CONSTRUCTION OF A FINANCIAL PORTFOLIO ON THE BUCHAREST STOCK EXCHANGE USING RISK/RETURN ANALYSIS

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ABSTRACT: The purpose of the paper is to present the advantages of the risk/return analysis when creating an optimum financial portfolio, with minimum risk, without sacrificing return. Having in consideration a holding period of three months (February-April 2014) and the stocks included in the Bucharest Stock Exchange index BET, we show how can be minimized the risk associated to the portfolio and which is the minimum variance point for a two titles portfolio.

Keywords: portfolio management, risk, return, BSE

JEL Codes: G10, G11

Introduction

At the point of making an investment decision, each investor confront itself with a serious problem: how to choose between a large number of securities and how much to invest in each of them. The theoretical background shows us that there are several methods of finding the optimum portfolio, as well as they are formulated in the literature some strategies of portfolio management, meant to provide the best risk/return ratio.

In this sense, it becomes useful to make an analysis and a selection of financial instruments meant to be introduced in the portfolio, prior to the creation of the portfolio. This analysis must take into consideration the risk/return associated with each individual selected stock. The objective of our study is to show the applicability of Markowitz theory for a two titles portfolio, with application on the Romanian capital market, on Bucharest Stock Exchange. We will select the two titles from a range of ten securities most traded on Bucharest Stock Exchange and we will build a two title minimum variance portfolio according to Markowitz theory.

The remainder of the paper is organized as follows. Section 2 reviews the theoretical background related to the proper management of a financial portfolio. Section 3 provides the empirical analysis that has been performed in order to achieve an optimum two titles portfolio. Section 4 concludes.

Theoretical background

The analysis and selection of portfolios has been subject of debate for a a very long period of time. In the literature we have traditional as well as modern methods of portfolio construction and selection developed once with the introduction of the concept of modern portfolio theory by Markowitz in 1952. It was Markowitz who had the brilliant idea that the best method of valuation of a security is represented by its mean, standard deviation and correlation with other securities in the portfolio and preferred to ignore the other financial information provided by the firm (capital structure, earnings etc.) He advised investors to rather seek the overall risk/return characteristics of

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a portfolio instead of focusing on compiling portfolios composed from attractive individual stocks. Rubinstein (2002) stated that the most important contribution of Markowitz' work for the investment decisions was to show that it is not the individual risk of a security the most important to be considered, but the contribution that this security makes to the variance of its entire portfolio, the covariance with the other portfolio components. After 1952, Sharpe (1964), Litner (1965), Mossin (1966) and Ross (1976) added new dimensions to his work. Since then, a number of theoretical and empirical papers have been formulated against it. One of the most common critiques related with Markowitz approach had to do with the complexity of his method, which grows with the increase in the number of titles in the portfolio. However, this problem has been solved quite rapidly, given the numerous software applications that makes easier the computation process, the mean-variance optimization and include portfolio analysis functions. Other studies (McLeod, 1998) mention the fact that Markowitz portfolios are unrealistic portfolios, which are not properly diversified. Moreover, there are some papers that bring evidence that external events, such as the financial crisis could interfere with the correlations between assets, or that returns do not have a Gaussian distribution. All these criticism remain of great interest nowadays, in the attempt of validating or rejecting the Markowitz hypotheses.

There is a significant body of literature that has focused on the application of Markowitz portfolio model on the domestic stock market in order to check its availability, having in consideration the current real market conditions. Some recent studies have proved the efficiency of these models including on the Romanian capital market case (Anghelache and Anghelache, 2014; Viju et al., 2004; Badau, 2004). Others have tried to reach much further, with the aim of optimizing the input parameters of the model in order to increase the average return of the minimum risk portfolios and reduce the risk in an even more effective way than the classical model does (Armeanu and Bălu, 2009).

From a traditional approach, an efficient portfolio is based on satisfying the needs of its holder and is constructed by considering at least the following elements: the objectives of a portfolio (different kind of desired revenue - present or regular, the safety of a portfolio, revenue income, accumulated growth, capital appreciation, provision for future) and the composition of a portfolio, considering the liquidity and time horizon. The modern approach focuses on equity base portfolio and does not focus in general on the needs of the investor, but instead on the risk and return analysis, that must be done in order to minimize risk and maximize return (Babu, 2007).

