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THE INFLUENCE OF MARKET RISK ON SHARE PRICE TRENDS IN THE REPUBLIC OF CROATIA

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ABSTRACT

Market risk is the risk of macroeconomic factors that significantly affect all companies and all investments to varying degrees. This risk cannot be reduced or eliminated because it is affected by external factors such as; inflation, political events, terrorist attacks, interest rates, not affected by diversification. Market risk is most often calculated through the expected rate of return on investment in the CAPM model, where it is expressed by the Beta coefficient. This paper deals with the impact of market risk on stock return rates. The sample of research in this paper are the shares of several companies within the CROBEX10 index of the Zagreb Stock Exchange. Attention is paid to the semi-annual calculations of the beta coefficient and the required rates of return. In addition to the semi-annual ones, the annual and three-year calculations of one selected joint stock company will be presented.

Key words: *Market risk, Beta coefficient, required rate of return, CAPM model*

1. INTRODUCTION

A subject of this research paper is market risk, as type of risk that exists regardless of financial quality and business of entrepreneurs, and it cannot be eliminated so it is treated as a component of the stock price of the joint-stock company. The purpose of this paper is to point out the influence of market risk on the returns of Croatian shares listed on the Zagreb Stock Exchange, while the problem of the paper is measuring its influence on stock price movements.

The aim of this paper is proving the possibility of applying the Capital Asset Pricing Model (CAPM) in the Republic of Croatia from the aspect of market risk. CAPM determines market risk premium through the beta coefficient and it derives the price of market risk from the difference of returns on total stock market and risk-free interest rate.

2. THEORETICAL ASSUMPTIONS

Within their papers on the topic of capital structure, Franco Modigliani and Merton Miller (1958, 1963 and 1969) developed capital market theories and derived security market lines, firstly as single-index and then based on that also multi-index which observe the interdependence of risk and reward through linear relationships.

2.1. EVALUATING MARKET RISK

Since the emergence of modern portfolio theory by Harry Markowitz (1952 and 1959) for the risk premium, it seeks to set up the requirement of additional return that corresponds to the so-called systematic, i.e. market risk. Market risk measures the response of security prices to general market movements. Market risk is a risk of macroeconomic factors and it refers to unexpected investment changes caused by changes of interest rates, inflation rates and the economy that influence all businesses on different scales. It shows changes of security returns or portfolio related to changes of returns on the market. (Van Horne, Wachowicz Jr, 2002:100)

Market risk is actually something like a fixed risk and it cannot be diversified, while specific risks that are not explained by market movements of changes in returns of stock or portfolio can be avoided by diversification. Although diversification reduces exposure to specific risk, most investors limit it to 10 to 20 stocks due to transaction and monitoring costs.

2.2. BETA COEFFICIENT

The beta coefficient can be used to assess the risk of assets in financial management decisions, not only shares, but facilities, takeovers of other companies, etc. This requires a good assessment of the joint probability distribution of assets (Vidučić, 2012: 71).

The theory holds that a good measure of stock risk is the one held in a well-diversified covariance portfolio. For clarity of the risk measure, beta was developed as a relative covariance.

$$\beta_j = \frac{(cov\,(r_j;r_M))}{(\sigma_M{}^2)}$$

The beta coefficient is a relative measure that shows the sensitivity of changes in stock returns to changes in returns of the market portfolio. It can be calculated from the ratio of the covariance of the return of the security and the return of the market portfolio, with the variance of the market index.

Beta is a measure of the risk of a security held in a well-diversified portfolio. It shows the tendency of an individual security to co-vary with the market. It has relative significance as a measure for market index whose value is 1.0. If a stock has a lower or negative Beta coefficient, it has a worse return on the market portfolio and vice versa. This gives the beta coefficient the role of hedging if the asset is included in a diversified portfolio. The beta coefficient can be viewed as the coefficient of the reaction of the return of the security/portfolio to market movements.

2.3. REGRESSION LINE OF THE SECURITY

Regression line of each security is a result of searching for a linear relationship between the return on an investment according to the movement of the return on the total investment market. The first discussion of the regression line of securities introduced by Harry Markowitz (Orsag, 2015) was reaffirmed by Sharpe (1963) calling it the Capital Asset Pricing Model (CAPM), or single-index model. The model describes the relationship between risk and expected (required) return, where the expected return is the risk-free rate plus premium adjusted by market risk.

$$R_j = R_f + \beta_j{}^* \,(R_m - R_f)$$

where is:

R_j = required rate of return for share j,

R_f = risk-free interest rate,

β_j = Beta coefficient for stock j

R_m = expected return for the market portfolio.

