TESTING THE VALIDITY OF CAPM ON BUCHAREST STOCK EXCHANGE

Florin BLAGA[1] ORCID: 0000-0001-8424-4755
Dănuț-Georgian MIHAI[2] ORCID: 0000-0002-3273-9411,
Ludovic-Cosmin TRIFU[3] ORCID: 0009-0009-8347-5020
Antonela BICHIR-GHELASE[4] ORCID: 0009-0007-0535-2274

Abstract. *In this paper, we test the validity of CAPM hypothesis during COVID-19 period. Using 10 high-liquid securities traded on Bucharest Stock Exchange during February 2020 to April 2020, we estimate the baseline CAPM alongside two additional extensions controlling for COVID-19 related news and foreign stock exchange evolution. With only one exception, for all the securities included in the analysis, the CAPM is valid regardless the model specification, suggesting that during COVID-19 financial turmoils, the investors trading on Bucharest Stock Exchange had a rational behavior.*

Keywords: CAPM, Bucharest Stock Exchange, COVID-19, investor behavior.

Introduction

The Capital Asset Pricing Model (CAPM) is one of the fundamental concepts in financial theory and is essential for evaluating and allocating assets in investment portfolios. This model provides a method for determining the expected price of a financial asset, taking into account its level of risk. Essentially, CAPM estimates the expected return of an asset based on the market return and a specific risk known as the beta factor.

In the context of the global COVID-19 pandemic, understanding risk dynamics and investor behavior becomes crucial. Given that this pandemic has had a significant impact on financial markets, including increased volatility and uncertainty, assessing the validity of the CAPM model under these conditions becomes essential.

In this paper, we chose to test the validity of CAPM during the COVID-19 pandemic on the Bucharest Stock Exchange, a capital with its own specificities. Using 10 highly liquid stocks, we analyzed whether the CAPM model remains relevant in times of financial turbulence such as those caused by the COVID-19 pandemic. The results showed that CAPM remained valid regardless of the model specification for the vast majority of analyzed companies, suggesting that investors on the Bucharest Stock Exchange exhibited rational behavior even in the face of increased uncertainty and significant changes in global markets.

These findings underscore the importance and robustness of the CAPM model, even in extreme market conditions. They suggest that despite exceptional events and rapid changes in the economic environment, fundamental theoretical tools and financial models can continue to provide valuable insights and guidance for investors. However, it is essential for analysts and financial professionals to continue adapting and refining these models in the context of an ever-changing economic environment and significant uncertainties.

[1] The Bucharest University of Economic Studies, Bucharest, Romania, email: blaga.florin@yahoo.com
[2] The Bucharest University of Economic Studies, Bucharest, Romania, email: danut.mihai@fin.ase.ro, Corresponding author
[3] The Bucharest University of Economic Studies, Bucharest, Romania, email: ludovic.trifu@fin.ase.ro
[4] Valahia University of Târgoviște, Romania, email: antonela.bichir@yahoo.ro
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Literature review

The Capital Asset Pricing Model (CAPM) is used to describe the relationship between the expected return of a stock and its associated risk. It is an equilibrium model that states that in a competitive market, the expected return of an asset varies proportionally with the risk of that asset as measured by beta. In analytical terms, the CAPM model can be summarized based on equation (2.1):

$$ER_i = R_f + \beta_i\left(ER_m - R_f\right) \qquad (1)$$

where ER_i represents the expected return of stock i, ER_m denotes the market return, and R_f stands for the risk-free rate.

Numerous extensions have been made to this model, which, in addition to systemic risk, also consider capitalization, stock value, company profitability, investment intensity, and macroeconomic context. Thus, recent academic research has further contributed to the debates on the validity of the CAPM model in emerging countries, offering nuanced perspectives on its application and limitations. For instance, Raza et al. (2020) investigate the impact of macroeconomic factors on CAPM performance in emerging markets, revealing that variables such as inflation and interest rates significantly influence asset prices. This underscores the need to extend the model presented in equation (2.1) and consider broader economic indicators for a more accurate evaluation of risk and return dynamics. Additionally, Chandra et al. (2022) explore the role of financial market development in shaping the validity of the CAPM model in emerging economies. Their conclusions suggest that the level of market maturity and efficiency significantly influence the performance of the CAPM model.

