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THE APPLICATION OF THE CAPM MODEL ON SELECTED SHARES ON THE CROATIAN CAPITAL MARKET

Abstract

The Capital Asset Pricing Model is a model that describes the relationship between risk, expected return and valuation of securities. The theoretical and practical value of this model has proved unquestionable, but under ideal circumstances. The theory has been utilized by numerous researchers and it confirms the linear relationship between risk and return under the CAPM *(Capital Asset Pricing Model)* model showing that greater exposure to risk provides higher returns. However, empirical research showed there were numerous factors that CAPM model did not take into account since it is based on assumptions which exist in reality, but are invisible.

Therefore, it is very interesting to study the application of the CAPM model on selected shares on the Croatian capital market and analyze the possibilities of its application in discovering the misvalued shares. Share price changes on the Croatian capital market suggest there are some unknown factors that also influence share valuation. There is no doubt that the fundamental analysis of shares is not sufficient for evaluating the real share value in light of various invisible elements and all available information available which affect their value as well.

Keywords: CAPM Model, share, return, risk, beta index

1. Introduction

The Capital Assets Pricing Model (CAPM) describes the relationship between systematic risk, expected return and valuation of securities. The main features of this model show that the expected return on the portfolio and standard deviation depend on the structure of the portfolio and that the increase of the risk-free asset in the portfolio affects its expected return. This model makes it possible to select the optimal portfolio when investing in risky and risk-free assets, which is determined by the equity market line (*CML - Capital Market Line),* containing all optimal portfolios that are combination partners of the risk-free asset and the market portfolio M. The model shows that the expected return on any portfolio associated with a risk-free asset and the portfolio beta results in the market line *(SML- Securities Market Line)* describing a linear relationship between the expected rate of return and the systematic risk measured by beta. How to calculate the beta for shares of a portfolio where the beta is a measure of systematic risk and a share return sensitivity measure in relation to the market portfolio return changes has been done in this paper. The findings suggest a relatively high impact of the financial market on the share return. The high risk-free rate that influences the risk premium and subsequently results in the relatively high expected annual returns of observed shares by applying the model must be noted.

2. Theoretical framework

The relationship between the expected return and inevitable risks as well as the valuation of the security is the core of the model for determining the cost of invested capital (Pindyck, Rubinfeld, 2005: 166-169; 546-547). This model was developed by William F. Sharpe and John Lintner. CAPM (Capital-Asset Pricing Model) is the most frequently used model for determining the cost of invested capital (Brealey, Myers, 2003: 187).

He takes into account not only the risk difference between ordinary shares and government securities, but also the difference between company's ordinary shares and the average ordinary shares of all companies or the total defined market portfolio. The difference in risk between ordinary shares and government securities is called the risk premium, and the difference in risk between the ordinary shares and the common shares of all companies is shown by the beta coefficient (Salvatore, 1993: 602).

According to Markowitz, portfolios are divided into efficient and inefficient. Between efficient and inefficient portfolio there is a frontier in the form of curves. The line between efficient and inefficient portfolio is called the efficient frontier. The efficiency frontier consists of a series of portfolios with an efficient combination of the expected return and risk. These are portfolios with the highest return accompanied by a certain risk and the lowest risk with a certain return.

The Markowitz approach is based on the relation between the return and the risk, taking into account the diversification of the portfolio (different forms of property). Risk measurement uses the standard deviation or variance of expected returns. It is a statistical measure of the dispersion of returns (in different periods) around the expected value of return (average value). The greater the dispersion of returns around the expected return, the greater the uncertainty about future returns, and the higher the risk. (Brealey, 2003: 191 – 211)

The covariance measures a degree to which the two securities move relatively in the same line in the observed period as a function of their average returns. A positive covariance means that the return on two securities moves in the same direction. A negative covariance means that the return on two securities moves in different directions. But the covariance does not give exact information about the extent to which the two securities move in the same direction i.e. they mutually correlate. Therefore, a better measure was introduced; the correlation equal to the relation of the covariance and the product of standard deviations of two securities. CAPM is based on certain assumptions. It is assumed that capital markets are very efficient when investors are informed, when transaction costs are zero, investment restrictions are ignored, the assumption of no-taxes and no investor is large enough to affect the share price is undertaken. In addition, it is assumed that there is no consensus among investors about the probable return and the risk of certain securities and that their expectations are based on the average time of holding securities. Under such conditions, all the investors would set the same efficiency frontier.

The Markowitz model has not dealt with securities price setting. The complexity of the Markowitz model and the generalization of the assumptions have led to further improvements. William Sharpe, a professor at Harvard (1964), Lintner, a professor at Harvard (1965) and Mossin designed the CAPM model, which was later upgraded by Black. The model defines the relationship between the risk and the expected return.

CAPM is a linear balancing model that explains returns above risk-free rates using the covariance of return on these investments through their covariance with the overall market. Thus, the introduction of non-risky securities in the portfolio led to the Capital Market Theory or to the CAPM model.

The development of the Markowitz model has led to the efficient frontier curve that provides optimal portfolios depending on the preferences of investors for the required return and risk. By adding non-risky securities, the Capital Market Theory was developed, and the efficient frontier curve was changed in the Capital Market Line (CML). Investors choose portfolios that are located along this line.

