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# TESTING THE APPLICABILITY OF THE CAPM MODEL USING SELECTED SHARES LISTED ON THE BELGRADE STOCK EXCHANGE

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**Abstract**. *One of the basic types of portfolio valuation as well as valuation of individual company shares is the CAPM (Capital Asset Pricing) model, which uses a well-known measure of systemic risk in its analysis, which is beta. The CAPM model in its analysis uses the link between the systemic risk measure (beta) and the expected market return. Guided by this model, the analysis of monthly returns of selected shares on the Belgrade Stock Exchange in the period from 2011 to 2021 was performed in this research. In the research, the beta coefficient of selected shares was calculated with the help of the covariance of market return and stock return. The results and their statistical value were confirmed by the linear regression test. The rest of the research tests the applicability of the CAPM model to selected actions and in the same way, the SML (security market line) is devised, which is a graphical representation of the model. The research indicated that the basic assumptions of the CAPM model are not applicable as a predictor of future expected returns of selected shares on the Belgrade Stock Exchange due to various other elements that affect price movements and returns of selected shares not covered by the model.*

**Keywords**: *CAPM model, Beta coefficient, Belgrade Stock exchange, BelexLine*

**JEL Classification:** G17, G12

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## 1. INTRODUCTION

The Capital Asset Pricing Model makes a significant contribution to our understanding of asset price determinants. According to the CAPM, diversified investors' ownership of assets lowers expected returns and raises prices. Furthermore, investors with undiversified portfolios are more inclined to take risks for which they will not be compensated (Perold, 2004, p 3-24). The CAPM's attractiveness stems from its ability to make powerful and appealing predictions about how to evaluate risk and the connection between expected returns and risk. The model is a simplified representation of how financial markets determine prices of securities and, as a result, also determine predicted capital investment returns. The CAPM model is a mechanism used to evaluate risk and convert it into expected return on equity projections (ROE). The main benefit of the Capital Asset Pricing Model is the objectivity of the predicted costs of equity that the model may produce. To generate an accurate and meaningful cost of equity calculations, financial managers might utilize it to enhance other methodologies and their judgment (Rossi, 2015, p. 604-617). The Capital Asset Pricing Model is undoubtedly the most important and commonly utilized contribution to finance (Ross, Westerfield, and Jordan, 1996). It is necessary to describe the company's business purpose while discussing the financial market and individual stocks of specific corporations. In today's business world, a company's ability to adapt to increasingly unstable business conditions is critical to its survival. Companies analyze the success of their management decisions against a predetermined aim, hence they require a goal. Companies develop metrics and operational goals that they wish to attain in their business to reach the defined goal. (Mirović, Mijić, Andrašić & Kalaš, 2019, p. 5). The CAPM model's assumptions for proper implementation are concerned with investor behavior and capital market conditions. According to these assumptions, the market should be made up of risk-averse investors, risk should be measured by the standard deviation of portfolio income, investors should have a common period for making investment decisions, and investors should have similar expectations about future income and security risks. Finally, the capital market must be perfect. Regardless of the CAPM model's broad application, the model's fundamental flaw is the anticipated investor expectation, not the achieved return (Vunjak, 2008, p. 251). In the continuation of the research, we review the literature related to the application of the CAPM model. After reviewing the literature, we review the methodology of the paper and finally present the results of the research and discuss the results obtained. In the conclusion, we express our concluding remarks and give suggestions for further research.

## 2. LITERATURE REVIEW

The model itself assumes the existence of perfect market conditions, which is not the case in practice. The model itself was developed by William F. Sharpe (1964) and John Lintner (1965) as a reaction to the modern portfolio theory developed by Markowitz (1952). Portfolios are classified into two types, according to Markowitz: efficient and inefficient. The efficient frontier is the boundary between an efficient and an inefficient portfolio. The efficiency frontier is made up of a set of portfolios that have a good balance of expected return and risk. According to the frontier, the higher the return dispersion around the predicted returns, the more uncertain future returns, as well as the risk, which increases exponentially. (Brealy & Myers, 2016). Additionally, the cautious long-term investor will

stay away from such overweights to protect themselves from two types of declines in investing opportunities: declining anticipated returns on stocks and rising volatility (Cambell, Giglio, Polk & Turley, 2018).

Modern portfolio theory served as a common foundation for the creation of many financial ideas and concepts that are still frequently employed today but are also subject to ongoing critique. The introduction of new financial instruments, as well as various sorts of investors, has necessitated the inclusion of severe risk effects in portfolio optimization models. Investors will choose to put their funds in financial assets whose return distribution is favorably asymmetrical, while they will avoid financial assets whose return distribution is long-tailed, based on statistical features of return distributions. (Stanković, Petrović & Denčić - Mihajlov, 2020, p. 17-26).