The increasing liquidity of the financial instruments on the stock market make the portfolio diversification more approachable, taking into consideration the level of risk that the investor is willing to take.

The expected return for a portfolio is given by the average of expected returns for the individually assets. Consequently, the expected return rate will be located between the highest and the lowest individual return rate of the titles chosen in the portfolio. For a two titles portfolio, the expected return will be given by:

$$E(R_p) = x * E(R_i) + y * E(R_j) \quad (1.1)$$

where:

$E(R_i)$, $E(R_j)$ - expected returns for the two titles, i and j;

x,y – the weights invested the total invested capital

The risk of the portfolio is therefore a combination of the individual risks. This combination results in the lowest possible risk level for the rate of expected return. The investments in a minimum variance portfolio are individually riskier than the portfolio as a whole. Volatility is used as a replacement for risk, and in which less variance in volatility correlates to less risk in an investment.

According to Stancu and Stancu (2012), for a two titles portfolio, the variance in the expected return of the portfolio will be given by:

$$\sigma^2{}_p = x^2\sigma_i^2 + y^2\sigma_j^2 + 2xy\sigma_{ij} \tag{1.2}$$

where:

σ^2_i, σ^2_j – the dispersion of the expected return for titles i and j;

σ_{ij} – covariance between the expected returns for titles i and j.

This combination depends consequently on the level of individual risk, of the weights of the titles in the portfolio, but also on the size and sense of the covariance σ_{ij} between these returns:

$$\square_{ij} = \square_{ij} \cdot \square_i \cdot \square_j \tag{1.3}$$

A correlation coefficient that equals 1 leads to the highest degree of risk of the portfolio. This risk cannot be managed in a positive way by changing the weights of the titles. A relative low correlation coefficient ($o < \square_{ij} < 0{,}5$) leads to an improvement of the risk of the portfolio. A correlation of 0 between the returns of the titles leads to lowering the risk of the portfolio with 50 %. Moreover, the perfect negative correlation ($\square_{ij} = -1$)) can lead to the complete elimination of the risk. Although, the last two situations are less encountered on the capital market. The most often seen are positively and low intensity correlations. On these types of correlations there are two possible ways of acting:

- Minimum variance portfolio (MVP), for the risk averse investors
- Efficient portfolios, that for a given level of standard deviation, will generate the highest return.

The expected return of the portfolio will change accordingly with the weights of the titles x and y. The risk of the portfolio will change both with the changes in the weights of the titles, and in function of the covariance (correlation coefficient) between expected returns of the titles. The change is not linear and assumes an optimum point known as minimum variance point (MVP).

$$d\sigma_p^2/dx = 2x(\sigma_i^2 + \sigma_j^2 - 2\square_{ij}) + 2(\square_{ij} - \sigma_j^2) \tag{1.4}$$

This point is possible for the optimum weight of the first title:

$$x^* = \frac{\sigma_j^2 - \sigma_{ij}}{\sigma_i^2 + \sigma_j^2 - 2\sigma_{ij}} \tag{1.5}$$

Empirical approach

The scope of our empirical approach is to create a portfolio of two titles, following the minimum variance portfolio theory. The initial sum for the creation of the portfolio is 10000 Ron, and the analysis period is of 3 months (31.01.2014-31.04.2014). We were limited in our time horizon by the lack of availability of public data and of the fact that the market index (BET-C) was replaced on 23rd June 2014 with BET-Plus. The equities subject of our analysis are representative, since they are part of the BET index, the first index that was developed by Bucharest Stock Exchange. BET is a free float weighted capitalization index of the most liquid ten companies listed on the BSE market. However, the market portfolio theory promoted by Markowitz could be applied to any selection of equities. And a larger time horizon of analysis would certainly bring more robust results.

As far as concerns our initial portfolio structure, it is related with the full duplication strategy which implies that we should choose in the portfolio all the equities listed in the structure of an index. However, the full duplication strategy is not followed completely, since we did not weight the titles with their market capitalization (we invest in all titles in equal proportion, the same value, of 10 % of the initial portfolio).