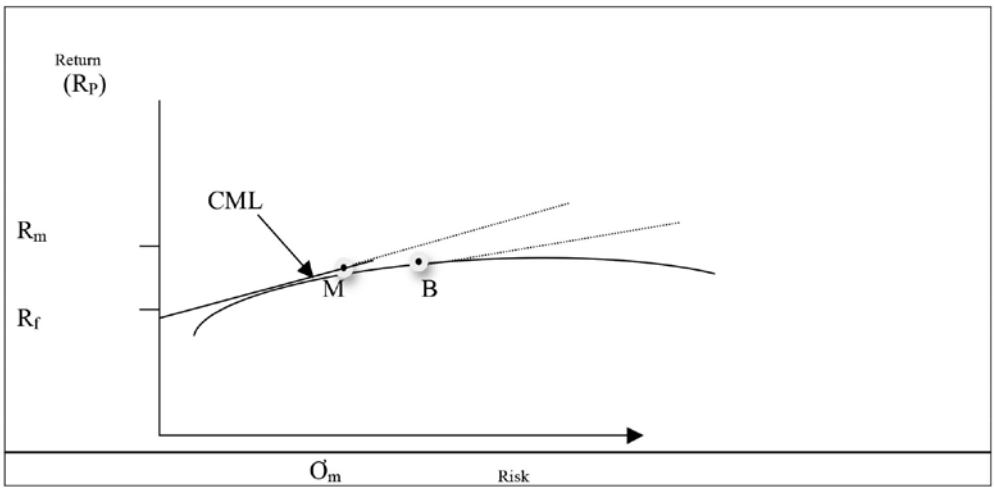
Having quantified the extent of risk, the next step was to connect the required return and risk. This led to the CAPM model (Capital Asset Pricing Model), which defines the expected/desired return at a certain risk.

CAPM is important because the quantification of the expected/required return also results in the discount factor used in models for determining the share fair market value.

Also, if the client has used other methods for estimating the expected investment return, CAPM can compare both results and assess whether the price at which it entered the investment is a fair market price.

According to the Capital Market Theory, the market portfolio includes all risky securities, but the investor will almost always invest in risk-free instruments and include them in his portfolio (government bonds, treasury bills, etc.). The introduction of risk-free securities has a significant impact on return-risk relationship. According to the CMT, there is a market portfolio of securities (including all risky securities) along the efficient frontier. This portfolio is also the optimal portfolio. A rational investor chooses a linear combination between the market portfolio and the risk-free investments, depending on his risk preferences. Further research has shown there are two types of risk: own securities risk and risk arising from the systematic impact of the financial market on the price and securities return. The first risk can be influenced by an active policy portfolio, while the second one cannot. The authors divided the risk into the part that can and a part that cannot be reduced by diversification. Systematic risk cannot be eliminated by diversification because it arises from changes in economic conditions or basic variability of share prices.

Graph 1 CML (Capital Market Line)



Source: Author

The combination of risk-free securities and the risky portfolio shows the following:

- variance risk-free securities is 0;
- correlation between risk-free and risky securities is 0;
- standard deviation of the portfolio as a combination of risk-free securities and portfolios of risky securities is a linear combination of the standard deviation of the risky securities portfolio.

As the expected return and the standard deviation of returns of such a combined portfolio is a linear combination, the return-risk graph changes from curves into the line. The investor can achieve any combination of the expected return and risk along the RF line by varying the share of risk-free securities and the risky portfolio from point B.

The market portfolio is a portfolio of all potentially risky securities in the market represented by the M point. At this point, the efficiency curve touches the group of investment opportunities. According to CAPM, the M point contains ordinary and preferred shares, bonds and real estate. But in practice, most people create their market portfolios only from ordinary shares and bonds. However, along the R-B line, there are points at which a higher return is achieved under the same risk. Thus, the combination of B and a non-risky portfolio of securities is more efficient than Rf. Along the Rf-M line, which is also a curve tangent, the best combination of return and risk is obtained.

The line that describes the relationship between the expected rate of return and the risk measured by standard deviation is called the Capital Market Line, or the CML (Vukičević et. al, 2010: 348). Every portfolio along the Rf-M line is considered to be an efficient portfolio. The CML is valid only for efficient portfolios, and each point along this line represents a portfolio composed of risky and non-risky assets. The M point is only a portfolio made up of risky assets. The Capital Markets Line (CML) is a tangent of the efficient set of total assets. The expected rate of return on the portfolio is equal to the risk-free rate of return plus a risk premium according to the equation (Brigham and Ehrhardt, 2005: 185-187):

$$CML = \overline{R_p} = R_f + \left(\frac{R_{m-R_f}}{SD_m}\right) SD_m$$

The term in the parentheses represents the slope of the CML and reflects the attitude of investors to risk. The CML defines that in conditions of market equilibrium, the expected rate of return on portfolio is equal to the risk-free rate of return plus a risk premium.

According to the CAPM, the efficient portfolio risk is measured by the standard deviation of the portfolio (SDP), while the securities risk is measured by its beta. The beta is a measure of the relative risk, the covariance of return on security or market portfolio. This relationship is defined by the SML of the securities market ((Brealey and Myers, 2003: 197 -205; Horne and Wachowich, 2002: 104-106).

The Capital Market Line is a line which, under the market balance conditions, shows the relationship between the required rate of return of certain securities and the systematic risk expressed by beta.