With this equation of the regression line of the capital market the expected return of the stock is calculated. The CAPM shows an expectation of a safe return that is equal to risk-free rate plus a risk premium. If the expectation is not met or is not less than the required return, the investment should not be undertaken.

R_f risk-free interest rate is a theoretical concept that refers to returns on risk-free investments. A risk free asset is one where the actual return is always equal to the expected return. As there are no risk-free investments in the real world, the risk-free interest rate is based on the returns that are equal to risk free investments. These are mainly returns on government securities, interest rates on savings and returns of money market funds. At the same time, the return on an investment class equal to risk-free one that by its maturity corresponds with assessed asset should be chosen.

The first attempts to establish a proxy for risk in the characteristic regression security line (Sharpe, 1963), now known as a single-index model, highlighted the Beta coefficient as a measure of market risk (Farrar and Orsag, 2002). Is the Beta coefficient a good proxy for risk, and is it related to expected return? The answers to these questions have been debated for the past two decades.

R_m expected return on the market portfolio is an index that contains the stock that is analyzed, the index of developed markets or the global index.

βj $(R_m - R_f)$ is a measure of the sensitivity of assets to market movements (market risk). is a component received for market risk and represents the amount of risk, β_j, times the price of risk, $R_m - R_f$. β_j

The CAPM rate forecast should reflect the cost of time and the cost of investment risk in any profitable form of asset. The price of time is usually equated with a risk-free interest rate, while the price of risk is that part of the price, i.e. the cost of capital, which is called the risk premium.

This model of valuing capital assets CAPM (Sharpe, 1964; Lintner, 1965) was soon after its occurrence accepted in practice, and is still the most widely used today. Although it has received a lot of criticism, it is a useful starting point for discussing risk and return models when assessing the value of stocks or the company as a whole.

3. MEASURING MARKET RISK

Models that approach the issue of measuring market risk differently are CAPM, APM, and the multifactor model. In the CAPM, the risk measure is divided into two general types of risk: systemic (indivisible or market) and non-systemic risk (divisible or specific company risk). While most risk and return models agree on the first two steps of this process, i.e. this risk comes from the distribution of actual returns around the expected returns and that this risk should be measured from the perspective of a well-diversified marginal investor, there are two ways to measure systemic or market risk.

Although initial APM tests and multi-factor models have shown that they could provide more in terms of explaining differences in returns, a distinction should be made between the use of these models to explain differences in previous returns and their use for expected future returns. Competitive models compared to CAPM work better on explaining past returns because they are not limited to one factor like CAPM is. This multi-factor extension becomes a problem when trying to project expected returns in the future, since the beta coefficients and premiums of each of the factors from the CAPM must be estimated.

The first tests of the CAPM model suggested that the beta coefficient and market returns were positively related, although other risk measures (such as variance) explain the differences in actual returns. If an investor's portfolio is well diversified, it is concluded that the risk they should look at when investing in stocks is market risk. However, a study conducted by Fama and French (1995) examined the relationship between beta of stocks and annual returns between 1963 and 1990 and concluded that there was little association between them. Market capitalization and book to market value explained the differences in returns between companies much better than the beta did, and that they are therefore better risk proxies. These results were disputed by:

- Amihud, Christensen, and Mendelson (1992) who used the same data and conducted different statistical tests, and showed that the beta coefficients actually explained the returns in the observed time period
- Chan, Jegadeesh, and Lakonishok (2001) who observed a much longer time series of returns from 1926 to 1991 and found that the positive relationship between beta coefficients and returns deteriorated only after 1982. They attributed this to indices used by leading shares of larger companies with lower beta coefficients from the S&P 500, so they outperformed shares of smaller companies with higher beta coefficients. They consider beta coefficients useful for risk in extreme market conditions, where the most risky (10% of them with the highest beta coefficients) are far worse than the market as a whole.

Damodaran (2002) made a significant contribution to the specific application in valuation processes, by modifying the approach to the required return through the model of capital asset valuation with statistic of specific risk of individual countries.