Consequently, we have established that the initial portfolio, subject of our analysis, will comprise equities belonging to ten companies listed on Bucharest Stock Exchange, part of the BET index (at the end of January 2014). The selected equities, traded on the Regular market (REGS), are the following ones:

- BANCA TRANSILVANIA(TLV);
- SC FONDUL PROPRIETATEA SA – BUCURESTI (FP);
- S.N.G.N. ROMGAZ S.A. (SNG);
- OMV PETROM S.A. (SNP);
- BRD-GROUPE SOCIETE GENERALE S.A.(BRD);
- S.N.T.G.N. TRANSGAZ S.A. (TGN);
- C.N.T.E.E. TRANSELECTRICA(TEL);
- S.N. NUCLEARELECTRICA S.A. (SNN);
- SC BURSA DE VALORI BUCURESTI SA (BVB);
- S.S.I.F. BROKER S.A. (BRK).

For each stock, part of the portfolio, there has been analysed:

- The associated risk, through the variance of each component stock;
- The volatility of the title, through the computation of β;
- The intensity of the correlation of the returns provided by each title and the market return, through the correlation coefficient.

We have reconstructed the portfolio, maintaining only two different types of equities, which have the lowest risk/return ratio and we have computed for these two titles the optimum minimum variance point, following Markowitz portfolio theory for two titles.

In order to establish separately the risk/return associated with the equities, we have considered the weekly closing prices, in the period 31st January 2014- 30th of June 2014. The return rate for all companies is computed below:

$$R_i = \left(\frac{p_1 - p_0}{p_0}\right) \cdot 100 \quad (1.6)$$

where: P_0 = closing price for the beginning of the period (week)

P_1 = closing price at the end of the period (week)

Weekly return rates as well as the average return rate for all selected companies are presented below (Table no.1):

Table no. 1

Weekly return rates and average returns for the selected companies

Date	Weekly return rate (Ri)									
	TLV	***FP***	***SNG***	***SNP***	***BRD***	***TGN***	***TEL***	***SNN***	***BVB***	***BRK***
03.02.2014	-1,16	1,96	-1,87	-1,12	-1,01	-1,36	-1,32	-0,98	-5,47	-2,48
10.02.2014	-4,06	-2,10	-0,45	-0,81	0,00	0,52	1,88	-6,14	1,62	3,67
17.02.2014	6,44	0,61	0,52	-0,88	-0,68	1,21	2,70	-9,28	-2,20	-3,40
24.02.2014	0,92	-0,85	2,09	-0,61	1,26	4,78	2,37	5,23	0,17	-2,77
03.03.2014	-6,45	-3,19	-3,73	-5,69	-2,82	-2,82	-5,08	-2,76	-6,57	-4,31
10.03.2014	3,90	2,79	1,23	1,04	0,58	2,13	3,63	2,39	5,56	1,45
17.03.2014	-1,94	-2,10	1,82	-0,23	-4,28	0,18	-0,96	0,11	-3,96	-6,50

24.03.2014	2,34	-0,44	-0,96	0,53	0,24	1,33	-0,32	-2,66	-1,90	-0,76
31.03.2014	0,94	5,13	-0,54	-2,69	-1,20	0,31	8,32	6,83	7,15	-1,79
07.04.2014	4,35	-1,20	2,97	4,22	2,44	1,28	0,48	-2,13	-0,24	0,52
14.04.2014	-0,56	-1,71	-1,53	-0,67	-2,80	3,29	7,29	0,22	0,42	-5,36
22.04.2014	0,56	0,31	3,05	2,83	2,27	0,05	4,14	3,26	0,62	5,67
28.04.2014	-3,33	-5,50	-0,09	-2,53	-1,80	-2,08	-4,46	-0,53	-1,69	-2,68
Average return rate	**0,15**	**-0,48**	**0,19**	**-0,51**	**-0,60**	**0,68**	**1,44**	**-0,50**	**-0,50**	**-1,44**

Source: realized by author, own computation

The next step was to compute the weighted average return (expected return) for the portfolio, taken into account all obtained returns and having in consideration that each title accounts in a similar proportion to the portfolio. We have obtained a value of -0,16:

$$\overline{R_i} = \frac{\sum_{i=1}^{n} Ri}{no.comp.} \quad (1.7)$$

where:
Ri - average return for each company
no.comp – number of selected companies

Then we proceeded on tracking the evolution of the stock market, by looking at the BET-C index, index that has into its composition all equities listed on BSE, on the first and second tier, less the financial investment companies (SIF). We took into consideration also the weekly values registered by BET-C and we have computed the average return of the market, as well as the dispersion and standard deviation, as measure of the risk. The expected return (E(R)) of the market in the following period is -0.26 % ± 1.61 % ={-1.97;1.45}(Table no.2).