The line intersects the ordinate along which there are expected rates of return. Its slope reflects the degree of aversion of investors to risk. The greater the aversion, the higher the risk premium, the sharper the slope of the line and the higher the expected rate of return. The SML equation is calculated as follows:

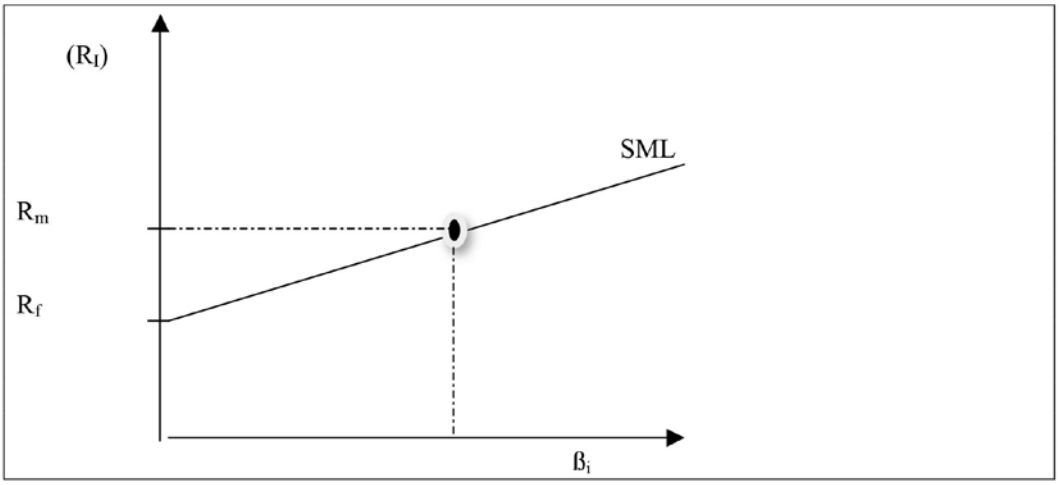
$Rj = rf + (Rm- rf)\ \beta j$
The slope is the market risk premium = Rm - Rf

The SML says that the required rate of return on a security depends on the beta or the market risk of securities, risk-free rate of return (R) and the market risk premium (RPm). Thus, the SML equation shows that the share price can change even without a change in cash flows of the company by changing the required rate of return under the influence of changes in the nominal rate of return without risk, beta or market risk premium.

The CML considers risk as the overall risk of the portfolio, which is measured by standard deviation, because it is a choice between risk and return on the efficient portfolio. The SML is a choice between risk and return on certain securities and is therefore an appropriate measure of beta risk, and not the standard deviation.

Beta is a relative covariance which shows the sensitivity of changes of the return on a security on changes in the market return. The beta coefficient is a measure expressing the systematic risk.

Graph 2 SML – Securities Market Line



Source: Author

Adopting beta for the appropriate measure of risk means that the risk assessment by an investor should be based and carried out in the context of cohesion of specific financial decisions related to shares and market investments.

Investors typically hold the market portfolio, i.e. a large portfolio. A large portfolio means the portfolio in which it is possible to increase the number of securities indefinitely, therefore eliminating the overall unsystematic risk. For this reason, it is essential to calculate the systematic risk. According to market and share returns data during, for example, the last five years, a dissipating diagrams should be developed defining the possibility of the existence of a linear relationship between market and share returns and setting the linear regression equation line (Brigham, 2005: 187 - 189; Pindyck, 2005: 654 -661; Salvatore, 1994: 129 – 146).

The linear regression equation: Y= bX + a

The explanation of the parameters in the regression equation:

a - constant measure, i.e. the expected value of the dependent variable (Y) when the value of the independent variable (X) is zero.

b - regression coefficient that shows the average change in the dependent variable (Y) when the independent variable (X) is increased by one (a single unit of measurement). Geometrically, it represents a slope, so it will be positive if the line is growing (variables are directly proportional), and negative if it is falling (variables are inversely proportional).

The formula of the characteristic regression line is: kjt = Ai + βj KMT + ejt

where

kjt = profitability of securities

KMT = profitability of the securities market

Ai = alpha

βj = beta

ejt = residual

The measure of the systematic investment risk or the investment portfolio is ß, a coefficient which shows the sensitivity of investment or the portfolio to changes in the securities markets.

- aggressive portfolio - reacts more intensely to changes in the market - ß> 1
- defensive portfolio - responds more slowly to changes in the market - ß <1
- the average portfolio - reacts proportionally to market changes - ß = 1

The covariance between two sections:
$\mathbf{Cov(k_A, k_B) = ß_A\ ß_B\ var(k_M)}$

- variance profitability of the market indicates the change of macro conditions
- betas of individual shares show the intensity of both shares reacting to changes in macro conditions
- covariance residuals is zero

Alfa shares represent a constant which indicates the return on shares when the market is saturated - there is no impact on return changes - there is no impact on the standard deviation of returns.

The calculation of beta is done by comparing the individual share trends (or portfolios) and the overall market trends (index). The standard estimate of beta coefficients is done through regression, i.e. by using the method of least squares where the observed share return is in relation to the market return in a given period. The calculation of the β coefficient can be based on historical beta coefficients, the expected beta coefficients and the expected beta coefficients with the help of historical beta corrections. The historical beta coefficient is calculated based on share and market returns historical data. The calculation may be based on the regression analysis of the share and market returns or the calculation of the relationship between two variables, such as the covariance and correlation coefficient (Brigham, Ehrhardt, 2005: 186 – 195).