There is a large amount of recent international and regional research on this topic. Džaja J., Aljinović Z. developed a Testing CAPM model on the emerging markets of Central and Southeastern Europe, and Učkar D. and Nikolić J. (2008) tested the possibility of applying the Securities Market Line (SML) to identify erroneously valued stocks on Croatian capital market. There are many papers on this topic, such as Strmota J. (2016) Quantitative analysis of shares on the Croatian capital market using MV and CAPM models or Sakić A. (2017) Testing of CAPM models – analysis on the Croatian capital market. Many try to evaluate the effectiveness of the model such as Škrinjarić and Šostarić (2014) through the Complementarity of the Markov Chain Methodology and Markowitz's portfolio optimization model, also a topic is elaborated in the region e.g. Janković D. Application of CAPM in property valuation in the Montenegrin capital market.

In addition to the use of Damodaran's and similar modifications, some other models which were made as a modification of the capital asset valuation model are available to analysts. The Fama-French (1992, 1995) three-factor model is primarily interesting for these purposes.

4. CALCULATIONS AND EXPLANATIONS

A sample of 9 shares from the Zagreb Stock Exchange index CROBEX 10 was selected for this paper for time period in stock exchange trading days from January 2nd to June 28th, 2019 through daily changes in observations. It's about sufficient number of observations, where changes in stock prices by trading days are taken into account (number of days x 6 months approx. 180 observations). One of the main reason why the observation horizon is only 6 months is instability of long-term interest rates on Croatian kuna bonds.

- The beginning of the calculation is based on the collected data on trading gathered from the website of the Zagreb Stock Exchange. There is data for calculating the prices of an individual share, more precisely the last price, so that the ratio of the difference between the last price at the beginning of the observation period and the last price at the end of the period shows the percentage of price change necessary for further calculations
- The next step is to find the index data that was taken as an proxy for the market. This is the index of the Zagreb Stock Exchange Crobex10. When calculating the changes in the index, the same formula was used as for the observed 9 stocks.
- After calculating the changes of individual shares and the corresponding index as market proxy, a risk-free interest rate was found on the website of the Ministry of Finance, i.e. the interest rate on treasury bills of the Ministry of Finance for the 6 observed months of 2019. The risk-free interest rate was 0.09%.

- (R_m - R_f) is a risk premium and is nothing but a change in the price of the Crobex10 index obtained in the previous step from which the amount of the risk-free interest rate is reduced.
- After that, changes in prices or returns on shares and then on the index were calculated.
- After the obtained arithmetic mean which is denoted as $\bar{R}_i$, where subscript i is added and which denotes the share, this data is transferred to the following formula of the expression $(R_i - \bar{R}_i)$
- The arithmetic mean should be subtracted from any change in return, the same those we used to calculate the arithmetic mean. The squaring of the results of the previous formula follows. $(R_i - \bar{R}_i)^2$
- After calculating all the data from the former written formula, the arithmetic mean of these data is sought, which interprets its significance as the value of variance, and its root is the standard deviation.
- The same follows for the amounts of the change in return but this time for the index, and the new expression is written as $\bar{R}_j$. The arithmetic analysis paired with the dates is searched again and this expression is written as $(R_j - \bar{R}_j)$, according to the formula is squared $(R_j - \bar{R}_j)^2$
- It takes a step back to all the calculations obtained $(R_j - \bar{R}_j)$, and by multiplying the data obtained by this expression for index $(R_j - \bar{R}_j)$, and the same expression that stands for stocks with subscript *i* , new data are obtained whose arithmetic mean forms a new data called covariance.
- The correlation coefficient is calculated as the ratio of the covariance and the product of the standard deviations of the stock and the index, $R_{ij} = \frac{Cov}{SD_i * SD_j}$ which is actually the beta coefficient $\beta = \frac{Cov}{Var_j}$
- With the obtained beta and already known data, the required return is calculated by including in the CAPM formula $R_i = R_f + \beta_j * (R_m - R_f)$
- Perhaps an easier, faster, and simpler way to calculate the beta is to skip all previous calculations through MS Excel and the slope function by typing [= SLOPE] and then include historical changes after the expression in parentheses, the ones you manually count for each stock and then for an index of eg. cells (H2: H22; N2: N22), so that the whole formula looks like: = SLOPE (H2: H22; N2: N22). Thus obtained beta is then inserted into the CAPM formula along with a risk-free interest rate and risk premium, and the result is required rate of return..
- This is followed by an analysis of the impact of risk on the movement of prices of selected shares on the Zagreb Stock Exchange, one by one. A comparative review and comparative analysis are presented.

