PORTFOLIO OPTIMIZATION IN INVESTMENTS: EMPIRICAL EVIDENCE FROM THE REPUBLIC OF SERBIA

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Abstract
The main subject in this study is to test and analyze efficient portfolio optimization in investments with focus on the financial market of the Republic of Serbia. The basic objective of the research is to provide quantitative information about specific aspects of portfolio optimization in investments, especially having in mind the specificities of the financial market of the Republic of Serbia. The methodology used in the research includes quantitative methods in area of portfolio optimization. The results of the research point to the necessity of portfolio optimization in function of return maximization from the investment activities.
Keywords: portfolio, portfolio optimization, investments, risk, return.

Introduction
Modern aspects of portfolio investments understand an adequate approach regarding investment risk/return characteristics, especially having in mind the volatile business conditions. Namely, frequent occurrences of extreme events, which are enhanced by the global economic crisis, significantly affect the return from investment activities. This fact is particularly important for markets in transition, having in mind that these markets are “famous” for specific volatility and turbulent market conditions.
With that reason, the research is conducted on the financial market of the Republic of Serbia, as typical representative of transitional markets in general. The possibility of portfolio optimization in investments at these markets (for example, in the Republic of Serbia), opens a lot of questions about new ways in investment optimization.
This research is especially interesting regarding acquiring the specific knowledge about the investments assessment, that is, effects from investment activities, based on the empirical evidence from the transitional market of the Republic of Serbia. Hence, the significance lies in the fact that the research is conducted using concrete stocks historical data from the financial market of the Republic of Serbia.
Dynamic nature of investment return induces the necessity of testing the possibilities of portfolio optimization with special attention to investors risk preferences. Continuously changing environmental conditions significantly stress and change the investors risk aversion, in light of changing their attitude regarding the effect from investment activities. Previously mentioned is reflected in terms of adequate determination of portfolio weights, i.e. the shift in optimal balance of risk and risk free portfolio investment assets.

Research methodology

The methodology used in the research is contemporary oriented and takes into consideration the specific nature of the tested data. The applied portfolio optimization methods are based upon the following:

$$\sum_{j=1}^{n} \sigma_{ij}\omega_j - \lambda_1 \bar{r}_i^{\,p} - \lambda_2 = 0, \quad i = 1,2,...,k \tag{1}$$

$$\sum_{i=1}^{n} \omega_i \bar{r}_i^{\,p} = \bar{r}_\pi^{\,p} \tag{2}$$

$$\sum_{i=1}^{n} \omega_i = 1 \tag{3}$$

p takes the values: 1, 2 and 3.

The first approach is based on the following presumptions:

Objective: maximization of portfolio return for a given level of risk;

Changing variable: portfolio weight coefficient;

Constraints: The weight of every stock in the portfolio should not be less than zero;

The sum of all weights is: equal to 1;

The risk of the portfolio is: less than or equal 0.002 (or 0.2%).

The second approach is based on the following presumptions:

Objective: minimization of the portfolio variance;

Changing variable: portfolio weight coefficient;

Constraints: The weight of every stock in the portfolio should not be less than zero

The sum of all weights is: equal to 1;

The portfolio return: should be/used value is 5.04%

Results and discussion

The data used in the research comprises stock historical data from the Belgrade Stock Exchange. The stocks are selected with special focus on different segments of the stock market in the Republic of Serbia, with the objective to provide competent comparative data regarding the specific market conditions in the Republic of Serbia.

Calculation for the first approach: the research results for p=1 are shown in tables 1 and 2; for p=2 and p=3 only summarized data is given in tables 3 and 4.