Some researchers employed a variety of techniques to forecast market movement. The Box-Jenkins (ARIMA) test was used by Jakšić, Milanović, and Stojković (2020) to perform an empirical study that found that the share market in the Republic of Serbia will not have any noteworthy trends in 2019. Forecasting, on the other hand, cannot accurately predict future movements, thus the analysis and interpretation of the gathered data should be viewed as potentially erroneous. Because uncertainty and potential errors are proportional to the length of the forecast period, the prediction should be focused on a short time frame (Jakšić, Milanović & Stojković, 2020, p. 87-96). In this example, we can see the breadth of predictable research on the results of stock market actions. The CAPM model is one of the first widely recognized models for determining future expected results of actions concerning the market. There is also minimal support for the theory's basic concept that increased risk (beta) is associated with higher returns, according to some research. To alleviate the statistical issues that occur from measurement errors in individual beta estimations, the securities are merged into portfolios to diversify away from the majority of the company's elements of returns, hence increasing the precision of estimates of the beta coefficient (Fama and French, 2004, p. 25-46). The generalized CAPM with IIAPD errors has beneficial qualities, according to Bao, Diks, and Li's research findings. In terms of commonly used performance measures, portfolios produced with IIAPD errors beat portfolios constructed with normally distributed errors, according to the testing. (Bao, Diks & Li, 2018, p. 611-621). On the other hand, in one study, the author employed the Capital Asset Pricing model approach of financial asset evaluation to estimate future yields on both the titles in the portfolio and the return on the portfolio. They discovered an increase in both the beta and the coefficient of market risk, with the latter being substantially connected with capital market development. (Anghel & Paschia, 2013, p. 541). Also according to Baltes, Dragoe & Ardelean (2014), the C.A.P.M. model continues to be the most often utilized one for both portfolio selection and company evaluation, particularly those aspects linked to the beta coefficient variability over time and the potential for mere approximation.

Focusing on the applicability of the CAPM model in similar financial markets as the market of the Republic of Serbia, we can see the following: Using monthly stock returns from nine countries, spanning the period from January 2006 to December 2010, one of the research articles looked at whether the model is adequate for capital asset assessment in the Central and South-East European emerging securities markets. It was determined that the CAPM model is not appropriate for appraising capital assets in the Central and Southeastern European emerging economies, according to a cross-sectional study of the test data. It was discovered that stock market indices do not lie on the efficient frontier, do not reflect an efficient portfolio, and thus cannot be considered a market portfolio of

models, as was previously supposed (Džaja & Alijanović, 2013, p. 164-175). Therefore we can see the use of other predictive models in addition to the CAPM model. According to research, variations in stock prices on the Croatian capital market indicate that certain undiscovered elements influence share valuation. It was found that the fundamental analysis of shares is insufficient for determining the true value of a share in light of different invisible variables and all available information that affects its value (Odobašić, Tolušić & Tolušić, 2014, p. 297-311).

The extension of the CAPM model is precisely APT (Arbitrage pricing theory) which includes much larger macroeconomic predictable variables compared to the CAPM model. The key difference is that APT takes many more components in its model instead. Its primary limitation is the precise measurement of the values of all its variables. In the period 2008-2010, Kisman and Restiyanita investigated whether there was an effect of market excess return on LQ45 company stock returns (using the CAPM model), as well as whether there was an effect of variable/factor (such as gross domestic product and interest rates) Arbitrage Pricing Model (APT) on stock returns. The findings of multiple regression demonstrated that CAPM and APT are highly significant, as evidenced by the t-test and F-test results. APT model outperformed the CAPM model in predicting stock returns based on the coefficient of determination. The model's drawback is that it is dependent on whether or not the capital market is efficient (Kisman & Restiyanita, 2015, p. 184-189). Some studies favor the Arbitrage Model while on the other hand there are studies that support the CAPM model. One of the examples of support for the APT model is the findings of Kisman & Restiyanita (2015), who claim that the coefficient of APT is more accurate than CAPM at forecasting stock returns. On the other hand, the Suroso et. al (2018) study states, analyzing the application of the model to different periods, that the CAPM model is a better predictor of stock values in the short, medium, and long periods than the APT model. Also in the study by French (2017), researching the effects of macroeconomic variables on the stock returns of stock markets of Singapore, Thailand, Indonesia, Malaysia, and the Philippines, the capital asset pricing model was proven to be a more reliable pricing tool for the six countries studied than the arbitrage pricing theory. The main basis of different sites is the analysis of returns of certain types of markets. Kisman & Restiyanita (2015) based their research on the return of shares of companies listed on the Indonesian Stock Exchange, while Suroso et. al (2018) focused more on the return of banking stocks also in the Indonesian market.

