

RESEARCH OF INVESTMENT RISK USING BETA COEFFICIENT

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Abstract

Beta coefficient is a measure of the investment or asset's systematic risk in relation to the overall stock market. It enables comparison of level of the risk of investments or assets with different characteristics. Before interpretation of its results it is necessary to understand the specificity of this coefficient, the conditions of the capital market, as well as investments that are being analysed. This paper analyses the applicability of beta in determining the risks of, by the characteristics, different types of investments and presents the results of the research of level of the risk and return of investments in capital projects compared to investment in a portfolio of selected stocks on the Croatian capital market. Given the above the aim of this work was to determine the usefulness of the beta coefficient and in the different types of investments risk analysis. Analysing the results of the research it has been found that, in the period 2003-2010, according to analyst projections, the investments in capital projects were, in average, less risky compared to investing in a portfolio of selected stocks. It was also found that the expected return on investment in a portfolio of selected stocks is 1.4 times greater than the average expected return on investment in capital projects (measured by the CAPM model). By adjustment of the beta calculation model to the characteristics of the market it was used on, it was found that beta coefficient is a useful measure in the risk analysis and can be used to compare riskiness of, by characteristics, different types of investments.

JEL Classification: G11

Keywords: beta coefficient, risk assessment, capital market, decision-making.

1. INTRODUCTION

Assessment of justification of capital investment is important element of decision making process in any capital investment projects. The basic component of assessment of capital investments is risk assessment. If the investor does not have information about the level of risk of the project, he will not be able to determine and evaluate all its characteristics. When assessing the risk level, the key question is the size of minimum expected profit that investor expects to realize when it depends on the investment risk and investors preferences towards the risk. When conducting the investment risk assessment and presenting expected profitability, ratio of achievable profit and possible risk might not be satisfactory, and more exact estimations of the level of capital risks in all sectors might be necessary. At the micro level, in manufacturing sector, where uncertainty of business success is highly expressed, additional need for a comprehensive review of the problems in investment decisions making, as well as the elaboration of risk assessment techniques applicable in practice, is additionally stimulated. In fact, projects in the domain of manufacturing sector require a detailed and comprehensive analysis of risk factors and evaluation of investments due to the complex manufacturing process, the length of the production cycle, market conditions, specific (hardly measurable) risks, "What makes investments interesting and exciting is that you have lots of noise in the data." (SR Vishwanath, 2009:98). When assessing the risk, it is necessary to evaluate the relevance of certain information and to determine the risk with greater precision. In Croatia, a number of academic staff is engaged in the work related to the risk assessment. Previous studies covered theoretical background of the problems, while the practical problems were addressed only in certain cases. According to the available data, studies of risk investment in the medium and large agricultural business, which have higher level of production organization and business management, addressed in this paper, have not been yet implemented in more comprehensive format. The main objective of this paper is to present the results of research of the beta as a measure of systematic risk; to analyse applicability of this coefficient when determining the risk of investment and to implementation risk analysis of different types of investments. One of the focuses was to determine level of risk of investment in relation to overall capital market risk (for research purposes representative portfolio of securities was selected, both in regard to the period of research and securities market). This paper aims to stimulate further research, to present new results in order to introduce new knowledge, as well as strengthen decision making processes in capital investment areas. Next chapter of this paper

will presented methods of beta coefficient, specificity of its calculations and the assessment of its applicability in regard to the characteristics of the Croatian capital market. Third part of the paper will introduce the scope of research, describe the sample and the methods used in the research. Fourth section will presents the results of research which will be used as base for the conclusions addressed in the last part of the paper.

2. BETA COEFFICIENT (β)

Beta coefficient (β) measures volatility of expected result of specific investments (either in the real or in the financial assets) in relation to the efficiency of the overall capital market. Therefore it is measure of systematic risk of financial assets, investment project, the business entity or any other type of property in a diversified model.

Beta coefficient of investment projects is determined by calculating the standard deviation of the internal rate of return and the profitability of market index and their correlation.

Equation 1: The formula for calculation of beta coefficient

$$\beta_{P,T} = \frac{\sigma_P}{\sigma_T} r_{P,T}$$

where:

σ_P = standard deviation of internal rate of return

σ_T = standard deviation of profitability of market

$r_{P,T}$ = correlation coefficient of project profitability and profitability

Value of the beta coefficient of the project can range between 0 and 4. The higher coefficient inciates proportionally higher risk in cash flows of the investment project. Risk free asset has a coefficient 0 since its covariance with the market portfolio is 0 (Gossy, 2008:35). If the result of the beta coefficient is 1, it means that the systemic risk of the project is equal to the risk that investor would take over if he invests its assets in a diversified portfolio of securities in the referenced market. This coefficient is important because it allows comparison of levels of the risk of investment projects by the size of the investment, the length of the economic life span of the project and the level of return.

„Beta is important for the investment manager because it can be used to:

- select individual stocks for investment,
- construct portfolios of financial assets with desired levels of risk and return, and
- evaluate the performance of portfolio managers.“ (C.-F. Lee et al., 2010:99)

In this study, calculation of beta includes an analysis of a selected portfolio of stocks and data on actual stock prices, for a period equal to the period of the economic life span of the projects in the sample.

