build resilience to new challenges and the inevitable transformation that the post-COVID era brought (Gössling et al., 2020; Koh, 2020). Consequently, a comprehensive understanding of credit risk is imperative for stakeholders, including lenders, investors, and policymakers, to effectively assess, mitigate, and navigate the associated challenges and opportunities (Brown & Moles, 2014) and that is essential in the hotel

industry, as well. In Serbia, tourism has emerged as a vital economic sector, advancing economic growth and regional development (Stakić & Stakić, 2020). The travel and tourism sector made up 5.9% of Serbia's GDP in 2019. However, it decreased to 3.7% in 2020 due to the pandemic's adverse effects. There was a partial recovery in 2021, with a growth to 3.6% (Statistical Office of the RS, 2023). According to the data of the OECD (2022), "in 2019, tourism provided 4.2% of total employment or 85,092 direct jobs and it remained stable at 4.3% of employment in 2021 with the number of jobs increasing to 99,216". In 2019, despite 3.6 million tourist arrivals, the negative effect of the pandemic caused a drop in tourist arrivals to 1.8 million in 2020. There was a rebound in 2021, with total tourist numbers rising to 2.5 million, followed by an increase to 3.8 million in 2022 (WTTC, 2022a). At the heart of the tourism experience in Serbia, the hotel industry stands as a central pillar representing one of the foremost components of tourism offering (Jovanović & Ilić, 2017). Beyond their fundamental function of providing accommodation, these hotels play a multifaceted role in shaping the perception, satisfaction, and overall experience of travelers. Since the hotel industry is an important sector of the Serbian economy, it is important to increase its resilience by providing stable financing. While Serbian tourism began its recovery in 2021 with an upturn in foreign and domestic tourist arrivals and overnight stays, the concern remains whether this level of rebound can adequately counteract the adverse financial consequences stemming from the ongoing impact of the COVID-19 crisis (Matejić et al., 2022). Based on the OECD (2022), Serbia is expecting a return of inbound tourism to pre-pandemic levels by 2025. According to Crespí-Cladera et al. (2021), the survival of hotels will hinge primarily on their financial resilience emphasizing the importance of financial variables in the overall strategy for overcoming the challenges caused by crisis. This paper investigates the multifaceted landscape of credit risk analysis specific to luxury hotels by exploring a range of variables, including the most commonly used the Altman Z-scores, Kralicek DF score, Springate S-score, and Zmijewski X-score. In doing so, the intention is to assist financial institutions, hoteliers, and other stakeholders in making informed credit decisions, mitigating potential risks, and optimizing their lending strategies in the post-COVID era. Therefore, the primary aim of the research is to analyse the difference between credit risk levels of Serbian luxury hotels, before, and during the COVID-19 pandemic. The paper is structured as follows - the next section offers a literature review when it comes to credit risk analysis in hospitality, as well as the COVID-19 pandemic effect on it. This will be followed by the research methodology section where both statistical methods used in this research and the process of research will be explained. The results of the conducted research will be presented in the following section. Finally, conclusions will be drawn, and suggestions for future research endeavours will be made.

2. Literature review

The credit risk of an entity has a substantial impact on stakeholders, including investors, managers, and financial institutions (Altin et al., 2016). Understanding the factors contributing to credit risk empowers managers and policymakers to mitigate potential consequences effectively. Previous studies have analyzed credit risk in various industries, including the hotel industry, highlighting the significance of factors such as location, diversification, liquidity, indebtedness, operational efficiency, and profitability (Vivel-Búa et al., 2018). Studies in the hotel industry have explored credit risk and financial performance. Researchers have emphasized the importance of liquidity and profitability indicators in assessing credit risk, especially during periods of economic downturn in 2008 (Mizdraković et al., 2015). Additionally, previous research has shown that weakened global economies can influence overall business solvency and increase bankruptcy risks across industries, including hotels (Mizdraković et al., 2015). Regarding the financial sustainability of the hotel

sector, Metaxas and Romanopoulos (2023) have pinpointed the financial determinants associated with hotel default. The research results have demonstrated that measures of debt and liabilities elevate the risk of default, whereas indicators of profitability and size in terms of total assets mitigate the risk.