In addition to the previously mentioned research, there are other papers related to the practical application of the APT model, but in this paper, we focus on the CAPM (Capital asset pricing model).

## 3. RESEARCH METHODOLOGY

This research paper consists of five parts. In the beginning, we dealt with the introduction of the concept of the CAPM model and then a review of the literature related to the application of the model itself. In this chapter, we present the main mathematical formulas on which the CAPM model itself is based and which were used in the calculation of the obtained results. Also in this chapter, we present the basic hypotheses of the research itself. In the next section, we present the obtained calculated results using linear regression and covariance. In the last chapter, we make concluding remarks and give suggestions for

future research. The paper itself covers the period from 2011 to 2021 of selected shares of the Belgrade Stock Exchange as shown in Table 1 below. Due to the accuracy of the data, the data from January 2011 to December 2021 were used to calculate the beta coefficient, while the annual returns of selected shares of companies calculated based on monthly data were used to calculate the application of the CAPM model.

The main hypotheses derived in this research are the following:

H0: A higher return on stocks is expected at a higher level of risk

H1: The CAPM model is a valid predictor of stock returns

As mentioned earlier, we deal with the presentation of the main formulas and graphs that represent the assumptions and components of the CAPM model. A market portfolio is more of a theoretical concept than a real-world application. It is a value-weighted portfolio that includes all risk assets in the global economy, resulting in a percentage equal share of the market value of all capital investments around the world. Given the unpredictability of the number and market value of the world's risk activity, it is evident that calculating a value-weighted entirely comprehensive market index, especially for everyday use, is extremely difficult. Instead, several estimates are utilized, the most common of which are larger stock market indices (Šoškić, 2010, p. 105). Graphically, the market portfolio can be presented with the help of the so-called CML (Capital market line), which is a set of efficient solutions equal for all investors. For the investor, in theory, it is ideal for the portfolio to be on this line because CML is an efficient frontier. In theory, a portfolio gathered from certain stocks closer to the x-axis represents a portfolio that contains more secure securities (mostly bonds) while a portfolio further than the x-axis and along the line represents a risky portfolio, and the main assumption of the modern portfolio theory is that the higher the amount of risk (standard deviation) the higher the profit is expected.

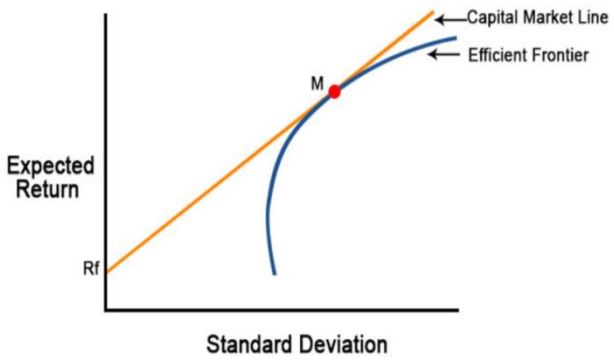


**Fig. 1** Capital market line (CML)
*Source*: Schoenmaker & Schramade (2020)

One of the foundations of the model is the understanding of the beta coefficient. The beta coefficient is usually calculated by reviewing historical data. Because investment and financial decision-making are future-oriented, the argument for employing a beta coefficient whose value is based on historical data can be questioned, especially since we know that financial market occurrences are not a straightforward extrapolation of past events (Krneta, 2006, p. 65). The basic idea of the beta coefficient or beta index is that if

β> 1 the stock price moves more aggressively concerning the market portfolio. When β <1 represents a slower movement of stock prices but in the same direction while β = 1 represents the beta coefficient of the market portfolio itself. One of the basic assumptions of the CAPM model is the existence of a market portfolio, but in practice, it is quite difficult to determine the real representation of the market portfolio, which is one of the limitations of the CAPM model. In practice, the stock exchange index of the country that is the subject of the research is mostly used, namely the index that includes the largest number of shares, so that its movements most accurately represent market movements. The most comprehensive index on the Belgrade Stock Exchange is the BelexLine index, which we used in this research as a representative of the market portfolio. For calculating the beta coefficient we use the covariance/variance method.