When calculating beta coefficient of new capital investment (especially in the case of “start-up” companies and new projects that are not comparable with existing business activities of investors), and if market or the historical (accounting) data are not available, problem of determination of the value of the market is specifically emphasized. In this case, the calculation of the coefficient is based on the projected financial reports and the expected cash flows. It is extremely important that the project is based on realistic input data. When calculating beta coefficient some concerns regarding the representative indicators of the systematic risk of diversified portfolio of securities can arise. Namely, risk assessment is based on actual data of previous period and main condition is development of capital markets (Karić, 1995:95). When choosing the index that is not enough representative and diversified, projections may give us inaccurate information regarding the level of risk of investing in a project in relation to the level of risk of investing in a diversified portfolio of securities. When analysing beta coefficient of investment projects in this study, profitability of the market was based on the profitability of the portfolio of 20 stocks on Zagreb Stock Exchange that are actively being traded since 2000 (some of these stocks are part of index CROBEX). In year 2000, 45 shares were quoted on the Zagreb Stock Exchange, of which 24 are still active.

Table 16: Preview of the value of created market portfolio of securities and dividends per stock

(value in HRK)

Year	Value of portfolio	Paid dividends	% changes	Cash flow	Annual return on investment	Cumulative Cash Flow
31.12.2000.	8.332			-8.332,37		
31.12.2001.	13.007	212,42	56%	212,42	2,55%	-8.119,95
31.12.2002.	13.009	212,42	0%	212,42	2,55%	-7.907,53
31.12.2003.	18.842	212,42	45%	212,42	2,55%	-7.695,11
31.12.2004.	24.364	212,42	29%	212,42	2,55%	-7.482,69
31.12.2005.	30.972	278,00	27%	278,00	3,34%	-7.204,69
31.12.2006.	48.100	237,00	55%	237,00	2,84%	-6.967,69
31.12.2007.	70.592	202,00	47%	202,00	2,42%	-6.765,69
31.12.2008.	23.004	18,00	-67%	18,00	0,22%	-6.747,69
31.12.2009.	29.378	354,80	28%	354,80	4,26%	-6.392,89
31.12.2010.	27.800	184,69	-5%	27.984,34	335,85%	21.591,45

Referenced ten year period is equivalent to the period of the economic life span of the projects from the sample. Composition of the market portfolio is presented in the Annex 1. Investment projects are mainly related to a longer time period in which is likely for the value of beta coefficient to change. In the initial period projects might have a high beta coefficient, but after the launch, when the realisation of the project is not stabile, decrease of risk level is possible and it is likely that risk will be decreased, and therefore the beta coefficient as well. Also, during the economic lifetime of the project, some changes of economic cycles can occur (periods of expansion or contraction), which will also affect the level of risk of the project in a specific year, compared to the year in which the investment is analysed. (Karić, 2006:20) Therefore, use of same value of the beta coefficient during the entire economic life of the project can results with projections which may differ from the actual results. Also possible changes in the business activities of the company, resulting in improving profitability, efficiency and profitability, are not foreseen by beta coefficient.

When calculating beta coefficient for project investments calculations should be made on the basis of the expected net cash flows. Rreliability of beta coefficient will depend on the quality of investment proposals. In general, when calculating beta coefficient following problems can occur (SR Vishwanath, 2009: 98):

- exact (present value) of the coefficient is never used
- in CAPM calculation estimation of beta coefficient is used, which is calculated with discrepancies of the actual values
- measurement discrepancy in the calculation of the coefficient will have influence on non-objective assesment (smaller risk in ratio where beta coefficient is lower)

Considering all above stated, it is necessary to interpret this coefficient with care, taking into account the all circumstances (characteristics of the project activities and characteristics of capital markets compared to the project).

3. EMPIRICAL STUDY OF INVESTMENT

3.1. The selection of sample, method and the implementation of research process

The research was conducted on a sample of medium and large privately owned companies that, in the period of the 2003 to 2010, implemented capital investments, with previously prepared investment studies. Research includes projects that are planned and / or implemented within the specified time period. The sample included a total of 49 investment proposals initiated by 38 economic entities operating in the eastern Croatian, where some entities in the reference period conducted a number of different investments. Total value of all investments included in the study, according to the presented investment projects amounts to 986 mln. HRK (figure includes the value of investments in fixed assets and permanent working capital, without value added tax). Also, minimum acceptable rate of return on investment is defined in a portfolio of securities selected on the Croatian capital market, which includes 20 stocks that are active in the analysed period, without significant interruptions on the Zagreb Stock Exchange. Analyses were carried out with statistical and mathematical calculations and methods of calculating the beta coefficient. Beta coefficient is determined for each project in the sample.

3.2. Analysis of the results of applicability of beta coefficient

This study analysed the level of risk of projects in the sample in relation to the risk of a portfolio of selected securities. The aim of this study was to determine whether the beta coefficient is applicable measure for comparison of the risk of

project with risk of capital markets and whether it is applicable measures for comparison of project with different characteristics of the investment.