The COVID-19 pandemic had a significant impact on industries worldwide, including Serbia, with a notable 3.4% decline in global GDP during 2020 (Statista, 2023). The hotel industry experienced one of the most severe impacts, as almost all hotels experienced closures and decreased revenues (Abraham et al., 2020; Chan et al., 2021; Ghorbani et al., 2023; Jiang, 2023; Radivojević et al., 2023). Previous studies have extensively investigated the financial repercussions of the pandemic on the hospitality industry (Clark et al., 2021; Wieczorek-Kosmala, 2021), highlighting the need for financial resilience to overcome the challenges posed by the crisis. Studies have emphasized the importance of financial resilience for hospitality companies in the time of the COVID-19 crisis. Researchers have analyzed the financial performance and creditworthiness of hotel businesses during the pandemic, particularly focusing on liquidity and profitability indicators (Radivojević et al., 2023). Certain hotels have prioritized liquidity over profitability in response to the pandemic's severe impact, leading to a prolonged and challenging recovery period (Radivojević et al., 2023). Statistical models and financial ratio analyses have been used to predict bankruptcy risk in the hotel industry. Susetyo and Susilowati (2023) were engaged in predicting bankruptcy for the years 2020–2021 among hotel chains with stocks listed on the NASDAQ and NYSE, using the Altman, Springate, and Zmijewski models. According to the study's findings, the Springate model exhibited the highest accuracy (80.56%) in forecasting bankruptcy. Studies have identified significant determinants of bankruptcy, such as indicators of profitability or liquidity (Papana & Spyridou, 2020; Zainol Abidin et al., 2021). Recent research has specifically examined the credit risk of Serbian luxury hotels during and after the COVID-19 crisis. Studies have utilized methodologies such as financial ratio analysis, comparative analysis, and multiyear predictions to assess the impact of the pandemic on credit risk (Matejić et al., 2022). The findings indicate a negative impact on bankruptcy risk, with a significant number of hotel entities facing the risk of bankruptcy (Matejić et al., 2022).

The research findings call for state-supported measures and business policies to ensure the long-term sustainability of hotel entities amid the COVID-19 crisis. Providing financial stability and credit support to the industry is crucial for its survival and recovery (Kozhamzharova et al., 2022). Policymakers need to consider the dynamic transitions of firms among risk zones to implement effective strategies for business resilience (Matejić et al., 2022). As a conclusion of this section, the reviewed studies highlighted the significance of financial resilience and the need for state-supported measures to ensure the survival and sustainability of the hotel industry in the face of the crisis.

3. Research methodology

To support the research aim stated in the Introduction section the hypothesis was designed:
There is a statistically significant difference between credit risk levels of Serbian luxury hotels, before, and during the COVID-19 pandemic.

The following study has been conducted based on the financial statements of selected hotels. The research sample consists of a total of 64 entities (Serbian 4- and 5-star hotels), comprising 192 observation units in total. The observed research period spans 3 years (from 2019 to 2021), which is considered suitable for analysing the credit risk of Serbian luxury hotels. It should be noted that the pandemic was officially declared in Serbia in March 2020. Consequently, the 2019 reporting period was not affected by the negative effects of the

pandemic, while the first impacts were felt in 2020 and progressed through 2021 and further on.

The data used in the research were collected from the Serbian Business Registers Agency (SBRA) website based on the ID numbers of the sampled entities. The same hotels were observed throughout the different periods to enable a comparison of the obtained research results. The selection of luxury hotels was done using the official site of Booking.com, one of the largest worldwide touristic agencies. The results were filtered for 4- and 5-star hotels exclusively, as other types of accommodation do not need to be registered as business entities in order to operate and, consequently, are not obliged to prepare and disclose financial statements. Hotels are mostly categorised as 4-star, and app. one-quarter of them are 5-star hotels.

The financial statements that were gathered have been utilized to compute financial indicators, which are employed to assess the credit solvency level of Serbian hotels during the observed period. For this purpose, we have selected the following, most commonly used, multivariate predictive models: Altman's Z'-score for private companies, Altman's Z''-score for emerging economies, Kralicek's Diversification Failure (DF) score, Zmijewski X-score, and Springate S-score.