Tables 1-9. Comparative analysis- 9 component stocks of CROBEX 10 from Zagreb stock exchange

Data summary of Ericsson Nikola Tesla	Period
Expected return (CAPM) (Jan 2.-June 28.)	3,48%
Realized Return	9,95%
Return (July 1.-Dec 30.)	27,30%

Data summary of Arena Hospitality Group	Period
Expected return (CAPM) (Jan 2.-June 28.)	4,23%
Realized Return	6,50%
Return (July 1.-Dec 30.)	1,64%

Data summary of AD Plastic	Period
Expected return (CAPM) (Jan 2.-June 28.)	4,95%
Realized Return	7,50%
Return (July 1.-Dec 30.)	1,10%

Data summary of Končar	Period
Expected return (CAPM) (Jan 2.-June 28.)	12,77%
Realized Return	25,23%
Return (July 1.-Dec 30.)	-5,90%

Data summary of Adris	Period
Expected return (CAPM) (Jan 2.-June 28.)	8,02%
Realized Return	11,50%
Return (July 1.-Dec 30.)	8,80%

Data summary of Podravka	Period
Expected return (CAPM) (Jan 2.-June 28.)	9,08%
Realized Return	8,58%
Return (July 1.-Dec 30.)	19,51%

Data summary of HT	Period
Expected return (CAPM) (Jan 2.-June 28.)	11,40%
Realized Return	8,10%
Return (July 1.-Dec 30.)	10,40%

Data summary of Atlantic Grupa	Period
Expected return (CAPM) (Jan 2.-June 28.)	12,13%
Realized Return	5,20%
Return (July 1.-Dec 30.)	7,40%

Data summary of Atlantska Plovidba	Period
Expected return (CAPM) (Jan 2.-June 28.)	14,02%
Realized Return	1,60%
Return (July 1.-Dec 30.)	16,10%

Source: Made by author, (June 20. 2020.)

As the last data in the tables, the actual historical return for 6 months from July 1 to December 31, 2019 is shown, which "hit" the CAPM. For the purposes of this paper, it was decided that the required return for the Ericsson Nikola Tesla share will be calculated for two more periods, in addition to the shown period of 6 months, followed by the calculation of a period of one year and three years.

Data summary of Ericsson Nikola Tesla (1 year)	Period
Expected Return (CAPM)	3,440%
Realized return	5,74%

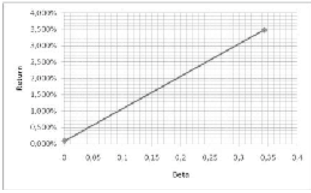
Data summary of Ericsson Nikola Tesla (3 years)	Period
Expected Return (CAPM)	6,73%
Realized Return	9,62%

Source: Made by author, (June 20. 2020.)

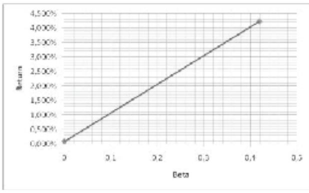
The third method of calculating the beta coefficient, a regression model related to past returns as market risk measures, was also developed. Historical data can be used for the beta coefficient if the past is considered a good surrogate for the future (Vukičević, Gregurek, Odobašić, Grgić, 2016: 95). In this case, these are data from the first half of 2019 from the Zagreb Stock Exchange, the same as in the already presented method of calculation. As part of the work with regression tables, only the SML lines of the observed sections are shown.

Pictures 1-11.Comparation of stocks of index CROBEX 10 with SML

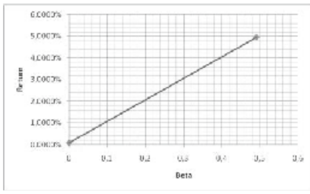
Picture 1 SML ERICSSON Nikola Tesla



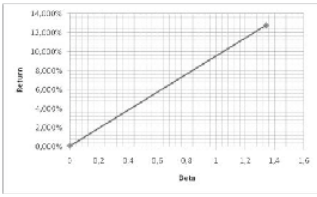
Picture 2 SML of stock Arena Hospitality