These recent studies shed light on the behavioral aspects of investors in emerging markets, such as Romania, and how psychological factors can influence asset prices, challenging the rationality hypothesis inherent in the traditional CAPM model. Chen et al. (2023) propose that deviations from the CAPM can be attributed to irrational behavior and sentiment-based trading, highlighting the importance of incorporating behavioral perspectives when assessing the validity of the CAPM in emerging markets.

Furthermore, Li and Yan (2021) analyze the role of political instability risk in shaping asset prices in emerging economies, revealing that political uncertainty significantly affects the risk-return relationship. This hypothesis was initially proposed by Koutmos (1997) decades earlier regarding the impact of political instability on CAPM application in these markets. With such recent perspectives, it becomes evident that the validity of CAPM in emerging countries continues to evolve, providing a more comprehensive understanding of the challenges and opportunities associated with its application.

Regarding the validity of the CAPM model in the Romanian market, numerous studies have provided mixed conclusions. Ihnatov and Sprincean (2015) found CAPM to be statistically validated for the US, Poland, and Romania markets, but the predicted returns closely match actual returns only for stocks traded on the New York Stock Exchange and Nasdaq. Thus, CAPM more accurately predicts expected returns in developed markets but fails in emerging markets, potentially leading investors to make flawed decisions and incur losses in their portfolios. Another study, such as that of Anghel et al. (2015), demonstrated that the Fama-French three-factor model explains variations in stock returns more coherently than the classic CAPM model, which has a lower adjusted R-squared.

Research on the impact of the COVID-19 pandemic on capital markets has been extensively documented in recent literature. Alansari et al. (2021) utilized sentiment analysis and machine learning techniques to uncover significant shifts in investor behavior and market volatility. Similarly, Bai et al. (2021) examined the effects of the pandemic on the Chinese stock market, focusing on the CSI 300 index. Li et al. (2020) investigated the influence of the COVID-19 crisis on the performance of the Hang Seng China Enterprises Index, providing valuable insights into market dynamics during this unprecedented period.

Methodology

In this section, we will present the data used to test the validity of the CAPM model on the Bucharest Stock Exchange during the COVID pandemic. We have selected the following companies from the BET index as representative: TLV, SNP, FP, SNG, BRD, TGN, EL, DIGI, SNN, TEL. For the sake of simplicity, we will extensively analyze the data of Banca Transilvania (TLV) and complement the exposition with results pertaining to the other considered stocks. We have chosen the study period to be November 2016 to December 2021 to assess the validity of the CAPM model under normal market conditions, as well as during sharp declines and rapid recoveries. Figure 1 illustrates the price evolution graph of TLV stock compared to the BET index.