Altman Z-Score model is a bankruptcy prediction model used to evaluate the financial stability of a company. It combines multiple financial ratios to generate a single score, which is then used to classify the company into different risk categories. The model primarily focuses on analyzing a company's financial statements, such as profitability, leverage, liquidity, solvency, and activity ratios. It is commonly used by investors, creditors, and analysts to assess the likelihood of a company experiencing financial distress or bankruptcy. Professor Edward Altman is credited with developing the most widely recognized approach to assessing the risk of corporate bankruptcy. The original formula was meant for public companies, but later professor Altman created two additional formulas. The first one (Z') is suitable for forecasting the likelihood of private company insolvency, while the second one (Z'') is better suited for entities operating within emerging markets. Therefore, those revised formulas were used in this research having in mind that almost all sampled hotels are private companies operating within an emerging market (Altman, 1968; Altman, 2002):

$$Z' = 0.717 \times X_1 + 0.847 \times X_2 + 3.107 \times X_3 + 0.420 \times X_4 + 0.998 \times X_5 \qquad (1)$$

$$Z'' = 6.56 \times X_1 + 3.26 \times X_2 + 6.72 \times X_3 + 1.05 \times X_4 \qquad (2)$$

where: Z = Value of the discriminant function; X_1 = Working Capital to Total Assets; X_2 = Retained Earnings to Total Assets; X_3 = EBIT to Total Assets; X_4 = Book Value of Equity to Total Liabilities, and X_5 = Sales to Total Assets. If the calculated value is lower than 1.23 for the first formula, or 1.2 for the second, the observed entity is in the distressed zone.

In the 1990s, Professor Peter Kralicek, following the framework of Altman's Z-score model, developed a financial indicator known as Kralicek's DF indicator (Lončarević, 2015). The abbreviation *DF* stands for *discriminatory function*. This indicator was created based on a sample of European companies operating in Austria, Germany, and Switzerland. Professor Kralicek utilized official financial statements and conducted a multivariate discriminatory analysis to establish a bankruptcy prediction model, thereby formulating a comprehensive business model (Zenzerović & Peruško, 2006; Mizdraković et al., 2015). DF indicator is a risk management tool that focuses on the potential failure of a portfolio due to diversification issues. It is primarily used in the context of portfolio management and investment strategies. The indicator helps assess the risk of inadequate diversification within a portfolio by

considering the distribution of returns. Professor Kralicek derived the following model, which can be represented by the following formula (Zenzerović & Peruško, 2006):

$$DF = 1.5 \times X_1 + 0.008 \times X_2 + 10 \times X_3 + 5 \times X_4 + 0.3 \times X_5 + 0.1 \times X_6 \qquad (3)$$

where: DF = Value of the discriminant function; X_1 = Net Cash Flow to Total Liabilities; X_2 = Total Assets to Total Liabilities; X_3 = Earnings before Interest and Taxes (EBIT) to Total Assets; X_4 = EBIT to Total Revenues; X_5 = Inventories to Total Revenues, and X_6 = Sales Revenues to Total Assets. Kralicek suggests that values lower than 0.3 indicate that observed entity has entered the beginning stage of insolvency.

In 1978, Springate utilized a step-wise multiple discriminate analysis approach to choose four out of the nineteen widely used financial ratios and thus created new model. These ratios were employed to differentiate the bankruptcy status of a company. This model, referred to as the S-Score, is structured as follows (Susetyo & Susilowati, 2023):

$$S - Score = 1.03 \times X_1 + 3.07 \times X_2 + 0.66 \times X_3 + 0.4 \times X_4 \qquad (4)$$

where: S-Score = Value of the discriminant function; X_1 = Working Capital to Total Assets; X_2 = EBIT to Total Assets; X_3 = EBIT to Current Liabilities; and X_4 = Sales to Total Assets. In the case of Springate's S-score, a value below 0.862 is frequently considered a red flag.

Finally, Zmijewski (1984) developed a bankruptcy prediction model using a cumulative normal probability distribution. Probit analysis was applied to a dataset comprising 40 companies that had encountered bankruptcy and 800 companies that remained operational during that specific period. The model introduced by Zmijewski, also known as the X-Score, follows the calculation formula (Susetyo & Susilowati, 2023):

$$X - Score = -4.3 - 4.5 \times X_1 + 5.7 \times X_2 + 0.004 \times X_3 \qquad (5)$$

where: X-Score = Value of the discriminant function; X_1 = Net Income to Total Assets; X_2 = Total Assets to Total Debt; and X_3 = Current Assets to Current Liabilities. When it comes to this score, a value below 0.00 predicts financial distress.