$$Cov(Rm, Rs) = \frac{\in (Rmi - \mu) * (Rsj - v)}{n} \tag{1}$$

$Cov(Rm, Rs)$ – represents the covariance of variables Rm and Rs.
$\Sigma$ – represents the sum of other parts of the formula.
($Rmi$) – represents all values of the *Rm*-variable.
$\mu$ – represents the average value of the *Rm*-variable.
$Rsj$ – represents all values of the *Rs*-variable.
$v$ – represents the average value of the *Rs*-variable.
$\Sigma$ – represents the sum of the values for both $Rmi - \mu$) and ($Rsj - v$).
$n$ – represents the total number of data points across both variables.

$$\beta = \frac{Cov(Rm, Rs)}{Var(Rm)} \tag{2}$$

$\beta$ – beta coefficient
$Rm$ – the return of the market
$Rs$ – the return of the stock
$Cov$ – covariance
$Var$ – variance

As we can see, the beta coefficient is calculated as the quotient of the stock return and market return, and the return variance. Based on that, we get a beta coefficient that represents the representative of systemic risk, i.e. risks that cannot be eliminated by diversification. However, according to other research, the beta coefficient as the only risk component in the CAPM may also require the addition of dividend yield, company size, and skewness, that are a few other risk factors that can be used to explain asset returns. Additionally, contrary to one of the CAPM assumptions, there are real-world restrictions on investor borrowing, such as those regarding short selling (Fernandez, 2019). In this research, as mentioned, we use selected shares listed on the Belgrade Stock Exchange, which are included in the BelexLine index. In the table below we can see which companies were taken for analysis and which their symbols will be used in the rest of the research.

**Table 1** Stocks listed on the Belgrade stock exchange

| | |
|---|---|
| Aerodrom Nikola Tesla a.d. | AERO |
| Nis a.d. | NIS |
| Enegroprojekt holding a.d. | EHNL |
| Impol Seval a.d. | IMPL |
| Dunav osiguranje a.d. | DNOS |
| Komercijalna banka a.d. | KMBN |
| Messer Tehnogas a.d. | TGAS |
| Jedinstvo a.d. | JESV |
| AMS Osiguranje a.d. | AMSO |
| Lasta a.d. | LSTA |

*Source*: Belgrade Stock exchange

As we can see in the paper, we used ten companies listed on the Belgrade Stock Exchange, where we used data on the return of shares in the period from January 2011 to December 2021 to calculate the exposure to systemic risk according to the CAPM model. Expected stock returns are determined by their matching amount of systematic risk, or ß, according to the model. To put it another way, the market does not reward risk that is taken unnecessarily. The model can be used to calculate the cost of capital, conduct event studies, and manage and appraise portfolios, among other things. Economists have been able to quantify risk and the payoff for taking it on (Ansari, 2000, p. 55-64). Divide the final index or stock value by the beginning value and remove one to get the returns. Subtracting the beginning value from the finishing value and dividing it by the beginning value is another way to calculate the return (Gardner, McGowan & Moeller, 2010). The second way is used in this research. Since we are testing the CAPM model itself, we need to present the model itself in the following formula.

$$CAPM(Ers) = Rf + \beta(E(Rm) - Rf) \tag{3}$$

$CAPM$ ($Ers$) – expected returns of the stock (security) using the model
$Rf$ – risk-free rate
$\beta$ – beta coefficient
$Rm$ – return of the market
($E(Rm) - Rf$)– market premium

SML (Security market line) is the graphic depiction of the CAPM model. According to the SML, the desired rate of return on an asset is determined by its beta, or market risk (systematic), risk-free rate of return ($Rf$), and market risk premium ($E(Rm) - Rf$). As a result of changing the desired rate of return under the effect of changes in the nominal rate of return without risk, beta, or market risk premium, the SML equation indicates that the share price can vary even if the company's cash flows do not change.

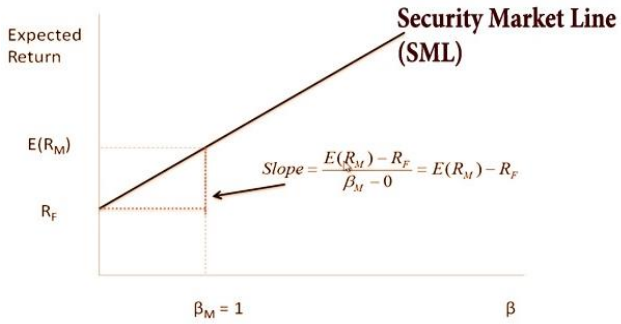


**Fig. 2** Security market line (SML)
*Source*: https://assignmentpoint.com/security-market-line-sml/

## 4. FINDINGS AND DISCUSSION

In this part of the research, we present the obtained results and discussthem. The PSPP statistical program was used in the calculation of the obtained results. In the first part of this chapter, we present descriptive statistics of the shares used in the research as well as the market index.