Table no.2

Dynamics of BET-C index

Date	**BET-C**	**Market return rate (R_M)**	$R_M - \overline{R_M}$	$(R_M - \overline{R_M})^2$
03.02.2014	3.317,87	-0,88	-0,62	0,38
10.02.2014	3.280,53	-1,13	-0,86	0,75
17.02.2014	3.271,21	-0,28	-0,02	0,00
24.02.2014	3.284,12	0,39	0,66	0,43
03.03.2014	3.160,48	-3,76	-3,50	12,28
10.03.2014	3.211,61	1,62	1,88	3,53
17.03.2014	3.181,45	-0,94	-0,68	0,46

24.03.2014	3.175,04	-0,20	0,06	0,00
31.03.2014	3.201,69	0,84	1,10	1,21
07.04.2014	3.269,30	2,11	2,37	5,63
14.04.2014	3.238,32	-0,95	-0,69	0,47
22.04.2014	3.307,05	2,12	2,38	5,68
28.04.2014	3.229,76	-2,34	-2,08	4,31
Estimated average return rate $\overline{R_M}$		**-0,26**		**35,13**

$\overline{R_M}$ = -0.26

$$\sigma_p^2 = \sigma_p^2 = \frac{\sum \left(R_M - \overline{R_M}\right)^2}{13-1} = \frac{35,13}{12} = 2,93$$

$$\sigma_p = \sqrt{\sigma^2{}_p} = \sqrt{2,93} = 1,71 \text{ (total risk)}$$

Source: realized by author, own computation

Afterwards we have proceedeed at calculating the risk, the volatility of the selected shares, having in consideration the weekly closing values. The risk of the investment is represented by the possibility that the investment's actual return will be different from the one expected due to the anticipated and unticipated financial and economic changes. The risk is usually measured by calculating the standard deviation of the returns from the average return. A high standard deviation is associated with a high degree of risk.

The risk of return of a financial instrument is normally divided in two:

a) a part generated by the influence of the stock market, part which determine the systematic risk, undiversifiable, called market risk;
b) a part generated by the influence of the characteristics specific to each financial instrument, called specific risk, unsystematic and diversifiable.

One measure of the systematic risk is given by the volatility coefficient of a share, β, which expresses the marginal variation of the return of the financial instrument in relation to the market return.

In the following table (Table no.3), we have calculated the risk and volatility associated with the selected shares. Then we have measured the intensity of the correlation between the returns provided by each title and the market return.

$$\beta_i = \frac{\sigma_{iM}}{\sigma^2{}_M} \tag{1.8}$$

$$\sigma_{iM} = \frac{\sum_{t=1}^{T}(R_{it} - \overline{R}_i)(R_{Mt} - \overline{R_M})}{T-1} \tag{1.9}$$

$$\sigma^2{}_M = \frac{\sum_{t=1}^{T}(R_{Mt} - \overline{R_M})^2}{T-1} \tag{1.10}$$

$$\rho_{iM} = \frac{\sigma_{iM}}{\sigma_i * \sigma_M} \tag{1.11}$$

Table no.3

Volatility and correlation coefficients for the portfolio components

	β_i	ρ_{iM}
TLV	1,19	0,75
FP	0,72	0,68
SNG	0,37	0,77
SNP	0,91	0,84
BRD	0,66	0,75
TGN	0,49	0,53
TEL	1,07	0,60
SNN	0,74	0,38
BVB	1,07	0,62
BRK	0,87	0,56

Source: realized by author, own computation

From the above table, we can see that the most volatile stocks are TLV, TEL and BVB, while the least volatile stocks in comparison with the index are SNG and TGN. The highest degree of dependency of the stocks to the stock index is registered in the case of SNP and SNG.

