Influence of return interval on stock's beta

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Abstract: - In this paper influence of return interval on stock beta coefficients of 12 stocks listed on Belgrade Stock Exchange that constitute index BELEX 15 is examined. The beta coefficients are calculated for each stock from the sample on the basis of daily, weekly and monthly rates of return for the period from January 2011 to December 2013.
Research results show that there is no statistically significant difference between betas calculated on the basis of daily, weekly and monthly return intervals. Also, results indicate that the highest beta scores are based on monthly rates of return and the lowest beta scores are calculated on the basis of daily rates of return. Betas based on weekly returns appear to be more stable within the sample than betas based on daily and monthly returns.

Key-Words: - Beta coefficient, intervaling effect, daily rates of return, weekly rates of return, monthly rates of return.

1 Introduction

It is well known that stock's historical rates of return can be used for determination of stock systematic risk measured by its beta coefficient. However theory does not state whether rates of return should be measured over a day, a week or a year. Betas determined on the basis of daily, weekly or yearly rates of return differ even when they are calculated for the same period of time. This phenomenon is known as intervaling effect in the literature.
Some researchers have focused on this phenomenon. For example, Dimson and Marsh [1] studied stability of beta measured from different intervals of time and found that stocks listed on thin markets appear to be sable. Also, they concluded that betas based on daily returns generate more stable beta estimates than betas based on weekly returns. The same can be said for weekly betas compared to monthly betas.
Hawawini [2] concluded that betas of stocks with smaller market value than average will decrease as return interval is shortened, while betas of stocks with larger market value than average will increase. Hawawini pointed out that stocks with relatively small value will tend to appear less risky than they really are, while stocks with relatively large value will tend to appear more risky then they really are.
Cohen, Maier, Schwartz and Whitcomb [3] showed that betas are sensitive to changes in the differencing interval.
Draper and Paudyal [4] searched for methodology of beta estimation that offers less variable beta estimates. They suggested increase in the number of observations used in estimation of beta and careful appraisal of the most appropriate technique for beta estimation.
Mateev [5] showed on the basis of the study of Bulgarian stock returns that beta coefficients estimated on the basis of daily and weekly returns seem to be more stable than betas estimated on the basis of monthly returns.
Relatively small number of papers examines beta coefficients of stocks listed on Belgrade Stock Exchange (BSE) [6], [7], [8], [9], [10]. It should be pointed out that up to now there is no published research about intervaling effect of stocks listed on BSE.
Therefore, in this paper, beta coefficients of each stock that constitutes BSE index BELEX 15 based on daily, weekly and monthly return intervals in the period from January 2011 to December 2013 will be calculated in order to determine whether there exists

statistically significant difference between values of beta coefficients based on different time series and to suggest the most appropriate return interval that should be used in the process of beta calculation.

2 Data and Methodology

Data base which is used in this research consists of twelve stocks that constitute index BELEX 15 on BSE. Prices for selected stocks are taken from the web site of BSE [11] and they are used for calculation of daily, weekly and monthly realized rates of return for each stock from the sample on the basis of formula:

$$r_i = \frac{p_t - p_{t-1}}{p_{t-1}} \quad (1)$$

where

p_t - the stock price at the end of day/week/month *t*,

p_{t-1} - the stock price at the end of day/week/month *t-1*.

Dividnd payments are not taken into account in the calculation of daily, weekly and monthly realized rates of return, because of the incompleteness of available data.

The beta coefficients for the selected stocks are calculated on the basis of Sharpe's market model [12]:

$$r_i = \alpha_i + \beta_i r_m + \mu_i \quad (2)$$

where

r_i – rate of return of stock *i*,

r_m – rate of return of market portfolio *m*,

α_i – estimated intercept for stock *i*,

β_i – estimated beta coefficient for stock *i*,

μ_i – unsystematic return of stock *i*.

Returns of index BELEXline [13] are used as a proxy for rate of return of market portfolio and its daily, weekly and monthly realized rates of return are calculated on the basis of Formula 1.

Beta coefficients of each examined stock are calculated by regressing the daily, weekly and monthly realized rates of return for particular stock against the daily, weekly and monthly rates of return of index BELEXline.

Descriptive statistics for the betas based on daily, weekly and monthly return intervals for selected stocks is examined, as well as their Pearson correlation coefficients.

Also, Kruskal-Wallis test is used in order to determine if statistically significant difference between values of beta coefficient based on daily, weekly and monthly time series exists. Kruskal-Wallis test is chosen because the sample of the stocks used in the study is small.

All calculations are done in Excel 2007 and E-Views 7.

3 Empirical Results

Regression results of daily, weekly and monthly realized rates of return for selected stocks for the period from January 2011 to December 2013 against the returns of BELEXline index for the same period of time are presented in the Table 1.

Analysis of attained results shows that majority of selected stocks have the lowest results of beta coefficient calculated on the basis of daily realized rates of return. Also, majority of stocks have the highest results of beta coefficients calculated on the basis of monthly realized rates of return.