Table 1. Portfolio optimization for the first calculation approach (p=1)

p=1						
	NIIS	AERO	ALFA	MTLC	BASB	AIKB
Weight	0.00000	0.46089	0.27440	0.26471	0.00000	0.00000
Expected return	-0.02140	0.07620	0.05040	-0.01020	-0.04240	0.00490
Covariation matrix	NIIS	AERO	ALFA	MTLC	BASB	AIKB
NIIS	0.00166	0.00109	-0.00015	-0.00011	0.0017	0.00072
AERO	0.00109	0.00468	0.00243	0.00046	0.00178	0.00113
ALFA	-0.00015	0.00243	0.00264	0.00027	0.00143	0.00027
MTLC	-0.00011	0.00046	0.00027	0.00054	-0.00001	0.00069
BASB	0.0017	0.00178	0.00143	-0.00001	0.00878	0.00164
AIKB	0.00072	0.00113	0.00027	0.00069	0.00164	0.00176
Variance	0	0.001357557	0.000525712	0.0001136	0	0
Return	0.00000	0.03512	0.01383	-0.00270	0.00000	0.00000

Source: the authors' calculations

Table 2. Portfolio optimization for the first calculation approach (p=1) – risk/return values

Portfolio variance	0.00199684
Standard deviation	0.044686011
Portfolio return	4.62%
Portfolio risk	0.002000997

Source: the authors' calculations

Table 3. Portfolio optimization for the first calculation approach (p=2) – risk/return values

Portfolio variance	0.002029924
Standard deviation	0.04505468
Portfolio return	0.37%
Portfolio risk	0.002000466

Source: the authors' calculations

Table 4. Portfolio optimization for the first calculation approach (p=3) – risk/return values

Portfolio variance	0.002029575
Standard deviation	0.045050799
Portfolio return	0.03%
Portfolio risk	0.001999656

Source: the authors' calculations

Calculation for the second approach: the research results for p=1 are shown in tables 5 and 6; for p=2 and p=3 only summarized data is given in tables 7 and 8.

Table 5. Portfolio optimization for the second calculation approach (p=1)

p=1						
Covariation matrix	NIIS	AERO	ALFA	MTLC	BASB	AIKB
NIIS	0.00166	0.00109	-0.00015	-0.00011	0.0017	0.00072
AERO	0.00109	0.00468	0.00243	0.00046	0.00178	0.00113
ALFA	-0.00015	0.00243	0.00264	0.00027	0.00143	0.00027
MTLC	-0.00011	0.00046	0.00027	0.00054	-0.00001	0.00069
BASB	0.0017	0.00178	0.00143	-0.00001	0.00878	0.00164
AIKB	0.00072	0.00113	0.00027	0.00069	0.00164	0.00176
Variance	0	0.000919491	0.001084091	0	0	0.000145061
Return	-0.0214	0.0762	0.0504	-0.0102	-0.0424	0.0049

Source: the authors' calculations

Table 6. Portfolio optimization for the second calculation approach (p=1) – risk/return values

Weight sum	1.00000
NIIS	0.00000
AERO	0.31616
ALFA	0.50454
MTLC	0.00000
BASB	0.00000
AIKB	0.17930
Portfolio variance	0.002148643
Portfolio return	0.050399

Source: the authors' calculations

Table 7. Portfolio optimization for the second calculation approach (p=2) – risk/return values

Weight sum	1.00000
NIIS	0.00000
AERO	1.00000
ALFA	0.00000
MTLC	0.00000
BASB	0.00000
AIKB	0.00000
Portfolio variance	0.00468
Portfolio return	0.005806440000000

Source: the authors' calculations

Table 8. Portfolio optimization for the second calculation approach (p=3) – risk/return values

Weight sum	1.00000
NIIS	0.00000
AERO	1.00000
ALFA	0.00000
MTLC	0.00000
BASB	0.00000
AIKB	0.00000
Portfolio variance	0.00468
Portfolio return	0.000000195762647

Source: the authors' calculations

Conclusions

Based on the conducted research, it can be concluded, that it is possible to achieve efficient portfolio optimization in investments at the specific financial market of the Republic of Serbia, but it is important to have in mind the fact that this market is highly volatile, with extreme return distribution tails, which point out to the significant level of investment risk. In this sentence lies both the importance of this research for academic and professional public and possible ways of further researches in the subject field.

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