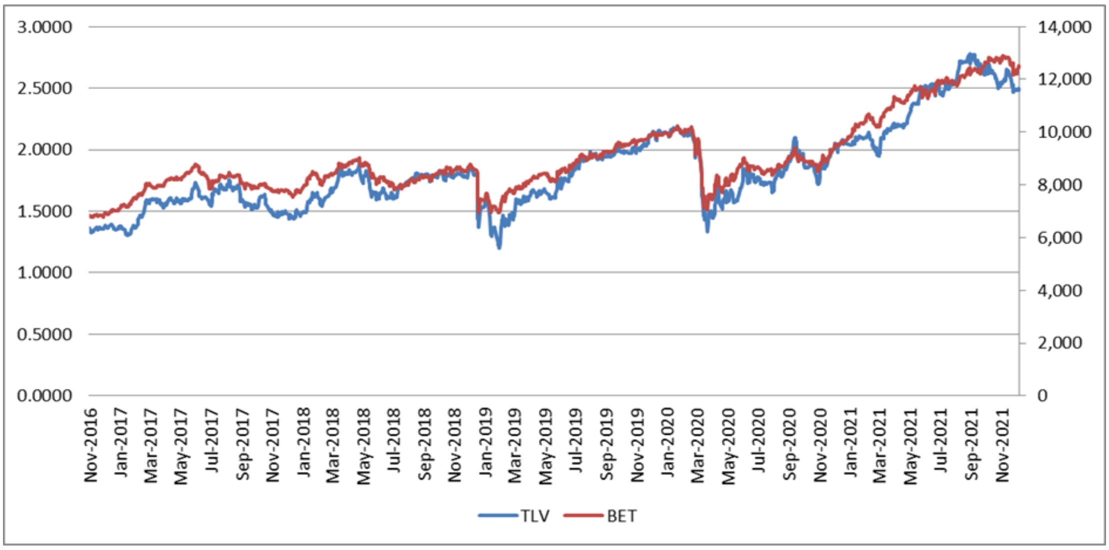

Figure 1. The evolution of TLV vs BET

During the period from November 2016 to February 2020, the BET index exhibited a steady growth, reflecting the stability and expansion of the Romanian capital market. Similarly, shares of Banca Transilvania (TLV) also experienced consistent growth, indicating investors' confidence in the bank's performance. However, with the outbreak of the COVID-19 pandemic in March 2020, financial markets experienced a significant downturn. Both the BET index and TLV shares witnessed abrupt declines, mirroring investors' uncertainty and apprehension about the pandemic's economic impact. As the pandemic was managed and economic outlooks began to improve, Romanian financial markets started to recover. The BET index and TLV shares saw a notable rebound, reflecting investors' optimism and the resumption of economic growth.

In testing the CAPM model, we must also incorporate the risk-free rate. As a proxy for this variable, we have chosen the yield of 10-year government bonds issued by the Ministry of Finance. The evolution of this variable is depicted in Figure 2.

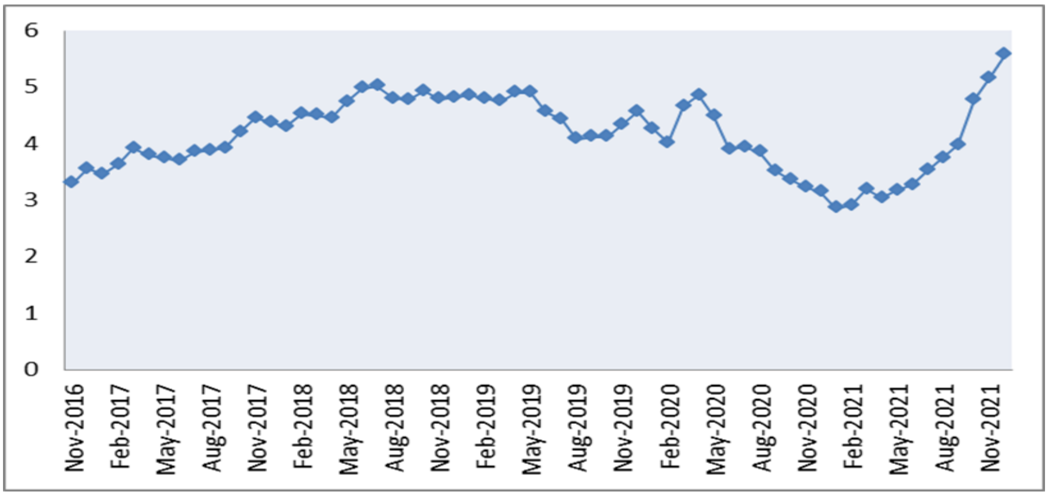

Figure 2. The evolution of the yield of 10-year government bonds (%)

As observed in the above figure, during the pre-pandemic period, the moderate increase in the yield of 10-year government bonds reflected a situation of relatively stable economic and political conditions. However, in March 2020, in line with the global impact of the pandemic, the yield experienced a significant decrease, attributed to the capital inflows from the EU aimed at combating the adverse effects of the COVID-19 pandemic. In the last months of 2021, as the pandemic seemed to subside and the negative economic effects became more acute, the yield reached higher levels, suggesting an intensified perception of the country risk associated with Romania, possibly amidst specific economic or fiscal challenges.

Results

In this section we will test the validity of the basic CAPM model, following that in section 2.4 we will take into account some informational aspects in the estimation of equation (2.1). Thus, for its validation we will use the following data series: ER_i is the daily return on the TLV share, ER_m is the daily return on the BET index and $R_f$is the risk-free rate, i.e. the daily interest related to government bonds with a maturity of 10 years (since the series is given in annual terms, we will use the daily adjustment for the estimates). For the actual testing of the CAPM model we will use the following specification given below:

$$ER_i - R_f = \alpha + \beta_i(ER_m - R_f) + \varepsilon_i \quad (2)$$

The results of the CAPM model represented by equation (2) are presented in Table 1 broken down into 3 time intervals. Estimates were made taking into account possible autocorrelation of errors. The Newey-West method is a technique used in regression analysis to correct estimated standard errors in the presence of autocorrelation (correlation between errors). This method is applied when the data have an autocorrelation structure, which means that the errors in the regression can be correlated with each other at different time lags.