For the purpose of determining data normality, common tests such as The Kolmogorov-Smirnov test and the Shapiro-Wilk test will be used. These tests are usually used when research sample consists of a relatively small number of observations (in this case 192 units). To validate the hypothesis, the non-parametric Wilcoxon rank-sum test will be employed along with previous normality tests. This test is suitable when the data does not meet the assumptions required for a parametric test like the t-test or when dealing with small sample sizes. The test operates by ranking the values from each sample and evaluating if there exists a significant difference in medians between the two groups:

$$U = W - \frac{n_2 \times (n_2 + 1)}{2} \qquad (6)$$

where: W = Test statistic, n_2 = Number of observations in the other group whose ranks were not summed.

Finally, all previously mentioned tests will be operated with SPSS IBM (*Statistical Package for the Social Sciences*).

4. Results and discussion

4.1. Data distribution and normality tests

The following table presents the results of descriptive statistics for selected prediction models across different reporting periods. Each row corresponds to a specific model, and the columns show the statistical measures for each reporting year (2019, 2020, and 2021). Additionally, when interpreting the results, it can be concluded that luxury hotels in the Republic of Serbia operate with moderate to high credit risk overall, with a significant spike in 2020. Only Altman Z''-score mean values showed that observed hotels were in a "safe" zone during 2019 and 2021. Specifically, selected indicators were calculated for each sampled hotel during each reporting period. Descriptive statistics were then performed using IBM SPSS based on these values.

Table 1: Results of descriptive statistics for selected models

Model	Year	Mean	Median	Min	Max	Range	Std. Error	Std. Deviation
Altman Z' - score	2019	2.54	1.00	-6.57	42.15	48.72	0.76	6.09
	2020	-0.70	0.63	-172.74	33.92	206.66	2.81	22.44
	2021	2.11	0.97	-3.31	32.24	35.55	0.56	4.48
Altman Z''-score	2019	4.26	0.72	-34.83	105.25	140.08	2.08	16.61
	2020	-2.66	0.47	-370.91	84.93	455.85	6.12	48.97
	2021	3.48	1.28	-28.10	80.65	108.76	1.56	12.44
Kralicek DF score	2019	-0.41	1.34	-102.89	16.57	119.46	1.75	14.00
	2020	-7.97	-0.70	-397.10	5.62	402.72	6.21	49.68
	2021	0.06	1.25	-55.45	14.12	69.57	1.03	8.23
Springate S-score	2019	0.03	0.21	-9.16	4.97	14.13	0.22	1.76
	2020	-60.13	-0.27	-3,810.97	1.08	3,812.05	59.54	476.30
	2021	0.18	0.21	-4.63	2.62	7.25	0.14	1.12
Zmijewski X-score	2019	29.43	4.15	-2.34	636.75	639.09	10.80	86.37
	2020	31.44	4.62	-2.15	514.98	517.13	9.68	77.43
	2021	23.13	4.94	-3.92	484.19	488.11	8.07	64.55

Source: Authors' research

When comparing the mean and median values of selected models in 2019 and 2020 respectively, all scores suggest that credit risk increased (some of them dramatically). Unexpectedly, when comparing the 2020 and 2021 reporting periods, the financial health of selected hotels improved. Having in mind that the level of credit risk was approximately the same in 2019 and 2021, it can be inferred that the management of these hotels adapted to the changed circumstances with great success, even though the most severe effects of the COVID-19 pandemic to whole economy were felt in 2021.

With the aim to assess whether the data from each reporting period follows a normal distribution, two different statistical tests Kolmogorov-Smirnov, and Shapiro-Wilk, were used. The following table presents the results across selected reporting periods, with statistics and significance values reported for each predictive model and test.

Table 2: Test of normality

Model	Year	Kolmogorov-Smirnov			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Altman Z' - score	2019	0.287	64	0.000	0.532	64	0.000
	2020	0.440	64	0.000	0.233	64	0.000
	2021	0.244	64	0.000	0.516	64	0.000
Altman Z'' - score	2019	0.234	64	0.000	0.624	64	0.000
	2020	0.375	64	0.000	0.299	64	0.000
	2021	0.241	64	0.000	0.625	64	0.000
Kralicek DF score	2019	0.379	64	0.000	0.339	64	0.000
	2020	0.404	64	0.000	0.169	64	0.000
	2021	0.280	64	0.000	0.488	64	0.000
Springate S-score	2019	0.228	64	0.000	0.746	64	0.000
	2020	0.531	64	0.000	0.106	64	0.000
	2021	0.144	64	0.002	0.904	64	0.000
Zmijewski X-score	2019	0.356	64	0.000	0.341	64	0.000
	2020	0.350	64	0.000	0.432	64	0.000
	2021	0.345	64	0.000	0.355	64	0.000

