DAY OF THE WEEK EFFECT IN SMALL SECURITIES MARKETS

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Abstract: In this article statistical investigation of the day-of-the-week effect was explored for the case of small securities market. By applying statistical analysis of Vilnius Stock OMX Index return data, the effect was not observed. After rearranging data to the meaningful subsets of return variable the significant difference among Monday and Friday compared pairwise to the other days of the week, has been observed. The hypothesis of equality of the higher moments across days of the week could be rejected by indicating that a weekly pattern on the higher moments exists.

1 INTRODUCTION

Many research studies address the problem of stocks profitability by using wide variety of methods. One group of authors use methods of technical analysis for investigating influence of historical prices deviations (Achelis, 2000), the others concentrate to the fundamental analysis of the stock market, aimed to development of financial indicators, which could reveal stock price changes (Thomsett, 2006). No method has any significant preference over the others, thus some price change phenomena or anomalies of the stocks can be explained only by integrative application of both methods groups. One of such phenomena is the influence of day-of-the-week for the profitability and risk of investment.

Day-of-the-week effect indicates the anomaly of the return of stocks, which occurs during the specific days of the week. The traditional understanding of return is presented by expression, where return on time moment *t,* R_t is evaluated by logarithmic difference of stock price over time interval (t-1,t]:

$$R_t = \ln(\frac{P_t}{P_{t-1}}) = \ln(P_t) - \ln(P_{t-1}), \qquad (1)$$

where P_t indicates the price of financial instrument at time moment t.

Day-of-the-week effect has attracted attention of many investigators. Fama (1965) and many other authors (Jaffe and Westerfield, 1989; Gregoriou et al 2004; Gordon and Tang, 1998) have substantiated that mean return and variance of investment significantly differs across days of the week. In these works the significance of „ Monday anomaly“ was indicated. This means that the volatility of return of Mondays is significantly higher, than during the other days, and the mean return is lower. Other articles (Syed and Basher, 2006; Tong, 2000) have verified the hypothesis about the exclusive shape of the return function at the first and last days of the week in different financial markets of US, European and Asia-Pasific exchange. In these research works the day-of-the-week effect analysis was based on the first two return distribution moments. Gordon and Tang (1998), Galai and Kedar-Levy (2005) have tested the effect of higher moments (e.g. skewness and kurtosis) of return and concluded that the hypothesis of equality of the higher moments across days of the week can be rejected, indicating that a weekly pattern on the higher moments exists.

The anomalies of the first trading day can be explained by the influence of institutional traders, also by the abundance of stock market news during the weekend, comparing to other days of the week. The effect of the last trading day can probably be explained by the psychological factor.

All these investigation have been made in developed securities markets. Some new research sources indicate that the influence of day of week effect is fading (Syed et al, 2006). There is no research presented, if similar dependencies are still important in the small securities markets with low turnover and comparatively small number of market players.

In this work we shall analyse the day-of-the-week effect in the small markets with low liquidity.

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The research methods, used in the article include traditional analysis, where the differences of first moments, calculated for the days of the week, will be investigated, and the methods, based on analysis of the higher moments.

The research outcomes and conclusions are presented in section 3. All calculations are made with the STATISTICA 6.0 for Windows software.

2 DATA AND METHODOLOGY

Data was taken from Vilnius Stock Exchange information (The Nordic Exchange, 2006). The OMX Vilnius Stock Index is a capitalization weighted chain linked total-return index. For the further calculations in this research we used the OMX Vilnius Stock Index values of the time interval from 2003-01-01 to 2006-11-21 on daily basis (Figure 1).

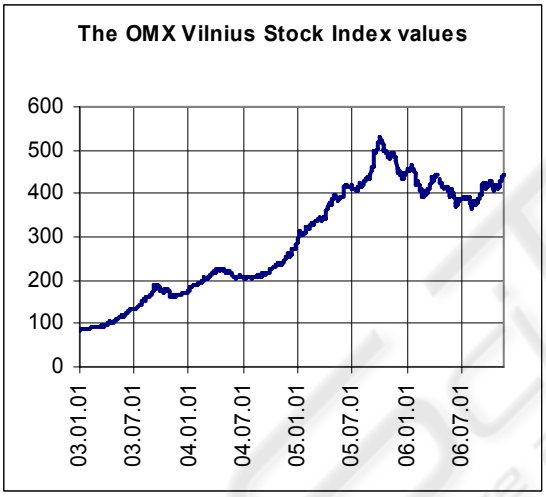

Figure 1: The OMX Index values.