Table 1. CAPM validity

Coeffcients	Pre-pandemic period	Pandemic period	All sample
α	0.0001	-0.0001	-0.0003
β_i	1.4339***	1.1852***	1.3030***
R-squared	0.6733	0.6891	0.6741

DW	2.0432	1.9297	2.0129
Observations	780	485	1265

*,**,*** denote statistical significance at 10%, 5% and 1% level, respectively

Normally, the validation of the CAPM model requires that the parameter α, which quantifies the excess return of the asset when the market excess return is zero, is not statistically significant. It can be observed that in none of the situations presented in Table 1 is the coefficient statistically significant.Furthermore, the coefficient β_i measures the sensitivity of the TLV to market movements given by the BET index. Higher values indicate higher sensitivity. All values are statistically significantly at the 99% confidence level, indicating a positive correlation between asset returns and market returns.

In general, the fairly high R-squared values in all three models suggest that the CAPM model was able to capture a significant proportion of the asset return variability in the analyzed context. However, it is important to keep in mind that this parameter does not provide information about the quality of the predictions or whether the relationship between the variables used is truly causal. It is always recommended to interpret it in conjunction with other statistics and analyze the specific context of the data and the model.

Thus, a final step in the validation of the CAPM model is to study the normality of the estimation errors. The histogram as well as the descriptive statistics related to the estimation of the CAPM model for the entire sample is presented in Figure 3.

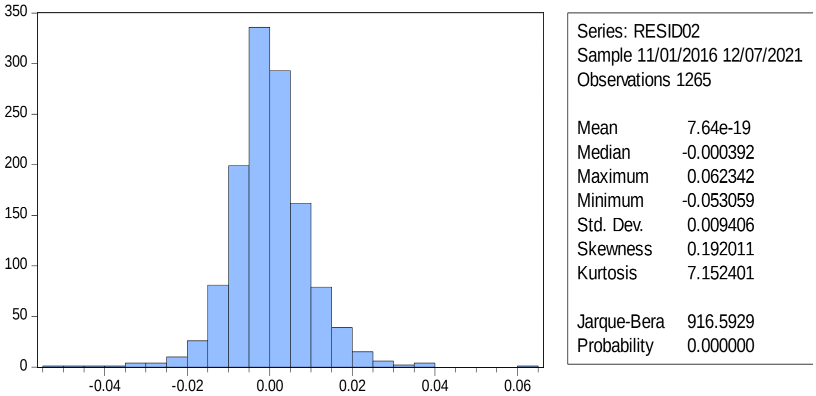

Figure 2. Descriptive statistics of the error term

As can be clearly seen in the figure above, the Jarque-Bera test rejects the hypothesis of normality of errors; the probability related to this test is below the 5% threshold. Thus, if the errors in the CAPM model regression are not normally distributed, this can have several implications on the validity of the results and the interpretation of the model.

Additional to baseline regression, we augument eq. (2) with some COVID-19 related variables but also with some foreign market evolution. In Table 2 we present the variables that are used to validate the CAPM hypothesis.

Table 2. Description of the variables

Variables	Description	Source
ER_{it}	Daily returns for a series of securities traded on Bucharest Stock Exchange February 1st, 2020 to April 30th, 2020. We use the following symbols (TLV, SNP, FP, SNG, BRD, TGN, EL, DIGI, SNN, TEL)	Refinitiv
ER_m	Daily returns for BET Index which is used as proxy for	Refinitiv