The beta is usually between 0.5 and 1.5. Securities are considered to be more or less sensitive-volatile market trends and therefore their beta is less than or higher than one. Beta shows a share tendency to behave in accordance with the behavior of the market. It has a relative meaning as a benchmark for market index which value is 1.0. Therefore, the return on the share with a beta of 1.0 increases and decreases by the same percentage as the market.

This means that the securities with a beta value higher than 1 are riskier than the market, as they go up and down more than the market does. Securities with a beta coefficient less than 1 are less risky than the market. The return on securities with the negative beta is lower when the return on the market portfolio is good and vice versa. The best example is the gold price trend, which price moves opposite to share prices. If the share has a beta = 2, then it oscillates on average two times more than the market. If the share has a beta = 0.5, it tends to be more stable than the market (it will rise or fall by 5% when the market rises or falls by 10%).

The beta coefficient can be defined as the reaction of the return on a security to market trends. For example, if the beta of a certain share is 1.5, this means that the return on the share is 1.5 times more reactive in relation to market trends (Horne, Wachowich, 2002: 103).

The beta coefficient can be calculated as the ratio of the covariance of the return on shares and the

$$\beta j = \frac{\mathrm{cov}(Rj, Rm)}{\sigma^2(Rm)}$$

$$\mathrm{cov}(Rj, Rm) = \sum Pi(Rj - \overline{Rj})(Rm - \overline{Rm})$$

return of the market portfolio and the variance of the market index (Brealey, Myers, 2003: 171 – 177).

The β coefficient is a standardized measure of the systematic risk of a security or portfolio. The β coefficient market index is 1 e.g. S & P500, Nasdaq, Eurostoxx 50 as in practice the market is approximated with indices (benchmark).

The standard deviation of the portfolio as a measure of the portfolio risk is not a weighted average of standard deviations of individual securities since in that case the connection or correlation between the return on the two securities would be ignored. The standard deviation of the portfolio depends not only on the variance of individual securities, but also on the covariance between different securities that are paired. The covariance of potential returns on two security measures the degree to which their mutual variations are expected. The standardized statistical measure of the linear relationship between two variables is the correlation coefficient.

Table 1 Interest rate of international government bonds of the Republic of Croatia issued in 2013

Bonds issued	2013	Euro-USD bonds	Coupons	Ponder	Pondered average
1	4th April	1.5 billion	5.50%	0.4615	0.025385
2	26th November	1.75 billion	6%	0.5385	0.032308
Total		**3.25**		**1.0000**	**5.77%**

Source: Author[1]

The standard deviation of the portfolio is obtained by summing across the rows and columns of all the elements of a square matrix. The matrix consists of the weighted covariance between every possible pair of combinations of securities with weights representing the product of the portion of assets invested in each of the two securities that make up each pair. The benefits of diversification in terms of reducing risks exist until the securities are not perfectly positively correlated.

3. Research methodology

This research will focus on the application of the CAPM model on selected shares which are listed on the Zagreb Stock Exchange, with the calculation of beta as a measure of a systematic risk shown as stock market indices. In order to calculate beta, historical data of the selected shares and CROBEX, representing the market return, will be used. In terms of the risk-free rate, the 5.77% average rate of government bonds of the Republic of Croatia will be used (table 1).

Table 2 Value of shares and CROBEX index in the period from 2008 to 2014

Period	CROBEX	ADPL-R-A	ADRS-P-A	ATGR-R-A	ATPL-R-A	ERNT-R-A	DLKV-R-A
01.01.2008	5,239.00	221.53	585.5	872.44	3,490.73	3,413.80	1,685.38
01.01.2009	1,722.25	38.58	196.13	469.13	724.46	1,224.39	400.62
01.01.2010	2,004.06	76.37	259.28	689.76	966.76	1,338.18	321.05
01.01.2011	2,110.93	118.54	265.84	804.42	743.75	1,361.26	257.77
01.01.2012	1,740.21	101.54	219.9	489	333.3	1,071.71	129.5
01.01.2013	1,740.39	107.98	264.83	554.53	202.33	1,401.81	68.22
01.01.2014	1,794.28	113.32	264.83	764.56	385.45	1,605.33	27.17

Source: Author [2]

In the application of the CAPM model in 2013 for the risk–free rate, the pondered rate of international government bonds of the Republic of Croatia for 2013 will be used, i.e. the average pondered rate of all international government bonds which have not been fully repaid on the maturity date i.e. 6.23% for Euro – USD bonds and 6.18% for Euro – EUR bonds.

Table 2 shows the selected shares and the historical value changes of CROBEX and the shares of the following companies: AD Plastik d.d., Adris Group d.d., Atlantic Group d.d., Atlantska plovidba d.d., Dalekovod d.d. and Ericsson Nikola Tesla d.d.