Source: Authors' research

It can be noticed that for all models and reporting periods, the Kolmogorov-Smirnov test statistic and Shapiro-Wilk test statistic are greater than zero, indicating that the data deviates from a perfect normal distribution. The significance values for all tests are very close to zero ($p < 0.005$), indicating that the deviations from normality are statistically significant. In general, the Shapiro-Wilk test appears to be slightly more sensitive to deviations from normality, as the test statistics are generally lower than the corresponding Kolmogorov-Smirnov test statistics. To conclude, the results suggest that the data for all selected models and reporting periods deviates significantly from a normal distribution.

4.2 Testing hypothesis

In order to test the previously defined hypothesis: *There is a statistically significant difference between credit risk levels of Serbian luxury hotels, before, and during the COVID-19 pandemic;* Wilcoxon signed rank test was used with related groups feature selected. For this purpose, data were reorganised for two different periods (2019-2020 and 2020-2021), in order to show if there were any statistically significant differences between credit risk levels when pandemic started and during the pandemic (Table 3).

Overall, the results show that there are statistically significant differences in credit risk levels for most models when comparing the periods 2019-2020 and 2020-2021. Altman Z' – score, Kralicek DF score, and Springate S-score, indicate the same results, that defined hypothesis should be rejected, meaning that there is a statistically significant difference in these scores between these periods. Results for Altman Z''-score show that there was a statistically significant difference for 2019-2020 period, but not for 2020-2021. However, for the Zmijewski X-score, there is no statistically significant difference between these periods.

Table 3: Testing hypothesis by using Wilcoxon signed ranks test

Model	Period	Z	Asymp. Sig. (2-tailed)	Decision
Altman Z'-score	2019-2020	-3.036	0.002	Reject the null hypothesis.
	2020-2021	-3.029	0.002	Reject the null hypothesis.
Altman Z''-score	2019-2020	-2.474	0.013	Reject the null hypothesis.
	2020-2021	-1.685	0.092	Retain the null hypothesis.
Kralicek DF score	2019-2020	-4.198	0.000	Reject the null hypothesis.
	2020-2021	-4.238	0.000	Reject the null hypothesis.
Springate S-score	2019-2020	-4.601	0.000	Reject the null hypothesis.
	2020-2021	-4.875	0.000	Reject the null hypothesis.
Zmijewski X-score	2019-2020	-.120	0.904	Retain the null hypothesis.
	2020-2021	-1.886	0.059	Retain the null hypothesis.

Source: Authors' research

Training data used to create predictive models might be one of the explanations for having different results for selected predictive models. Namely, the scoring systems might have been trained on a larger and more diverse dataset that includes a wide range of companies, including hotels. This broader training data can result in more robust and accurate models for predicting bankruptcy risk across different industries, including hotels.

Furthermore, the Altman, Kralicek, and Springate scoring systems might have better generalization capabilities, allowing them to perform well across different industry segments, including hotels. It is not a rare situation that scoring system created for specific industries or companies might not perform as effectively for them due to overfitting or limitations in the available data.

5. Conclusion with future implications and limitations

This research provides insights into the credit risk landscape of the luxury hotel industry in Serbia, with a specific focus on the impact of the COVID-19 pandemic. Critical role of credit analysis and risk management in ensuring the financial sustainability and resilience of hotels in the face of unprecedented challenges is highlighted. The literature review demonstrated that the pandemic's outbreak brought about severe disruptions, leading to an abrupt decline in revenue and financial instability for many hotels. The results of descriptive statistics show that credit risk of observed hotels increased for most models of bankruptcy prediction during 2020, which corresponds to the initial impact of the pandemic. However, by 2021, there were improvements in credit risk levels for some models, suggesting that the management of these luxury hotels in the Republic of Serbia adapted successfully to the challenging circumstances imposed by the COVID-19 pandemic. Results of Wilcoxon test are in line with the previous, indicating that creditworthiness of hotels worsened during 2020, reflecting the initial shock of the pandemic. Nevertheless, a positive trend can be observed in 2021, indicating that