In order to apply the MVP for two titles, we have chosen two titles that have the minimum risk/return ratio. Therefore, we have:

Table no. 4

Risk/return ration for the portfolio components

	Risk	**Return**	**Risk/Return ratio**
TLV	13,12	0,15	87,47
FP	7,49	-0,48	-15,60
SNG	4,02	0,19	21,16
SNP	6,12	-0,51	-12,00
BRD	4,06	-0,60	-6,77
TGN	4,3	0,68	6,32
TEL	16,39	1,44	11,38
SNN	19,29	-0,50	-38,58
BVB	15,18	-0,50	-30,36
BRK	12,24	-1,44	-8,50

Source: realized by author, own computation

Having in consideration the computed risk/return ratio, we have chosen the following two equities to be part of our portfolio: TGN and TEL. We have proceeded further at analysing the risk of the portfolio composed only by these two titles, finding the minimum variance point, the right weight of each of them in the portfolio (see equation 1.5, table no.5).

$$x^* = \frac{\sigma_j^2 - \sigma_{ij}}{\sigma_i^2 + \sigma_j^2 - 2\sigma_{ij}} = \frac{15{,}91 + 6{,}27}{4{,}30 + 15{,}91 + 2 * 6{,}27} = 67{,}72\%$$

Table no. 5

Minimum variance point computation

Date	R_i	$R_i - E(R_i)$	$[R_i - E(R_i)]^2$	Rj	$Rj - E(Rj)$	$[Rj - E(R_j)]^2$	$R_i - E(R_i)$ * $Rj - E(Rj)$
03.02.14	-1,36	-2,04	4,16	-1,32	-2,76	7,62	-11,48
10.02.14	0,52	-0,16	0,03	1,88	0,44	0,19	0,01
17.02.14	1,21	0,53	0,28	2,70	1,26	1,59	0,35
24.02.14	4,78	4,10	16,82	2,37	0,93	0,86	15,64
03.03.14	-2,82	-3,50	12,24	-5,08	-6,52	42,51	-79,80
10.03.14	2,13	1,45	2,11	3,63	2,19	4,80	4,62
17.03.14	0,18	-0,50	0,25	-0,96	-2,4	5,76	-0,60
24.03.14	1,33	0,65	0,42	-0,32	-1,76	3,10	-0,74
31.03.14	0,31	-0,37	0,14	8,32	6,88	47,33	0,96
07.04.14	1,28	0,60	0,36	0,48	-0,96	0,92	-0,35
14.04.14	3,29	2,61	6,82	7,29	5,85	34,22	39,90
22.04.14	0,05	-0,63	0,39	4,14	2,7	7,29	1,05
28.04.14	-2,08	-2,76	7,61	-4,46	-5,9	34,81	-44,90
	0,68		**51,63**	**1,44**		**191,01**	**-75,33**

Source: realized by author, own computation

$$\sigma^2{}_p = x^2\sigma_i^2 + y^2\sigma_j^2 + 2xy\sigma_{ij} = 0{,}44 * 4{,}30 + 0{,}33 * 15{,}91 - 2 * 0{,}67 * 0{,}33 * 6{,}27 = 4{,}37$$

$$\rho ij = \sigma ij / (\sigma i * \sigma j) = -6{,}27/(2{,}07*3{,}98) = -0{,}76$$

Consequently, an optimum minimum variance portfolio of two titles (TGN and TEL) should include 67 % of the invested capital in TGN shares and 33 % in TEL. In other words, 6700 lei goes for investing in TGN shares and the rest goes to TEL shares. The variance in the expected return of the portfolio will be then 4,37 and the return of the portfolio 0,93 %.

Conclusions

The optimal portfolio management is the one that provides the investor the risk that he is willing to take and the return he is willing to earn. The minimum variance portfolio provides the investor a portfolio with the lowest volatility, sensitivity to risk. Through diversification, the risk associated with the portfolio is significantly lower than the individual risks of the component assets.

We have shown how to select from a group of shares quoted on a stock market, the ones that have the lowest risk/return ratio and to determine the exact weight of the titles meant to be introduced in the portfolio. From the ten securities part of the BET index, we have chosen two for realizing a minimum variance portfolio according to the Markowitz theory.

Future research will consider daily closing prices of the stocks, a larger period of analysis (which will bring more robust results), the possibility of discussing of three assets portfolios or more.

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