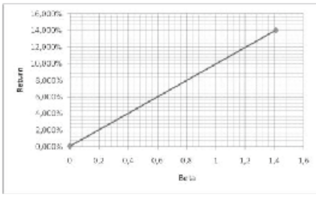
Picture 3 SML of stock AD Plastic



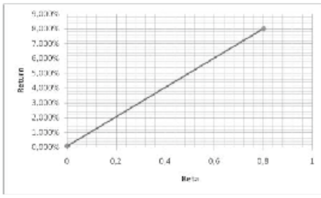
Picture 4 SML stock Končar



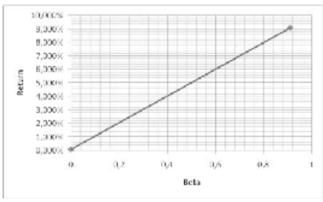
Picture 5 SML Atlanska plovidba



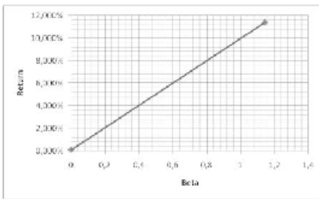
Picture 6 SML of stock ADRIS



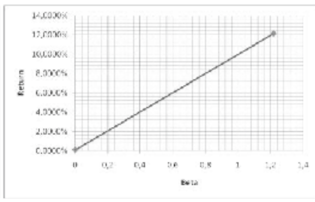
Picture 7 SML of stock Podravka



Picture 8 SML of stock HT

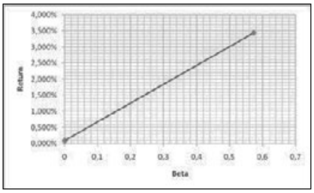


Picture 9 SML of stock Atlantic Group

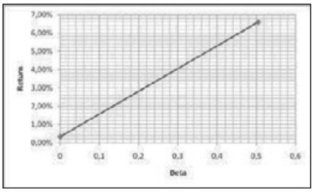


As the previous calculations started with the shares of Ericsson Nikola Tesla, which have the lowest expected price growth according to CAPM in the observed period, the following Pivot charts are shown in the same order for one year and three years.

Picture 10 SML ERICSSON Nikola Tesla



Picture 11 SML of stock ERNT (3.year)



Source: Made by author, (June 21. 2020.)

5. CONCLUSION

Different risk models aim to measure market risk, but differ in the way they do so. Each CAPM test can show that the model works (or not) given the proxy used for the market portfolio. In any empirical test claiming to reject CAPM, the rejection could refer to the proxy used for the market portfolio, not the model itself. Roll (1994) found on this basis that there is no way to ever prove that CAPM works, and thus that there is no empirical basis for using that model.

This paper shows that the influence of the beta coefficient on the movement of stock prices computationally really exists. The beta coefficient is the sensitivity factor of a certain stock when influenced by an external factor, i.e. the index as a representative of the market, because it increases or decreases the risk premium. These are data of overvaluation or undervaluation of shares in relation to what is expected.

The limitation of this research is the short horizon of observation, however, and there are fairly accurate estimates of the trend in the value of shares, except for the shares of Končar and Ericsson Nikola Tesla. By extending the horizon of the Erikson Nikola Tesla share observation, the data show the right trend. A guideline for future research would be to investigate the stability of the beta coefficient for an even more reliable assessment of CAPM in a small market such as the Republic of Croatia.

LITERATURE

1. Amihud Y., Christensen B.J. i Mendelson H. (1992).: Further Evidence on the Risk-Return Relationship, Research Paper No. 1248, Stanford University
2. Chan C., Jegadeesh N., Lakonishok J.: (2001) Earnings Quality and Stock Returns - NBER Working Paper No. 8308. Issued in May
3. Damodaran A.: (2002), Investment Valuation, Tools and Techniques for Determining the Value of Any Asset, John Wiley & Sons, Inc., New York
4. Džaja J., Aljinović Z. Testing CAPM model on the emerging markets of the Central and Southeastern Europe, Croatian Operational Research Review, 2013 - hrcak.srce.hr