hotels adapted and implemented effective strategies to cope with the crisis. This resilience is commendable and reflects the industry's determination to recover and thrive in the post-pandemic era. The pandemic has underscored the importance of financial resilience and prudent credit risk management in the hotel industry. It is imperative for stakeholders to recognize the significance of continuous monitoring and proactive measures to maintain the financial health of hotels, especially in times of crisis. Although the Republic of Serbia imposed significant amount of financial measures in order to aid impacted industries (hotels among else), it is important to monitor their financial stability and provide necessary credit support to ensure the survival and recovery of the luxury hotel industry. Policymakers should consider the dynamic transitions of firms among risk zones to implement effective strategies for business resilience. Finally, it is essential to acknowledge limitations of this research. The sample size and focus on luxury hotels in Serbia may limit the generalizability of the findings to the broader hotel industry. Future research could explore credit risk in different segments of the hospitality sector and expand the study to other regions, enabling a more comprehensive understanding of the industry's credit risk landscape.

Conflict of interest

The authors declare no conflict of interest.

References

1. Abraham, V., Bremser, K., Carreno, M., Crowley-Cyr, L., & Moreno, M. (2020). Exploring the consequences of COVID-19 on tourist behaviors: Perceived travel risk, animosity and intentions to travel. *Tourism Review*, *76*(1), 701–717. https://doi.org/10.1108/TR-07-2020-0344
2. Al-Awadhi, A., Alsaifi, K., Al-Awadhi, A., & Alhammadi, S. (2020). Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of Behavioral and Experimental Finance*, *27*(1), 100326. https://doi.org/10.1016/j.jbef.2020.100326
3. Altin, M., Kizildag, M., & Ozdemir, O. (2016). Corporate governance, ownership structure, and credit ratings of hospitality firms. *The Journal of Hospitality Financial Management*, *24*(1), 5–19. https://doi.org/10.1080/10913211.2016.1166022
4. Altman, E. (1968). Financial ratio, discriminate analysis and prediction of corporate bankruptcy. *Journal of Finance*, *23*(4), 589–629. https://doi.org/10.2307/2978933
5. Altman, E. (2002). Corporate distress prediction models in a turbulent economic and Basel Ii environment. *NYU Working paper No. S-CDM-02-11*. Retrieved July 15, 2023 from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1295810
6. Brown, K., & Moles, P. (2014). *Credit risk management*. Edinburgh: Edinburgh Business School.
7. Chan, J., Gao, Y., & McGinley, S. (2021). Updates in service standards in hotels: How COVID-19 changed operations. *International Journal of Contemporary Hospitality Management*, *33*(5), 1668–1687. https://doi.org/10.1108/IJCHM-09-2020-1013
8. Chen, M., Demir, E., García-Gómez, C., & Zaremba, A. (2020). The impact of policy responses to COVID-19 on U.S. travel and leisure companies. *Annals of Tourism Research Empirical Insights*, *1*(1), 100003. https://doi.org/10.1016/j.annale.2020.100003
9. Clark, J., Mauck, N., & Pruitt, S. (2021). The financial impact of COVID-19: Evidence from an event study of global hospitality firms. *Research in International Business andFinance*, *58*(1), 101452. https://doi.org/10.1016/j.ribaf.2021.101452

10. Crespí-Cladera, R., Martín-Oliver, A., & Pascual-Fuster, B. (2021). Financial distress in the hospitality industry during the COVID-19 disaster. *Tourism Management*, *85*(1), 104301. https://doi.org/10.1016/j.tourman.2021.104301

11. Ding, W., Levine, R., Lin, C., & Xie, W. (2021). Corporate immunity to the COVID-19 pandemic. *Journal of Financial Economics*, *141*(1), 802–830. https://doi.org/10.1016/j.jfineco.2021.03.005

12. Duro, J., Perez-Laborda, A., Turrion-Prats, J., & Fernández-Fernández, M. (2021). COVID-19 and tourism vulnerability. *Tourism Management Perspectives*, *38*(1), 100819. https://doi.org/10.1016/j.tmp.2021.100819

13. Ghorbani, A., Mousazadeh, H., Akbarzadeh Almani, F., Lajevardi, M., Hamidizadeh, M., Orouei, M., & Dávid, L. (2023). Reconceptualizing customer perceived value in hotel management in turbulent times: A case study of isfahan metropolis five-star hotels during the COVID-19 pandemic. *Sustainability*, *15*(8), 7022. https://doi.org/10.3390/su15087022