**Table 2** Descriptive statistics

| | Mean | Standard Error | Median | Standard Deviation | Minimum | Maximum | Count |
|---|---|---|---|---|---|---|---|
| Belex line | 1375.882 | 21.11682 | 1434.37 | 242.6138 | 858.41 | 1733.14 | 132 |
| AERO | 909.7204 | 32.63811 | 907.6091 | 374.9833 | 386.381 | 1801.65 | 132 |
| NIS | 694.2481 | 9.468468 | 683.4762 | 108.3716 | 482.2632 | 966.36364 | 132 |
| EHNL | 775.1323 | 26.59373 | 705.1579 | 304.3791 | 326.1905 | 1489.8889 | 132 |
| IMPL | 2090.748 | 107.2683 | 1736.1 | 1227.742 | 584.95 | 4012.7391 | 132 |
| DNOS | 1546.611 | 84.17999 | 1164.834 | 967.1545 | 538.1 | 3936.2105 | 132 |
| KMNB | 2160.63 | 64.27649 | 1889.297 | 738.4806 | 994.7391 | 4368.0909 | 132 |
| TGAS | 9044.952 | 335.7279 | 8746.1 | 3857.22 | 3132.45 | 16566.818 | 132 |
| JESV | 5385.555 | 98.49262 | 5074.601 | 1131.594 | 3826.696 | 8863.6364 | 132 |
| AMSO | 542.3225 | 33.9663 | 420.0000 | 390.2433 | 114.0000 | 1886.0909 | 132 |
| LSTA | 462.6345 | 18.22758 | 420.445 | 209.419 | 200 | 1147.1053 | 132 |

*Source*: Belgrade Stock exchange

In the table above we see data on the prices of selected shares. The subject of the analysis was the share prices in the period from 2011 to 2021 (monthly data). We notice looking at the level of standard deviation as a representative of the risk that the shares of IMPL, JESV, and TGAS show the highest level of standard deviation, which means that these shares have a large class of movement between the maximum and minimum price in the observation period. We notice the lowest level of variation at NIS because the amount of standard deviation is 108.37, which is the lowest amount in the sample.

**Table 3** Risk-free rate, market return, and market risk premium

| 10- year international bonds - Serbia | Market return (BelexLine) | Market risk premium |
|---|---|---|
| **6.813%** | **3.426%** | **-5.068%** |

*Source*: author's calculation

As we want to calculate the return on shares according to the CAPM model, we need certain variables such as risk-free rate and market return. The rate of return on 10-year bonds was taken as a representative of the risk-free rate. Serbian 10-year bonds experienced a maximum rate of 7.071% while the minimum rate was 2.264%. In addition, the return rate of the BelexLine stock index is shown, which is 3.426% per year on average, based on monthly data used to more accurately determine the actual return. Here we notice a violation of the concept of the CAPM model, which immediately gives us an indication of the impossibility of applying, in the form of predictability, this model on the Belgrade Stock Exchange. We notice that the premium market is negative, which means that in our market it pays more for investors to invest in bonds because the expected return from them is higher than from investing in the stock exchange index itself. This problem was later presented graphically with the help of SML (security market line).