Return on investment to this index was calculated by applying formula (1). For analysis of the day-of-the-week effect the collected return data has been processed in the following way.

The primary data set was assigned to the variable **RETURN** (or **R**). Then two additional data sets were derived from it. The first data set **RETURN+** (or **R+**) was combined of those values of data set **RETURN,** which had positive return on the prior trading day. The data set **RETURN-** (or **R-**) was made of **RETURN** values, which had negative returns on the prior trading day. The prepared sets of data, used for the further research consisted of 984 values for variable **R**; the derived data sets had 580 values of **R+** and 382 values of the **R-** variable. Similar method for splitting the initial data set was used by Galai (2005). This method of data rearrangement more clearly highlighted presence of the day-of-the-week effect.

The three data sets were initially analysed by presenting their Summary Statistics (Table 1).

Table 1: Day-of-the-week Summary Statistics (Bold numbers indicate 5% significance).

	1 N	2 Mean	3 Std.Dev.	4 Skewn.	5 Kurtosis
			Monday		
R	191	0,0669	0,9102	**-0,3634**	**3,9095**
R-	69	0,0265	1,0327	**-0,6738**	**5,5312**
R+	119	0,0843	0,8459	0,0244	**1,3858**
			Tuesday		
R	200	0,1600	0,9343	0,1474	**2,7382**
R-	87	-0,0240	1,0129	0,1326	**3,2598**
R+	110	0,3049	0,8514	0,4063	**2,0359**
			Wednesday		
R	199	0,1856	0,9238	-0,0719	**1,4051**
R-	81	-0,1580	0,8983	**-0,5874**	**1,1196**
R+	115	0,4319	0,8674	0,3951	**1,2061**
			Thursday		
R	201	0,2017	1,0255	**-0,5074**	**3,2218**
R-	74	-0,1735	1,1826	**-0,9696**	**1,8571**
R+	124	0,4065	0,8540	**0,8466**	**2,5315**
			Friday		
R	198	0,2201	0,9066	**0,9114**	**4,1792**
R-	76	0,0459	1,0107	**1,1628**	**5,9422**
R+	117	0,3314	0,8346	**0,8684**	**2,4017**
			All days		
R	989	0,1677	0,9412	-0,0129	**3,0616**
R-	387	-0,0579	1,0271	-0,2416	**3,5361**
R+	585	0,3118	0,8568	**0,4905**	**1,8574**

From this table we observe that the average return **R+** values exceed significantly the return values of other variables. One of possible reasons to explain this effect could be psychological drive for investment under the conditions of raising market index. The effect of Friday increase return is explained psychologically, by good moods of traders before weekend.

By analysing standard deviation we noticed, that there is no difference in volatility between days of the week and among volatility the variables **R, R+, R-**. The difference of daily rates of return distribution from normal distribution is most evident by analysing high moments (skewness and kurtosis). Significant difference of skewness and kurtosis from zero value indicates deviations from a normal

distribution. In the Table 1, the estimations of skewness and kurtosis were statistically significant at 5% level (printed in bold numbers) for almost all weekdays and all three variables. In this way we had to reject hypothesis about normality of return distribution.

Further, the day-of-the-week effect was be explored by applying the t-test for differences between mean returns for Monday and the other days of the week.

In the Figure 2 we can see that only the variable **R+** had statistically significant difference between Monday and Friday mean returns (grey background). By performing t-test for the other days of the week, similar results were obtained - only **R+** had a statistically significant difference between Monday and those on any other day.