5. Fama-French (1995) Size and Book-to-Market Factors in Earnings and Returns, The Journal of Finance, 47 (2), 427-465.
6. Farrar D., Orsag S., (2002) Moderna teorija portfolia, Priručnik za polaganje ispita za obavljanje poslova investicijskog savjetnika, redakcija Silvije Orsag, HUFA – Hrvatska udruga financijskih analitičara, Zagreb
7. Janković D. (2009) Primjena CAPM u vrednovanju imovine na Crnogorskom tržištu kapitala, Montenegrin journal of economics,
8. Modigliani, F.; Miller, M. (1958). „The Cost of Capital, Corporation Finance and the Theory of Investment". American Economic Review. 48 (3): 261–297. JSTOR 1809766.
9. Markowitz, H: (1952). „Portfolio Selection" . The Journal of Finance . 7 (1): 77–91. JSTOR 2975974 .
10. Markowitz, H (1959). Portfolio selection: Effective investment diversification. New York, John Wiley & Sons.
11. Merton, R.: (1972). „An analytic derivation of the efficient portfolio frontier," Journal of Financial and Quantitative Analysis 7, September 1851-1872.
12. Sharpe W.F., A Simplifed Model for Portfolio Analysis, Management Science, Jan, 1963.
13. Sharpe, William F. (1964). „Capital asset prices: A theory of market equilibrium under conditions of risk". Journal of Finance . 19 (3): 425–442. doi : 10.2307/2977928 . JSTOR 2977928 .
14. Lintner, J.:(1965) The market price of risk, size of market and investor's Vol. 52, str. 87-99, MIT Press DOI: 10.2307 / 1927602
15. Orsag, S. (2015). Investicijska analiza, Avantis i HUFA, Zagreb.
16. Roll, Richard; Ross, Stephen (1994). „ About the intersectional connection between the expected return and beta. "Journal of Finance . 49
17. Sakić A.(2017) Testiranje CAPM modela–analiza na hrvatskom tržištu kapitala,*https://urn.nsk.hr/urn:nbn:hr* 124:659748
18. Strmota J. (2016) Kvantitativna analiza dionica na hrvatskom tržištu kapitala primjenom MV i CAPM modela, https://urn.nsk.hr/urn:nbn:hr:124:485897
19. Škrinjarić T, Šostarić N. (2014) Komplementarnost metodologije Markovljevih lanaca i Markowitzeva modela optimizacije portfelja, Ekonomska misao i praksa, - hrcak.srce.hr
20. Učkar D. i Nikolić J. (2008) SML model i hrvatsko tržište kapitala, Economic research, hrcak.srce.hr
21. Van Horne J. C., Wachowicz J. M. (2002) Osnove financijskog menadžmenta. Mate d.o.o.. Godina izdavanja: 2014. str.100,
22. Vidučić Lj. (2012): Financijski menadžment, RRiF, Zagreb, str.71.
23. Vukičević, M; Gregurek, M; Odobašić, S; Grgić, J. (2016) Financijski menadžment u MS Excelu, Golden marketing-Tehnička knjiga, Zagreb, str,95.

TABLES AND PICTURES

Tables 1-9. Comparative analysis- 9 component stocks of CROBEX 10 from ZSE
Tables 10-11. Data summary of stock ERNT (1.year); (3.years)
Pictures 1. do 11. Comparation of stocks of index CROBEX 10 with SML

UTJECAJ TRŽIŠNOG RIZIKA NA KRETANJE CIJENA DIONICA U REPUBLICI HRVATSKOJ

SAŽETAK RADA

Tržišni rizik je rizik makroekonomskih čimbenika koji bitno utječu na sve tvrtke i sve investicije u različitim stupnjevima. Taj rizik se ne može smanjiti niti eliminirati, jer na njega utječu vanjski faktori poput; inflacije, političkih događaja, terorističkih napada, kamatnih stopa, a ne utječe diversifikacija. Tržišni rizik se najčešće izračunava kroz očekivanu stopu povrata na investiciju u CAPM modelu, gdje ga izražava Beta koeficijent. Ovaj rad obrađuje utjecaj tržišnog rizika na stopu povrata dionica. Uzorak istraživanja u radu su dionice nekolicine društava u sastavu indexa CROBEX10 Zagrebačke Burze. Pozornost je na polugodišnjim izračunima beta koeficijenta i traženim stopama povrata. Osim polugodišnjih prikazati će se godišnji i trogodišnji izračuni jednog odabranog dioničkog društva.

Ključne riječi: *Tržišni rizik, Beta koeficijent, tražena stopa povrata, CAPM model*