**Table 4** Risk-free rate, market return, and market risk premium

| | Market | AERO | NIS | EHNL | IMPL | DNOS | KMBN | TGAS | JESV | AMSO | LSTA |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Market | 0,0012515 | | | | | | | | | | |
| AERO | 0,0010588 | 0,014053 | | | | | | | | | |
| NIS | 0,0006772 | 0,000329 | 0.0029321 | | | | | | | | |
| EHNL | 0,0012405 | 0,001208 | 0,000759 | 0,0050265 | | | | | | | |
| IMPL | 0,000529 | 0,000659 | 6,822E-5 | 0,0010009 | 0,008422 | | | | | | |
| DNOS | 0,0009408 | -0,000449 | 0,0003273 | 0,0008577 | 0,0016251 | 0.0126168 | | | | | |
| KMBN | 0,001297 | 0,000532 | 0,0008446 | 0,0014182 | 0,0009601 | 0,0011263 | 0,0051577 | | | | |
| TGAS | 0,0009756 | 0,001015 | 0,0005959 | 0,0015253 | 0,0011636 | 0,0002633 | 0,0012259 | 0,0035905 | | | |
| JESV | 0,000582 | 0,00063 | -0,000182 | 0,0010567 | 0,0014391 | 0,0006473 | 0,0007161 | 0,0007841 | 0,002585 | | |
| AMSO | 4,257E-05 | -0,001694 | -0,000585 | -0,001616 | 0,0005096 | 0,0006096 | 0,0013337 | -0,000394 | 0,000916 | 0,0183287 | |
| LSTA | 0,0011164 | 0,000709 | 7,421E-05 | 0,0014069 | 0,0021323 | 0,0046685 | 0,0019706 | 0,000567 | 0,001109 | -0,0004926 | 0,0187351 |
| Calculated Beta | | **0,846** | **0,540** | **0,991** | **0,423** | **0,752** | **1,036** | **0,780** | **0,465** | **0,034** | **0,892** |
| VARIANCE (STOCK) / COVARIANCE (MARKET;STOCK) | | | | | | | | | | | |

*Source*: author's calculation

Using the previously mentioned formula for calculating the beta coefficient as a representative of the systemic risk to which an individual stock company is exposed, with the help of covariance performed using monthly return data, we obtained the following results which can be seen in the table above. We can notice that KBMN has the maximum amount of beta coefficient in the amount of 1.03, which means that the return on KBMN shares is moving a little stronger than the market itself. Also, the results affirm the statement of Baltes, Dragoe & Ardelean (2014) that said that the majority of cases have positive ß coefficient values and that the cases with ß0 are extremely uncommon. The volatility value suggests that the stock will evolve differently from the market. Accordingly, the research by Duangjan & Amporn (2019) examined the application of the CAPM model to the valuation of five stocks of highly profitable companies in the American market and discovered that the beta of all five sampling companies is positive, meaning that bigger the increase in the value of the stock, the

beta of all five sampling companies will increase. As the market grows, so will the returns of the sampling companies, and vice versa. The rest of the shares in the sample are bets below 1, which means that they are more defensive and less volatile. The average value of the beta coefficient of the observed stock is 0.729 which tells us that the hypothetical portfolio including these stocks is not as volatile as the market. This coincides with the results of Hundal, Eskola & Tulan (2019) who, observing 90 stocks on the Finnish stock market, discovered that the average beta was 0.64 which means that the market change of 10% implies that the hypothetical portfolio changes by 6.4% in the same direction. For a more precise calculation of the beta coefficient, monthly data were used concerning the annual ones, used mainly due to the statistical significance of the sample itself. In the following table, with the help of linear regression (which is another way of obtaining the beta coefficient), we also calculated the amounts of the beta coefficient but checked their statistical significance using p-values. In theory, if the P-value does not exceed 0.05, the sample is statistically significant. The only sample that we can say does not fit the required parameters is the p-value of the beta coefficient of the company IMPL. Linear regression shows us the average change of the dependent variable (return on shares) when changing the independent variable (return on the market) by one.

**Table 5** Results of linear regression

| Companies | Beta | p-value | Observations |
|---|---|---|---|
| AERO | **0.8460** | 0.0036 | 131 |
| NIS | **0.5401** | 0.0000 | 131 |
| EHNL | **0.9912** | 0.0000 | 131 |
| IMPL | **0.4227** | 0.0629 | 131 |
| DNOS | **0.7518** | 0.0065 | 131 |
| KMBN | **1.0364** | 0.0000 | 131 |
| TGAS | **0.7795** | 0.0000 | 131 |
| JESV | **0.4650** | 0.0002 | 131 |
| | **0.7291** | | |

*Source*: author's calculation

In the last part of the research, we come to the calculation of the expected returns on shares with the help of the CAPM model. We apply the formula given in the chapter on methodology of calculation work. As the CAPM model uses the annual return on shares in its assumptions, we calculated the average annual returns of each share in the sample for the period from 2011 to 2021 using monthly data. The table below shows the results obtained. We note that the basic assumptions of the CAPM model do not apply to the Belgrade Stock Exchange. An additional component of the alpha coefficient was introduced, which represents the deviation of the actual yields from the expected yields or the so-called abnormal yield.

As we can see, the results produced using the CAPM model's assumptions do not demonstrate the predicted relationship between risk and expected returns. The results obtained are the outcome of a negative risk premium. A greater beta index value reduces the return as long as the risk premium is negative which is contradictory to the basis of the model. The average return of selected shares under the CAPM assumptions is 4.34% but actual returns differ.