14. Gössling, S., Scott, D., & Hall, C. (2020). Pandemics, tourism and global change: a rapid assessment of COVID-19. *Journal of Sustainable Tourism*, *29*(1), 1–20. https://doi.org/10.1080/09669582.2020.1758708

15. Gootkind, C. (2023). *Fundamentals of credit analysis - CFA Program Curriculum level I*. Retrieved July 5, 2023 from https://www.cfainstitute.org/en/membership/professional-development/refresher-readings/fundamentals-credit-analysis

16. Jiang, B. (2023). Analysis of Marriott's financial position under the epidemic. *Highlights in Business, Economics and Management*, *10*(1), 122–126. https://doi.org/10.54097/hbem.v10i.7965

17. Jovanović, S., & Ilić, I. (2017). Regional features of tourism and hotel industry in the Republic of Serbia. In D. Cvijanović et al. (Eds.). *Tourism in Function of Development of the Republic of Serbia – Tourism Product as a Factor of Competitiveness of the Serbian Economy and Experiences of other Countries*. Thematic Proceedings II (pp. 538–555). Vrnjačka Banja: Faculty of Hotel Management and Tourism in Vrnjačka Banja.

18. Koh, E. (2020). The end of over-tourism? Opportunities in a post-Covid-19 world. *International Journal of Tourism Cities*, *6*(4), 1015–1023. https://doi.org/10.1108/IJTC-04-2020-0080

19. Kozhamzharova, G., Omarbakiyev, L., Kogut, O., Zhumasheva, S., Saulembekova, A., & Abdrakhmanova, G. (2022). Banking risks and lending to tourism and hotel businesses amid the COVID-19 pandemic. *Journal of Environmental Management and Tourism*, *13*(2), 427–437. https://doi.org/10.14505/jemt.13.2(58).12

20. Lončarević, S. (2015). Comparison to Kralicek DF indicators and Altman Z-Score model for Serbian metal industry. *International Journal of Industrial Engineering and Management (IJIEM)*, *6*(4), 199–204.

21. Matejić, T., Knežević, S., Arsić, V., Obradović, T., Milojević, S., Adamović, M., & Špiler, M. (2022). Assessing the impact of the COVID-19 crisis on hotel industry bankruptcy risk through novel forecasting models. *Sustainability*, *14*(8), 4680. https://doi.org/10.3390/su14084680

22. Metaxas, T., & Romanopoulos, A. (2023). A literature review on the financial determinants of hotel default. *Journal of Risk and Financial Management*, *16*(7), 323. https://doi.org/10.3390/jrfm16070323

23. Mijailović, O., Kljajić, M., Mizdraković, V., & Kilibarda, N. (2023). The profitability of the meat industry in Serbia: Did the COVID-19 pandemic have any impact? *Meat Technology*, *64*(1), 41–49. https://doi.org/10.18485/meattech.2023.64.1.4

24. Mizdraković, V., Knežević , G., & Stanić, N. (2015). Bankruptcy risk exposure of Serbian hotels in the period 2008-2012. *Sitcon: Tourism Destination Competitiveness* (pp. 164–167). Belgrade, Serbia: Singidunum University.

25. Nagaj, R., & Žuromskaitė, B. (2021). Tourism in the era of COVID-19 and its impact on the environment. *Energies*, *14*(7), 2000. https://doi.org/10.3390/en14072000

26. Nicola, M., Alsafi, Z., Sohrabi, C., Kerwan, A., Al-Jabir, A., Losifidis, C., & Agha, R. (2020). The socio-economic implications of the coronavirus pandemic (COVID-19): A review. *International Journal of Surgery*, *78*(1), 185–193. https://doi.org/10.1016/j.ijsu.2020.04.018

27. Organisation for Economic Co-operation and Development (OECD). (2022). *Tourism trends and policies 2022*. Retrieved July 1, 2023 from https://www.mlit.go.jp/kankocho/content/001577527.pdf

28. Ozdemir, O., Dogru, T., Kizildag, M., Mody, M., & Suess, C. (2019). Quantifying the economic impact of COVID-19 on the U.S. hotel industry: Examination of hotel segments and operational structures. *Tourism Management Perspectives*, *39*(1), 100864. https://doi.org/10.1016/j.tmp.2021.100864

29. Papana, A., & Spyridou, A. (2020). Bankruptcy prediction: The case of the Greek market. *Forecasting*, *2*(4), 505–525. https://doi.org/10.3390/forecast2040027

30. Park, S., & Hancer, M. (2012). A comparative study of logit and artifi cial neural networks in predicting bankruptcy in the hospitality industry. *Tourism Economics*, *18*(2), 311–338. https://doi.org/10.5367/te.2012.0113

31. Penciakova, V., Sander NGourinchas, P., & Kalemli-Ozcann, S. (2020). COVID-19 and SME failures. *NBER Working Paper 27877*.