The CAPM model formula is (Vukičević et. al, 2010: 351): $Rj = Rf + \beta (Rm - Rf)$

Rj = expected return

Rf = risk-free rate

β = systematic risk rate

Rm = expected market return

The results will present the return rates for each share separately. Classic MS Excel functions as well as VBA functions in accordance with the author's concept will be used for calculation.[3]

Table 3 Covariance of market and AD Plastik share returns

CALCULATION OF COVARIANCE					
Period	**CROBEX**	**Share**	**Deviation INDEX**	**Deviation share**	**Product of deviations**
1	-0,67126360	-0,82584752	-0,57145370	-0,82584752	0,47193362
2	0,16362897	0,97952307	0,26343887	0,97952307	0,25804445
3	0,05332675	0,55218018	0,15313665	0,55218018	0,08455902
4	-0,17561928	-0,14341151	-0,07580938	-0,14341151	0,01087194
5	0,00010344	0,06342328	0,09991334	0,06342328	0,00633683
6	0,03096432	0,04945360	0,13077422	0,04945360	0,00646726
Average return	**-0,09980990**			**Total**	**0,83821312**
Covariance	**0,13970219**	**<<=0,83821312/6**			
Cov. MS Excel	0,13970219	<<=COVAR(CROBEX;SHARE)			

Source: Author

This shows the accuracy of calculating the beta function which is applied on all other shares studied. The beta is calculated by putting market covariance in relation with market variance:

$$\beta j = \frac{\mathrm{cov}(Rj, Rm)}{\sigma^2(Rm)}$$

$\mathrm{cov}(Rj,R_{m)}$ = covariance of return on share and market

$\sigma^2(R_m)$ = market variance

Table 4 Calculation of market return varianc

CALCUCATION OF MARKET RETUN VARIANCE AND STANDARD DEVIATION FROM HISTORICAL DATA			
PERIOD	**RETURN CROBEX**	**DEVIATION**	**DEVIATION SQARED**
1	-0,67	-0,57	0,33
2	0,16	0,26	0,07
3	0,05	0,15	0,02
4	-0,18	-0,08	0,01
5	0,00	0,10	0,01
6	0,03	0,13	0,02
Total			0,45
Average return	**-0,10**		
Deviation	>>=RETURN CROBEX-Average return		
Deviation sqared	>>=(RETURN CROBEX-Average return)^2		
Variance	0,07537364		<<=0,45/6
Variance	0,07537364	<<=VARP(RETURN CROBEX)	
Standrard deviation	27,45%	<<=SQRT(0,07537364)	

Source: Author

3.1. Calculation of beta for share ADPL-R-A

Table 3 shows returns on CROBEX and the AD Plastik share and the number of days it was traded on the Zagreb Stock Exchange in the last six years. The share of certain shares in the portfolio has not been stated since it is not about the portfolio. The model shows how to calculate the beta value of a share which represents a systematic risk rate, i.e. sensitivity of the return on a share with regard to changes in the return of the market portfolio.

This table shows the market return rate and the AD Plastik share for the period from 2008 to 2014.4 The result of covariance is determined from the total variance by calculating the average variance. The

easier and simpler calculation is carried out by using the MS Excel COVAR function. In both cases the result should be equal to this calculation with the covariance of 0.13970219.

Table 4 shows the variance calculation of the CROBEX return index of 0.07537364.[5] In calculating the variance, it is simpler to use the VARP function. The AD Plastic share beta calculated based on historical data is the following:

$$\beta = \frac{0.13970219}{0.07537364} = 1.853462$$

The implementation of the beta calculation methodology on all other shares produced the following results:

Table 5 Calculation of the beta index for system

	ADPL-R-A	ADRS-P-A	ATGR-R-A	ATPL-R-A	ERNT-R-A	DLKV-R-A
Beta index	**1.8534621**	**1.1105574**	**1.1192394**	**1.38548087**	**1.0160646**	**0.58566856**

risk measure
Source: Author

Table 5 shows very high betas. As many as five shares have their betas higher than 1, while the AD Plastik d.d. share has the highest beta (β=1.85), followed by Atlantska plovidba d.d. (β=1.38), Atlantic Group d.d. (β=1.119) and Adris Group (β=1.111), indicating these are very risky shares.

Only one share, the Ericsson Nikola Tesla d.d. one has its beta close to 1, indicating its risk level approximate to the market portfolio. The most stable share with the lowest beta is the Dalekovod d.d. one (β = 0.58), indicating that the share is less risky than the average i.e. the market portfolio.

3.2. Calculation of share return by applying the CAPM model

What are the expected returns of the shares observed in late 2013 by applying the CAPM model? Below is a calculation example for the AD Plastik d.d. share, using an average rate of issued state bonds of the Republic of Croatia (Rf=5.77%) as a risk-free rate, CROBEX index market return (Rm=3.10%) and betas of AD Plastik d.d. shares (β=1.78).

$R_j = R_f + (R_m - R_f)^* \beta_j = 5.77\% + (3.10\% - 5.77\%) * 1.8534621 = 0.81\%$

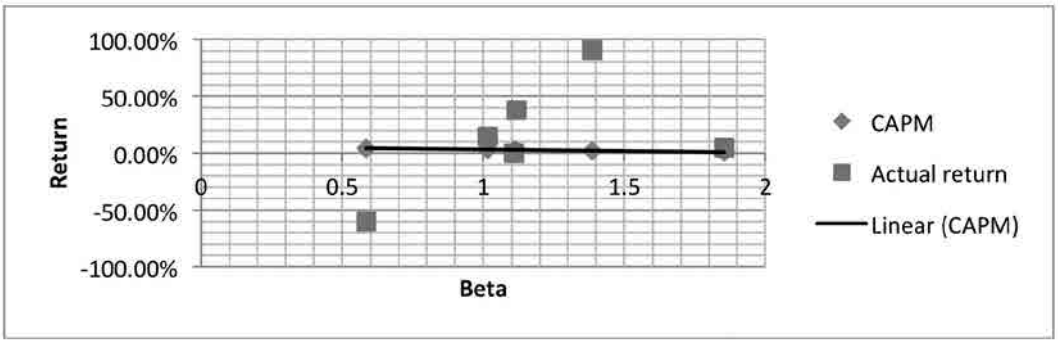
Results obtained under the CAPM model (table 6) do not show the expected link between the risk and the expected return. Obtained figures result from the risk premium (Rm – Rf) as long as the risk premium is negative, a higher beta index value decreases the return. The share with the highest beta i.e. ADPL-R-A yields the lowest return under the CAPM model (CROBEX 3.10% - int. bonds HR 5.77% = -2.67%).