**Table 6** Calculation of CAPM expected returns

| | Beta | CAPM return | Annual return | Alpha |
|---|---|---|---|---|
| Rf | 0 | **8.49%** | | |
| AERO | **0.8460** | 4.21% | 7.08% | 2.87% |
| NIS | **0.5401** | 5.76% | 1.12% | -4.64% |
| EHNL | **0.9912** | 3.47% | -2.43% | -5.90% |
| IMPL | **0.4227** | 6.35% | 20.54% | 14.19% |
| DNOS | **0.7518** | 4.68% | 13.41% | 8.72% |
| KMBN | **1.0364** | 3.24% | 7.24% | 4.00% |
| TGAS | **0.7795** | 4.54% | 11.94% | 7.40% |
| JESV | **0.4650** | 6.14% | 3.84% | -2.30% |
| AMSO | **0.0340** | 8.32% | 19.03% | 10.71% |
| LSTA | **0.8920** | 3.97% | 12.49% | 8.52% |

*Source*: author's calculation

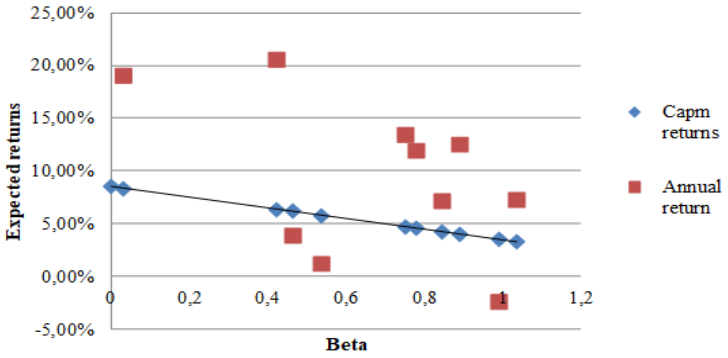


**Fig. 3** Security market line of selected shares
*Source*: author's calculation

The negative slope of the SML line is the result of the negative market premium present in the financial market of Serbia. On the chart, we can see the actual returns of selected stocks and their deviation from expected returns using the CAPM model. Based on this line, we can determine which shares are overvalued and which are undervalued. In theory, if the return is above the SML line then it means the stock is undervalued but if the return is below the line it means the stock is overvalued. This statement coincides with the findings of Baltes, Dragoe & Ardelean (2014) who, using the assumptions of the CAPM model on the Bucharest stock exchange, found that the shares were overvalued because their price was positioned under the Security market line of the market. This represents one of the useful ways to check the real value of shares in the financial market.

After applying the CAPM model to the example of selected shares listed on the Belgrade Stock Exchange, we established that, mainly due to the negative market premium, the CAPM model itself is not applicable as a valid model for valuing shares on the financial market of Serbia which coincides with the findings of Odobasic, Tolusic & Tolusic (2014) which also stated that the assumptions of the CAPM model, because of the negative market premium and the high risk-free rate, cannot be applied to the Croatian market. Also, similar results were obtained by Khudoykulov, Khamidov, & Aktamov (2015) whose findings,

analyzing the Czech Republic, Portugal, Greece, Poland, and Italy, claim that after CAPM model testing it was determined that high returns did not equal high beta. For that reason, the model was not adequate for the five countries' stock exchange markets. Other studies employing the sample of 33,301 US stock observations using data from 1991 to 2012 found that the Fama and French model (ex-ante FF3M) offers a better explanation of the dispersion of the implied cost of equity observations than the Capital Asset Pricing Model (CAPM) and that there was a significant average absolute difference between the cost of equity estimates of the two models (Mishra, Thomas, and O'Brien, 2018). The actual application of the ex-ante FFM model on the capital market of Serbia can be the subject of future research in addition to the APT model as a potential predictor of future share prices.

In addition to the CAPM model, the so-called Arbitrage model (APT) is widely used in the valuation of shares, which, unlike the CAPM model, takes into account various other variables in the analysis of the value of shares. The underlying premise of CAPM is fairly difficult to accept when taken literally. Contrarily, APT is slightly less demanding than CAPM in terms of fundamental presuppositions, but it is significantly less precise in its outcomes because it does not identify the model's input variables (Brandimarte, 2017). In the basic assumptions of the CAPM model, we noticed the application of the beta coefficient, which is a measure of systemic risk, or that risk that cannot be eliminated by diversification, which, together with the market premium, is used to value shares. An alternative to this model is the APT model, which in its application takes more dependent variables that can have an impact on price formation. The APT model mainly takes into account macroeconomic factors such as GDP (Gross domestic product), unemployment rate, inflation rate or CPI (Consumer price index), external debt as well as certain internal factors such as trading volume on the stock exchange itself.