Table 2: Beta coefficient result distribution

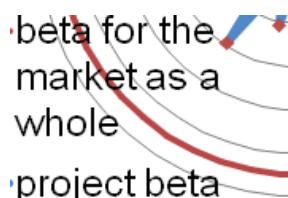
Distribution of the results of beta calculation	Distribution of the results in the sample	Share of the category in the sample
< 0,10	6	12%
0,11-0,20	19	39%
0,21-0,30	13	27%
0,31-0,40	6	12%
>0,40	5	10%

Source: calculation of the author

According to the research results, the most significant part of projects from the sample had lower level of risk than market risk, which is defined with beta coefficient 1. The largest share of projects in the sample, 78% had beta coefficient less than 0,30.

For only few projects beta coefficient was bigger than 1, meaning - the risk is higher than average risk of the entire capital market (where, for the purposes of research, selected portfolio of securities, presented in the previous section, is considered to be representative for securities market and period reviewed). According to the research, form of investment also has a significant impact on the level of risk. In the case of high investments in real estate, with a high residual value in the final year of economic flows, it is more possible that beta coefficient will be high (given that the standard deviation will record a higher value). On the other hand, when investing in equipment (regardless of the amount of investments), the most significant part of the value of the equipment is being reduced by amortisation, so in the final year of the project, equipment will not record high residual value. As the result of that, annual return over the final year does not differ significantly in comparison to other years of economic life. That will have an impact on the standard deviation and beta coefficient.

Graphic presentation 1: Comparison of beta coefficient from all projects in the sample in regard to the beta coefficient of capital market



Source: calculation of the author

In this research projects are also categorized according to sectors in which they invest. It was determined that average cost of invested capital in the sample of non-agricultural sector is 4,4% lower when compared to the projects in the sample of non-agricultural sector. The average price of invested capital in the sample of non-agricultural sector is 12,42% and average price of invested capital in the sample of projects from agricultural sector is 16,57%. Beta coefficient showed higher risk in the projects in the agricultural sector. Specifically, average beta coefficient in agricultural sector is 0,36 and in sample of non-agricultural sector is 0,25.

Table 3: Distribution of the results of the calculation of capital cost and beta coefficient in agricultural and non-agricultural sector

Price of the investment capital	Distribution of results in agricultural sector	Distribution of results in non-agricultural sector
< 10%	47%	59%
10% - 20%	44%	41%
> 20%	9%	0%
Average beta coefficient	0,36	0,25

In a survey conducted on the projects in agricultural sector, the average cost of invested capital of all analysed projects was 16,57%, and in relation to all projects in sample it was 15.13%. Annual return for observed portfolio of securities, for the period 2000 – 2010, was on the level of 36%

These data, along with other results, are indicators of a larger range of possible calculations of the beta coefficient and its higher value in the case of projects in agriculture sector, compared to projects that run in non-agricultural sector. This

analysis showed that beta coefficient enables comparison of the risk level of projects that run in different industries, that are different in investment sizes, with level of return and other characteristics.

The characteristics of the securities market in the period of calculating the beta coefficients are:

- the volatility of stock prices on Croatian capital market is significant,
- stocks take 80% of the securities in the domestic market but the market turnover is significantly reduced since 2008, although with a few exceptions, the liquidity of the shares is generally small. (Ivanov, 2009:1).
- The shares do not bring income like in 2008 and the number of participants on the domestic market decreased significantly. Size of capital market in Croatia is insignificant when compared to the international market. This research is limited just to the Croatian market assuming that domestic investors will not invest in foreign markets.
- calculation ratio included historical indicators of income on the capital market on the one hand and predictions of the future cash flows of investment projects
- Projects do not anticipate recession nor any possibility of decrease of the income. In almost all projects the lowest possible level of income is defined with income in the first year of the economic life of the project. From first year of the project, income and profitability are maintained at the same level, or are increased at a defined rate, which can be characterized as unrealistic projections.

4. CONCLUSION

Beta coefficient is most commonly used measure of systematic risk. This coefficient is important because it allows comparison of project risks levels between the projects with different investment sizes, different length of the economic life span and the level of return. Therefore it is a valuable risk measure that investors should take into account in the process of making a decision regarding the capital investments. Investors often take decisions on investments without sufficient information about the level of risks. Due to that, in the process of assessment of the acceptability of a specific investment it is necessary to conduct a risk analysis, us-

ing, among other methods, calculation of the beta coefficient. With this study, and results presented in this paper, beta coefficient is identified as measure applicable for determination and comparison of the level of risk of investments in capital projects in relation to the overall capital market. Beta coefficient enables the risk level comparison according to key characteristics of different projects. However, when analysing and interpreting beta coefficient all conditions should be taken into account. Possible concerns and restrictions that can occur in calculation of beta coefficient are partially listed in this paper. Therefore, calculation methods should be additionally analysed in order to determine input values specific for the market for which the analysis is conducted. Although beta coefficient is a useful measure in assessing the justification of investment, this coefficient should not be observed individually. It should be interpreted as one of the measures in the framework of a comprehensive analysis of investment risk assessment.

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