Table 6 Calculation of share return by applying

Period	CROBEX	ADPL-R-A	ADRS-P-A	ATGR-R-A	ATPL-R-A	ERNT-R-A	DLKV-R-A
01.01.2008.	5,239.00	221.53	585.5	872.44	3,490.73	3,413.80	1,685.38
01.01.2009.	1,722.25	38.58	196.13	469.13	724.46	1,224.39	400.62
01.01.2010.	2,004.06	76.37	259.28	689.76	966.76	1,338.18	321.05
01.01.2011.	2,110.93	118.54	265.84	804.42	743.75	1,361.26	257.77
01.01.2012.	1,740.21	101.54	219.9	489	333.3	1,071.71	12.5
01.01.2013.	1,740.39	107.98	264.83	554.53	202.33	1,401.81	68.22
01.01.2014.	1,794.28	113.32	264.83	764.56	385.45	1,605.33	27.17
Beta index		**1.8534621**	**1.1105574**	**1.1192394**	**1.38548087**	**1.0160646**	**0.58566856**
CAPM		**0.81%**	**2.80%**	**2.78%**	**2.07%**	**3.05%**	**4.20%**

the CAPM model
Source: Author

Graph 3 The SML and a trend of share returns from the sample



Source: Author

The highest expected return of the DLKV-R-A share is higher than the market return by 1.10%, while having the lowest beta. Only one ERNT-R-A share with the beta close to 1 has the actual return (3.05%) equal to the market return (3.10%). ADRS-P-A, ATGR-R-A and ATPL-R-A shares with betas between 1.11 and 1.38 have returns similar to the market one, but theirs decrease with the beta increase.

The above graph 3 shows a dissipation of actual returns by using the SML equation in a linear trend.

The graph shows two overvalued shares with returns lower than those shown by trend. These shares are designated as DLKV-R-A and ADRS-P-A and follow the order of risk increase. All other shares are above the line, compliant with the SML model rules and belong to the category of undervalued shares.

The issue emerging in the application of the CAPM model on the Croatian capital market is a low CROBEX return and a high risk-free rate. Potential share index impacts and the connection between CROBEX and particular factors are shown in Table 7 below.

The following table shows that CROBEX is primarily affected by macroeconomic indicators: fall of gross domestic product, decreased personal consumption and increased foreign public debt, which results in stock non-liquidity and the too low trading volume. The connection between the trading volume and CROBEX is very strong (0.75) and positive.

Table 8 shows an average CROBEX volatility and a negative average return in the observed period, while almost all observed shares have above-average volatility. Four out of six shares have a negative average return. The lower the share volatility, the higher its return under the CAPM model.

Table 7 Factors affecting CROBEX

PERIOD	TRADING VOLUME	CROBEX	GDP HRK bn	PERSONAL CONSUMPTION HRK bn	UNEMPLOYMENT (rate %)	CORE INFLATION INDEKS	CONSUMER PRICE INDEXS 2010.=100	INDEX CCI*	INDEX CEI**	INDEX CSI***	GROSS FOREIGN PUBLIC DEBT in bn
31.12.2007	22.000.747.040	5.239	91,1	53,2	13,8	10,0	10,0	-21,0	-12,4	-22,8	34.824,0
31.12.2008	16.842.297.729	1.722,25	84,2	49,1	13,3	3,3	0,6	-40,8	-31,3	-35,8	41.643,8
31.12.2009	7.434.324.152	2.004,06	81,9	47,0	16,5	-3,4	0,5	-48,5	-35,2	-47,9	44.713,3
31.12.2010.	5.777.096.972	2.110,93	81,7	47,5	18,0	1,9	2,9	-40,0	-26,4	-47,8	46.385,8
31.12.2011	5.233.192.378	1.740,21	80,0	46,8	18,0	1,3	-0,1	-21,8	-5,9	-39,1	45.942,7
31.12.2012	2.914.904.102	1.740,39	79,4	45,8	20,1	4,1	4,2	-44,2	-31,7	-48,0	45.942,7
31.12.2013.	2.717.015.796	1.794,28	79,0	45,6	20,6	0,5	3,4	-33,8	-20,1	-41,1	45.864,5
TOTAL	62.919.578.169	16.351	577	335	120	18	22	-250	-163	-283	305.317
AVERAGE	8.988.511.167	2.336	82	48	17	3	3	-36	-23	-40	43.617
ST. DEVIATION	6.908.087.396,68	1.193,32	3,89	2,43	2,62	3,77	3,22	9,95	10,12	8,47	3.890,44
VARIATION COEFFICIENT	0,77	0,51	0,05	0,05	0,15	1,49	1,05	-0,28	-0,43	-0,21	0,09
CORRELATION COEFFICIENT	**0,75**		**0,91**	**0,90**	**-0,52**	**0,77**	**0,88**	**0,56**	**0,40**	**0,80**	**-0,90**