**Table 7** Correlation model

| | *BelexLine* |
|---|---|
| BelexLine | 1 |
| Trading Volume | **0.70383886** |
| GDP | 0.462281296 |
| GDP per capita | 0.526415086 |
| Unemployment (%) | **-0.916047487** |
| Gross external dept | 0.557048549 |
| CPI | **0.797684042** |

*Source*: author's calculation

In the analysis, we take exactly these factors collected for the period from 2011 to 2021, and, using correlation methods, we establish the connection of certain variables with the price movement of the BelexLine stock market index. In Table no. 7 we observe a significant correlation between the CPI index and the unemployment rate with index price movements. In the case of the CPI index, there is a positive correlation, while there is a negative but strong correlation with the unemployment rate. There is also a noticeable positive correlation between trading volume and share price growth. With the help of the analysis, we notice that the prices of shares on the Belgrade Stock Exchange are influenced by other factors. Since the analysis of these factors does not represent a problem of this research, we suggest that future deeper analysis of the effects of these factors can contribute to the establishment of a more precise model of the predictability of stock valuation on the Belgrade Stock Exchange.

## 5. CONCLUSION

Using the assumptions of the CAPM model, in this study we tried to test its actual applicability on the example of selected shares listed on the Belgrade Stock Exchange. Using a long time series, we aimed for the greatest possible precision of the model itself. It was determined that there is a negative market premium on the financial market of the Republic of Serbia, which means that it pays more for investors to invest money in bonds (as a representative of risk-free return) than in shares listed on the stock exchange. Due to the violation of this assumption of the CAPM model, which states that the market premium represents the market return above the risk-free market, we must conclude that the applicability of the CAPM model as a predictor of future stock returns is not valid. The Serbian financial capital market is still an emerging market with a small number of shares in circulation and a small volume of total transactions. We noticed that the actual stock returns in the sample differed significantly from those assumed by the CAPM model. Also, based on the obtained results, we could conclude that the biggest limitation of this research is the examination of the variable covered by the CAPM model. The significance of the research is reflected in the knowledge that the basic assumptions of the CAPM model cannot be applied in the process of predicting future returns of shares in the Serbian capital market. Research is primarily intended for potential investors in shares on the Belgrade Stock Exchange, firstly to understand the application of the CAPM model, and secondly to recognize the incompleteness of the model itself in the valuation of shares on the Serbian capital market. As it was discovered in the study that the CAPM model has certain limitations mentioned earlier in the research, for future research it is suggested to apply the APT (arbitrage pricing theory) model in the assessment of the movement of stock returns, as well as the research of the ex-ante FF3M (Fama & French) model, which was shown in previous studies to be more precise.

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# ISPITIVANJE PRIMENLJIVOST CAPM MODELA KORIŠĆENJEM ODABRANIH AKCIJA KOJE SE KOTIRAJU NA BEOGRADSKOJ BERZI

*Jedan od osnovnih vidova procene portfolija kao i vrednovanja pojedinačnih akcija preduzeća je CAPM (Capital Asset Pricing) model, koji u svojoj analizi koristi dobro poznatu meru sistemskog rizika, a to je beta. CAPM model u svojoj analizi koristi vezu između mere sistemskog rizika (beta) i očekivanog tržišnog prinosa. Rukovodeći se ovim modelom, u ovom istraživanju izvršena je analiza mesečnih prinosa odabranih akcija na Beogradskoj berzi u periodu od 2011. do 2021. godine. U istraživanju je beta koeficijent odabranih akcija izračunat uz pomoć kovarijanse tržišnog prinosa i prinosa akcija. Rezultati i njihova statistička vrednost potvrđeni su testom linearne regresije. Ostatak istraživanja testira primennjivost CAPM modela na odabrane radnje i na isti način se izvodi SML (linija tržišta bezbednosti), koja predstavlja grafički prikaz modela. Istraživanje je pokazalo da osnovne pretpostavke CAPM modela nisu primenljive kao prediktor budućih očekivanih prinosa odabranih akcija na Beogradskoj berzi zbog raznih drugih elemenata koji utiču na kretanje cena i prinose odabranih akcija koje nisu obuhvaćene modelom.*

Ključne reči: CAPM model, Beta koeficijent, Beogradska berza, BelexLine