32. Radivojević, V., Dimovski, J., & Mitić, G. (2023). Quantifying the financial impact of COVID-19 on the largest global companies in the hotel industry. *Hotel and Tourism Management*, *11*(1), 165–176. https://doi.org/10.5937/menhottur2301165R

33. Sarwari, S., Huq, S., & Minar , T. (2021). COVID-19: The way luxury hotels deal with the pandemic. *International Journal of Tourism and Hospitality Management in the Digital Age*, *5*(2), 1–13. https://doi.org/10.4018/IJTHMDA.20210701.oa5

34. Skare, M., Soriano, D., & Porada-Rochon, M. (2021). Impact of COVID-19 on the travel and tourism industry. *Technological Forecasting and Social Change*, *163*(1), 120469. https://doi.org/10.1016/j.techfore.2020.120469

35. Stakić, A., & Stakić, N. (2020). Various sources of financing the development of rural tourism in the Republic of Serbia. In D. Cvijanović et al. (Eds.). *Tourism in Function of Development of the Republic of Serbia – Tourism and Rural Development* (pp. 179–196). Vrnjačka Banja: Faculty of Hotel Management and Tourism in Vrnjačka Banja.

36. Statista. (2023). *Economy & Politics - Impact of the coronavirus pandemic on the global economy - Statistics & Facts*. Retrieved June 20, 2023 from https://www.statista.com/topics/6139/covid-19-impact-on-the-global-economy/#topicOverview

37. Statistical Office of the RS. (2023). *Tourists arrivals and overnight stays by regions and areas - Annual data*. Retrieved September 16, 2023 from https://data.stat.gov.rs/Home/Result/220201?languageCode=en-US

38. Susetyo, A., & Susilowati, D. (2023). Hotel chain bankruptcy prediction: Comparison of the Altman, Springate, and Zmijewski models. *Proceeding of International Students Conference on Accounting and Business*, *2*(1), 867–884.

39. Vasilakakis, K., Tabouratzi, E., & Sdrali, D. (2023). Economic sustainability of tourism enterprises: A proposal of criteria in the hotels. *International Journal of Professional Business Review*, *8*(4), 1–7. https://doi.org/10.26668/businessreview/2023.v8i4.1769

40. Vivel-Búa, M., Lado-Sestayo, R., & Otero-González, L. (2018). Risk determinants in the hotel sector: Risk credit in MSMEs. *International Journal of Hospitality Management*, *70*(1), 110–119. https://doi.org/10.1016/j.ijhm.2017.11.004

41. Wieczorek-Kosmala, M. (2021). COVID-19 impact on the hospitality industry: Exploratory study of financial-slack-driven risk preparedness. *International Journal of Hospitality Management*, *94*(1), 102799. https://doi.org/10.1016/j.ijhm.2020.102799

42. World Travel & Tourism Council (WTTC). (2022). *Critical factors to attract hotel investment*. Retrieved June 21, 2023 from https://wttc.org/Portals/0/Documents/Reports/2022/Critical-Factors-To-Attract-Hotel_Investment.pdf

43. World Travel & Tourism Council (WTTC). (2023). *Economic impact research*. Retrieved July 20, 2023 from https://wttc.org/research/economic-impact

44. World Travel & Tourism Council (WTTC). (2022a). *Serbia 2022 annual research: Key highlights*. Retrieved September 16, 2023 from https://wttc.org/DesktopModules/MVC/FactSheets/pdf/704/197_20220613170452_Serbia2022_.pdf

45. Zainol Abidin, J., Abdullah, N., & Khaw, K. (2021). Bankruptcy prediction: SMEs in the hospitality industry. *International Journal of Banking and Finance*, *16*(2), 51–80. https://doi.org/10.32890/ijbf2021.16.2.3

46. Zenzerović, R., & Peruško, T. (2006). Kratki osvrt na modele za predviđanja stečaja [Short retrospection on bankruptcy prediction models]. *Ekonomska istraživanja – Economic Research*, *19*(2), 132–151.