Source: Author[6]

Table 8 Volatility of CROBEX and selected shares

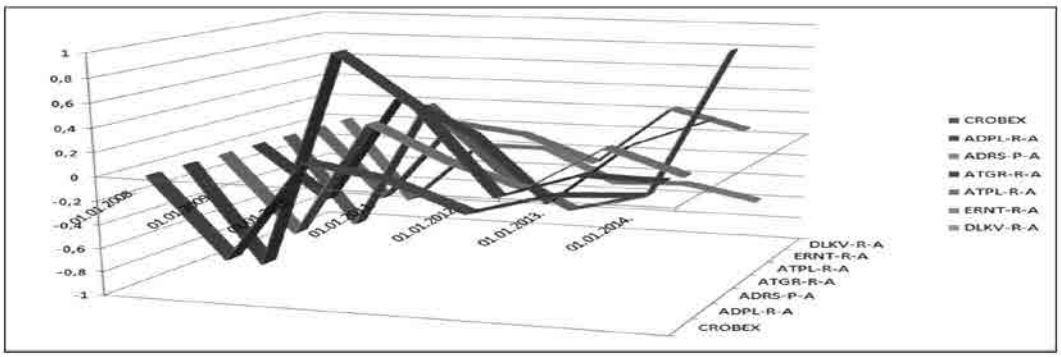
	CROBEX	ADPL-R-A	ADRS-P-A	ATGR-R-A	ATPL-R-A	ERNT-R-A	DLKV-R-A
1 January 2008							
1 January 2009	-67.13%	-82.58%	-0.66502	-0.46228	-0.79246	-0.64	-0.7623
1 January 2010	16.36%	97.95%	0.32198	0.470296	0.334456	0.09	-0.19862
1 January 2011	5.33%	55.22%	0.025301	0.166232	-0.23068	0.02	-0.1971
1 January 2012	-17.56%	-14.34%	-0.17281	-0.39211	-0.55187	-0.21	-0.49761
1 January 2013	0.01%	6.34%	0.20432	0.134008	-0.39295	0.31	-0.4732
1 January 2014	3.10%	0.0495	0.0000	0.3788	0.9051	0.1452	-0.6017
Variance	7.54%	31.62%	10.08%	12.72%	33.05%	9.46%	4.17%
St. deviation	0.274543	**56.23%**	**31.74%**	**35.66%**	**57.49%**	**30.75%**	**20.43%**
Average return	-9.98%	**11.26%**	**-4.77%**	**4.92%**	**-12.14%**	**-4.84%**	**-45.51%**
Correlation coef		**90.49%**	**96.06%**	**86.16%**	**66.17%**	**90.71%**	**78.72%**
CAPM		**0.81%**	**2.80%**	**2.78%**	**2.07%**	**3.05%**	**4.20%**

Source: Author

ADRS-P-A, ATGR-R-A and ATPL-R-A shares with an average volatility and a strong CROBEX correlation, regardless of their positive or negative average return, yield expected returns close to the market one.

It can be concluded from the above stated that the CAPM model rule, under which a higher return and a higher share value is expected from higher risk, cannot be applied to the Croatian market.

Graph 4 Volatility of CROBEX and selected shares



Source: Author

It is known that the share return is primarily affected by two factors which were studied some twenty years ago by Fama, E and French, K. i.e. that the company size and the M/B indicator of the market price/share book value ratio in small companies could result in high returns with a low M/B indicator. A large number of analyses and share evaluation indicators are being used today including the price and earnings ratio, earning per share, dividend growth rate etc. Further research conducted on developed markets showed the non-existence of any connection between the beta of share risk and return, which is the main constraint of the CAPM model. However, this model is being upgraded in practice "The Fama- French Three – Factor Model" (Brigham, Ehrhardt, 2005: 200).

The main issue emerging from the application of the CAPM model on the Croatian market is a negative risk premium i.e. low CROBEX return and a high risk-free rate, which is the consequence of macroeconomic indicators. The trading volume can be increased by listing new shares or increasing trade. However, limitations from the macroeconomic environment are present as well.

4. Interpretation of research findings

Research findings show that the expected returns calculated under the CAPM model are not in line with the model theory. CAPM is a model under which the capital investment risk premium depends on the correlation between the return on investment and the return on the entire capital market. The stock market reflects the expected future profit which depends on the overall state of economy. It implies that the expected return on the capital market should be higher than the risk-free rate. The market risk premium is an additional expected return which results from the acceptance of the capital market non-diversified risk. The risk exposure depends on the correlation between the share return and the change of the stock exchange index. Share prices which do not follow stock exchange index trends should have a lower degree of non-diversifiable risk, and their return is close to the risk-free rate. If a share is closely connected with market trends, it is more exposed to the non-diversifiable risk, so the return on such a share should, on average, be higher than the market return (Vukičević et al, 2010: 341-365).

CAPM findings show that the expected returns are relatively low. They range from a minimum of 0.81% to a maximum of 4.20%, which means that investing in shares listed on the Croatian capital market is not profitable.