	market evolution	
R_{ft}	Romanian Government 10 years yield use as proxy for risk free rate	Bloommberg
The Panic Index (PI)	It measures the level of news associated with panic or hysteria and coronavirus. The index ranges between 0 and 100.	https://coronavirus.ravenpack.com/
The Media Coverage Index (MCI)	It shows the percentage of all news sources covering the topic of the novel coronavirus in total news sources covered by RavenPack. Values range between 0 and 100, where a value of 50.00 means that 50% of all sampled	https://coronavirus.ravenpack.com/
The Infodemic Index (CI)	It calculates the percentage of all entities such as places, companies, etc. that are somehow associated to COVID-19. Values range between 0 and 100, where a value of 50.00 means that 50% of all entities covered by the media are being associated or co-mentioned with COVID-19	https://coronavirus.ravenpack.com/
The Country Sentiment Index (CSI)	It measures the level of sentiment across all entities mentioned in the news alongside the coronavirus. The index ranges between (-100) and 100, where a value of 100 is the most positive sentiment, (-100) is the most negative, and 0 is neutral.	https://coronavirus.ravenpack.com/
The Media Hype Index (MHI)	It measures the percentage of news involving coronavirus related news in total number of news covered by RavenPack. The index ranges in the interval 0 and 100.	https://coronavirus.ravenpack.com/
The Fake News Index (FNI)	It measures the level of media chatter about the novel pandemic that refers to misinformation alongside COVID-19. It ranges between 0 and 100.	https://coronavirus.ravenpack.com/
DJIA	Daily returns for DOW JONES Industrial Average Index which is used as proxy for global market evolution	Refinitiv

The main goal of this research is to test the CAPM model on Bucharest Stock Exchange market during the Covid-19 pandemic. We employ three specifications:

$$\begin{cases} Model\ 1: ER_{it} - R_{ft} = \alpha + \beta_i\left(ER_{mt} - R_{ft}\right) + \varepsilon_t \\ Model\ 2: ER_{it} - R_{ft} = \alpha + \beta_i\left(ER_{mt} - R_{ft}\right) + (COVID-19)_t + \varepsilon_t \\ Model\ 3: ER_{it} - R_{ft} = \alpha + \beta_i\left(ER_{mt} - R_{ft}\right) + DJI_t + \varepsilon_t \end{cases}$$

The estimation results are sumarized in Table 3:

Table 3. Results of CAPM validity with COVID-19 related variables

Equity	M	α	β	PI	MHI	CI	CSI	MCI	FNI	DJIA	R^2
TLV	1	-0.0007	**1.1183**								0.8541
	2	0.0010	**1.1061**	0.01	0.01	-0.01	0.01	0.01	0.01		0.8630
	3	-0.0007	**1.1333**							-0.01	0.8541
SNP	1	-0.0003	**1.0341**								0.6430
	2	0.0007	**1.0204**	0.01	0.01	-0.01	-0.01	-0.01	-0.01		0.6625
	3	-6.9300	**1.1917**							-0.14	0.6545
FP	1	0.0018	**1.1935**								0.6391
	2	0.0018	**1.1703**	**-0.01**	-0.01	0.01	**0.01**	-0.01	0.1		0.6736
	3	0.0016	**1.0648**							0.11	0.6449

SNG	1	-0.0011	**0.7348**								0.7166
	2	-0.0018	**0.7588**	0.01	-0.01	0.01	0.01	0.01	0.01		0.7426
	3	-0.0009	**0.8107**							-0.01	0.7225
BRD	1	-0.0020	**1.0020**								0.8373
	2	-0.0021	**1.0306**	0.01	0.01	0.01	**-0.01**	-0.01	-0.01		0.8586
	3	-0.0021	**0.9307**							-0.01	0.8406
TGN	1	-0.0007	**0.7100**								0.5548
	2	-0.0003	**0.7140**	0.01	0.01	-0.01	-0.01	**-0.01**	-0.01		0.6014
	3	-0.0008	**0.6886**							0.02	0.5552
EL	1	0.0014	**0.8378**								0.7254
	2	0.0004	**0.8471**	0.01	0.01	-0.01	-0.01	0.01	0.01		0.7503
	3	0.0011	**0.6829**							**0.14**	0.7445
DIGI	1	0.0016	**0.6781**								0.5915
	2	0.0019	**0.6994**	0.01	-0.01	0.01	**-0.01**	0.01	0.01		0.6337
	3	0.0019	**0.8669**							**-0.16**	0.6268
SNN	1	**0.0047**	**0.9332**								0.7047
	2	0.0046	**0.9675**	**0.01**	-0.01	0.01	**-0.01**	0.01	-0.01		0.7431
	3	**00046**	**0.8954**							0.03	0.7056
TEL	1	0.0005	**0.7073**								0.6978
	2	-0.0001	**0.7281**	0.01	0.01	0.01	0.01	0.01	-0.01		0.7148
	3	0.0005	**0.6787**							0.02	0.6987

Significant values are in bold; M=model; the values for COVID-19 related variables were rouded up to two digits.