Overall lowest result of beta coefficient has stock JESV (0.240) and this beta coefficient is calculated based on daily return intervals. On the other hand, the highest beta score has stock SJPT (2.063). This beta coefficient is calculated on the basis of monthly return intervals.

In the sample does not exist stock with negative beta coefficient. Approximately half of the stocks from the sample have beta that ranges from 0 to 1, which leads to conclusion that prices of these stocks move in the same direction as the market, but it can be said that these stocks are slightly less volatile than the market. The rest of the stocks from the sample have beta higher than 1, which means that they are more volatile than the market as a whole.

Table 1. Betas calculated on the basis of daily, weekly and monthly return intervals for selected stocks

TIK	Daily Betas	Weekly Betas	Monthly Betas
ALFA	0.342	0.257	0.313
ENHL	1.536	1.598	1.256
FITO	0.561	0.511	0.607
GMON	0.419	1.023	1.012
IMLK	0.921	0.785	0.382
JESV	0.240	0.441	0.442
MTLC	0.601	0.771	1.023
NIIS	1.227	1.259	1.494
SJPT	1.579	1.632	2.063
TGAS	0.397	0.840	1.314
AIKB	1.902	1.770	1.428
KMBN	1.453	1.234	1.747

Source: Author's calculation

ISBN: 978-960-474-386-5

Table 2. presents descriptive statistics of daily, weekly and monthly betas for selected stocks. It can be seen from the table that the highest average beta is calculated on the basis of monthly realized rates of return and the lowest average beta is based on daily realized rates of return, which is in accordance with previous conclusions.

Betas calculated on the basis of daily return intervals range from 0.240 (JESV) to 1.902 (AIKB) for selected stocks. Betas based on weekly return intervals go from 0.257 (ALFA) to 1.770 (AIKB) and betas based on monthly return intervals are in the range from 0.313 (ALFA) to 2.063 (SJPT) for stocks from the sample.

Standard deviation is the highest for daily betas (0.581) and the lowest for weekly betas (0.495).

Jarque-Bera test shows that daily, weekly and monthly betas have normal distributions (p_d=0.544<0.05, p_w=0.697<0.05, p_m=0.748<0.05).

Table 2. Descriptive statistics of daily, weekly and monthly betas for selected stocks

	Daily Betas	Weekly Betas	Monthly Betas
Mean	0.931	1.010	1.090
Median	0.761	0.931	1.139
Maximum	1.902	1.770	2.063
Minimum	0.240	0.257	0.313
Std. Dev.	0.581	0.495	0.564
Skewness	0.323	0.112	0.060
Kurtosis	1.580	1.819	1.929
Jarque-Bera	1.216	0.722	0.581
Probability	0.544	0.697	0.748
Sum	11.177	12.120	13.079
Sum Sq. Dev.	3.708	2.700	3.501
Observations	12	12	12

Source: Author's calculation

Results of Pearson correlation coefficients (Table 3.) between betas based on daily, weekly and monthly return intervals indicate that strong positive correlation [14] exists between these variables.

Table 3. Pearson correlation

	Daily Betas	Weekly Betas	Monthly Betas
Daily Betas	1		
Weekly Betas	0.909**	1	
Monthly Betas	0.709**	0.826**	1

**Correlation is significant at the 0.01 level (2-tailed)
Source: Author's calculation

The strongest correlation exists between daily and weekly betas, while the weakest correlation exists between daily and monthly betas.

Results of Kruskal-Wallis test (Table 4.) confirm that there is no statistically significant difference between betas based on daily, weekly and monthly return intervals (KW=0.599, p=0.741<0.05).

Table 4. Kruskal-Wallis test

Method	df	Value	Probability
Kruskal-Wallis	2	0.599	0.741

Source: Author's calculation

4 Conclusion

In this paper, we examine influence of return interval on beta coefficients of 12 stocks listed on BSE that constitute index BELEX 15. For each stock from the sample beta coefficients based on daily, weekly and monthly rates of returns are calculated for the period from January 2011 to December 2013.

Research results show that betas calculated on the basis of monthly rates of return have the higher values than betas calculated on the basis of weekly and daily rates of return.

Pearson correlation coefficients indicate that strong positive correlation exists between betas based on daily, weekly and monthly rates of return. Strong positive correlation suggests that there is probably no significant difference between betas calculated on the basis of daily, weekly and monthly return intervals.

These results are confirmed with results of Kruskal-Wallis test, which leads to conclusion that there is no significant difference between daily, weekly and monthly betas.

Although research results show that there is no significant difference between betas estimated on the basis of daily, weekly and monthly rates of return, it should be pointed out that betas estimated on the weekly rates of return appear to be more stable within the sample compared to betas estimated on the basis of daily and monthly rates of return. Therefore, research results justify use of weekly betas.

However, it has to be pointed out that this study is based on twelve stocks and that more extensive study has to be undertaken in order to draw final conclusions.

ISBN: 978-960-474-386-5

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ISBN: 978-960-474-386-5