Low expected returns are the result of CROBEX decreasing in the observed period from 5,239 points to 1,794.28 points or by 65.75%, the consequence of which are low expected share returns. Beta is very high, ranging from 0.58 to 1.85, which shows a high impact of the financial market risk on share return trends. Therefore, taking decreased CROBEX and beta results into consideration, the expected return under the CAPM model for the observed shares is very low. This results in a logical question of why an individual investor would invest in shares on the Croatian capital market if he/she can get a higher savings interest rate than an average rate of return on observed shares of 2.62%.

Insufficient stock trading volume results in a high CROBEX correlation. As a small number of shares is traded on the Croatian capital market, it is too small and shallow. Shares with the highest turnover are purposely excluded from the analysis (HT-R-A; INA-R-A). The trading volume and the CROBEX correlation show that bigger investors can affect the index value trends and market stock prices by their trading volumes. Furthermore, there is a very strong correlation between CROBEX and the Consumer Sentiment Index, which results from financial institutions and funds (pension) being the main investors instead of individual entities. Such investing structure results in a smaller trading volume on the Croatian capital market and increased bank savings. This shows that the share return on the Croatian capital market is adversely affected by numerous factors which are mutually chain linked and multiplied, and not considered under the CAPM model as it is based on the efficient capital market assumptions.

5. Conclusion

The application of the CAPM model on the selected shares listed on the Zagreb Stock Exchange in the period from 2008 until 2014, excluding from the analysis those shares with the highest turnover, shows that this model is inapplicable on the Croatian capital market as it is based on the efficient capital market assumptions. Returns under the CAPM model significantly differ from actual share returns, which are caused by a low CROBEX return and a high risk-free rate. The Croatian capital market is characterized by a small number of listed shares, a small trading volume and a high impact of systematic risk on share return trends. As the low share return under the CAPM model misvalues shares, the share price trend on the Croatian capital market suggests that the share valuation is affected by other factors which are obviously visible to the investment public. The research of some factors indicates the strongest positive correlation between CROBEX and gross domestic product, personal consumption, consumer sentiment index and trading volume. These factors are intertwined and multiplicative. They are not considered under the CAPM model as its application is based on the efficient capital market assumptions. As the market includes all information when forming the share price, the prices of selected shares are volatile regardless of the rise and fall of CROBEX. In most selected shares cases (5 out of 6), the return under the CAPM model is significantly lower than the CROBEX return as the CAPM model does not include all the factors which are important in determining the CROBEX return. A small number of traded shares, small trading volume, a high impact of systematic risk, high CROBEX volatility, average 2.62% return under the CAPM model and other unfavorable factors have resulted in a negative attitude of individual investors in the observed period resulting in their capital being directed into bank savings accounts and some other investments instead of investing it in shares on the Croatian capital market. The CAPM theory of a higher risk resulting in expected higher returns and a higher share value cannot be applied to the Croatian capital market.

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(Endnotes)

1 List of international government bonds issued by the Republic of Croatia is available at http://www.mfin.hr/hr/obveznice-meduna-rodne

2 Trading on Zagreb Stock Exchange from 2007 to 2014 available at http://www.zse.hr/default.aspx?id=26521

3 There are MS Excel functions and VBA functions. Beta function has been calculated by using MS Excel Macros (VBA). MS Excel functions macros (VBA) can be used, new functions of MS Excel could be done with VBA or only VBA macros could be used.

4 Covariance is calculated by first calculating the average market and share returns, followed by calculating the difference between the actual and average returns. Having set separate differences for the market and the share respectively, differences are multiplied.

5 The variance is calculated by taking a difference between the actual and average return following the calculation of a mean return and squaring the obtained difference. The sum of squared differences is a total variance which must be divided by a number of returns to obtain the result i.e. a mean variance.

6 According to Bulletin 206, Statistical Review, longer time series - http://www.hnb.hr/ and http://zse.hr/default.aspx?id=178 CCI* - Consumer Confidences Index, CEI** - Consumer Expectations Index, CSI*** - Consumer Sentiment Index

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Primjena modela vrednovanja kapitalne imovine na hrvatskom tržištu kapitala

Sažetak

Model vrednovanja kapitalne imovine (Capital Asset Pricing Model - CAPM) opisuje odnos između rizika, očekivanog prinosa i vrednovanja vrijednosnica. Teorijski i praktični značaj ovoga modela je neupitan, ali u idealnim uvjetima. Teoriju koriste brojni znanstvenici i ona potvrđuje linearni odnos između rizika i povrata predviđen CAPM modelom koji pokazuje da veća izloženost riziku donosi veći prinos. Međutim, empirijska istraživanja pokazala su da postoje brojni čimbenici koji u CAPM modelu nisu uzeti u obzir jer se taj model temelji na pretpostavkama koje u stvarnosti postoje, ali su nevidljive.

Zbog svega navedenog, vrlo je zanimljivo istraživati primjenu CAPM modela na odabranim dionicama na hrvatskom tržištu kapitala i analizirati mogućnosti njegove primjene u prepoznavanju pogrešno vrednovanih dionica. Promjene cijena dionica na hrvatskomu tržištu kapitala ukazuju na to da postoje nepoznati čimbenici koji utječu na vrednovanje dionica. Nema sumnje da fundamentalna analiza nije dovoljna za procjenu stvarne vrijednosti dionica s obzirom na različite nevidljive čimbenike i sve dostupne informacije koje također utječu na njihovu vrijednost.

Ključne riječi: CAPM model, dionica, prinos, rizik, koeficijent beta