As we can see in Table 2, with only one exception, for all the securities included in the analysis, the CAPM is valid regardless the model specification, suggesting that during COVID-19 financial turmoils, the investors trading on Bucharest Stock Exchange had a rational behavior. For SNN the Intercept is statistically significant in two out of three cases, which invalidates the CAPM hypothesis.

The COVID-19 related variables have a marginal impact on daily returns for a series of securities such as FP, SNP, TGN, DIGI or SNN which are companies with large market capitalization. Only two out of ten securities have the daily returns sensitive to DJIA, suggesting that Bucharest Stock Exchange is marginally linked to USA capital market evolutions.

Conclusion

The spread of COVID-19 pandemic was an unexpected shock to the global financial system. Unlike other finacial turmoils such as the Global Financial Crisis from 2008, the COVID-19 pandemic did not follow the patterns of a classical crisis. However, the damages suffered by the financial markets and the economis worldwide were far more powerfull.

All these facts have led to a sharp decline in local stock markets, the main indexes reacting with unprecedented volatility in a relatively short period of time. In this context, and also given the global impact of the pandemic on financial markets, the literature investigating markets reaction during COVID–19 market crash has grown rapidly

In this paper we test the validity of CAPM hypothesis during COVID-19 period. Using 10 high-liquid securities traded on Bucharest Stock Exchange during February 2020 to April 2020 we estimate the baseline CAPM alongside two aditional extensions controling for COVID-19 related news and foregn stock exchange evolution. With only one exception, for all the securities included in the analysis, the CAPM is valid regardless the model specification, suggesting that during COVID-19 financial turmoils, the investors trading on Bucharest Stock Exchange had a rational behavior.

References

1. Alansari, M., Shen, D., & Li, Y. (2021). A Study on the Impact of COVID-19 Pandemic on Stock Markets Using Sentiment Analysis and Machine Learning. In 2021 IEEE 19th International Conference on Industrial Informatics (INDIN) (pp. 962-967). IEEE.
2. Anghel, L., et al. (2015). Explaining Stock Returns: A Comparison of CAPM and Fama-French Three-Factor Model in the Romanian Market. Procedia Economics and Finance, vol. 22, pp. 440-446.
3. Bai, Y., Zhang, H., & Xiong, Y. (2021). The impact of COVID-19 pandemic on Chinese stock market: Evidence from CSI 300 index. Finance Research Letters, 39, 101804.
4. Chandra, S., et al. (2022). Role of Financial Market Development in Shaping the Validity of the CAPM Model in Emerging Economies. Emerging Markets Finance and Trade, vol. 58, no. 1, pp. 143-162.
5. Chen, H., et al. (2023). Deviations from CAPM: Behavioral Perspectives in Emerging Markets. Journal of Behavioral Finance, vol. 20, no. 1, pp. 87-104.
6. Ihnatov, I., & Sprincean, N. (2015). Validity of CAPM in Different Market Conditions: Evidence from US, Poland, and Romania. Procedia Economics and Finance, vol. 32, pp. 214-221.
7. Koutmos, G. (1997). Political Instability and the CAPM: Evidence from Some Emerging Markets. Journal of International Money and Finance, vol. 16, no. 2, pp. 219-230.
8. Li, X., & Yan, Z. (2021). Political Instability Risk and Asset Prices in Emerging Economies. Review of Finance, vol. 25, no. 4, pp. 1489-1524.
9. Li, X., Wang, M., & Zhang, C. (2020). Forecasting Chinese stock market and the impact of COVID-19 pandemic: Evidence from Hang Seng China Enterprises Index. International Review of Economics & Finance, 70, 325-336.
10. Raza, A., et al. (2020). Impact of Macroeconomic Factors on CAPM Performance in Emerging Markets. Journal of Financial Research, vol. 43, no. 2, pp. 215-233.