T-tests; Grouping: Diena
Group 1: Monday
Group 2: Friday

Var	**Mean Monday**	Mean Friday	t-value	df	p
R	0,0669	0,2201	-1,66271	387	0,097180
R-	0,0265	0,0459	-0,11422	143	0,909223
R+	0,0843	0,3314	-2,25879	234	0,024818

Figure 2: T-test between returns on Monday and Friday.

Further for the research of the day-of-the-week effect we shall use the regression model. Generally it is defined it with the help of the following equation:

$$R_t = a + a_1 D_{1,t} + a_2 D_{2,t} + a_3 D_{3,t} + a_4 D_{4,t} + \varepsilon_t \quad (2)$$

where a estimates the average return on Friday, a_i estimates the average difference between the return on Friday and the i-th (i=1,2,3,4) trading day's return, $D_{i,t}$ is the dummy variable for the i-th trading day on date t, $\varepsilon_t > 0$ is for random regression error.

The null hypothesis for this model H_0 stated the equality of average daily rates of return: $H_0 : a_1 = a_2 = a_3 = a_4 = 0$. The results of application of the regression model for **R** and **R+** variables are presented Figure 3. The analysis of the variable **R** revealed, that only subset the of data for Friday (grey background) had the statistically significant difference from other days of the week.

Model is: v2=a+a1*v5+a2*v6+a3*v7+a4*v8
Dep. Var. : Return
Level of confidence: 95.0% (alpha=0.050)

	Estimate	Standard error	t-value df = 984	p-level
a	0,220061	0,066915	3,28868	0,001042
a1	-0,153184	0,095495	-1,60411	0,109012
a2	-0,060110	0,094395	-0,63679	0,524410
a3	-0,034423	0,094513	-0,36421	0,715778
a4	-0,018388	0,094278	-0,19504	0,845403

Model is: v4=a+a1*v5+a2*v6+a3*v7+a4*v8
Dep. Var. : Return+
Level of confidence: 95.0% (alpha=0.050)

	Estimate	Standard error	t-value df = 574	p-level
a	0,334305	0,079320	4,21463	0,000029
a1	-0,249272	0,111699	-2,23163	0,026025
a2	-0,029399	0,113695	-0,25858	0,796053
a3	0,101349	0,112667	0,89955	0,368739
a4	0,082245	0,111011	0,74087	0,459074

Figure 3: Regression model for **R** and **R+** variables

The **R+** indicates the significance difference for Friday and Monday (grey background). The **R-** had no statistically significant difference among those days. The comparable results for big security markets can be found in (Kohers et al, 2004, Tong, 2000).

Very similar results we obtained using analysis of Variance method.

Analysis of Variance
Marked effects are significant at p < ,05

Var	**SS Effect**	MS Effect	SS Error	F	p
R	2,7924	0,6981	872,3735	0,7874	0,5334
R-	3,2118	0,8030	404,0196	0,7592	0,5524
R+	8,9776	2,2444	419,7405	3,1013	0,0153

Figure 4: ANOVA results.

As we can see on Figure 4, only the analysis of variable **R+** indicates significant difference between days of the week. Application of F criteria to **R+**, allows us to reject the hypothesis of absence of average differences among the return of the different days of the week.

By applying the Kolmogorov-Smirnov test we tested hypothesis, that two samples were drawn from the same population. This test is sensitive to the differences of the general shapes of the distributions of the two samples (i.e., to differences of variance,

skewness, kurtosis etc.). It is generally applied for testing the influence of higher moments for the distribution (StatSoft Inc., 2006). In our case, for investigation of the day-of-the-week effect, we applied Kolmogorov-Smirnov test for different days of the week. It was defined, that the variable **R+** has significant pairwise difference of the days of the week only for Monday and Friday, what means, the value of return index of first and last trading day of the week differed from the other weekdays. In the Figure 5, the Kolmogorov-Smirnov test values for indicating difference among Monday and Tuesday distributions was presented.

Kolmogorov-Smirnov Test
By variable Diena
Marked tests are significant at p <,05

var	**Max - Differnc**	Max + Differnc	p-level	Mean Monday	Mean Tuesday
R	-0,0999	0,0227	p > .10	0,0669	0,1600
R-	-0,0570	0,1000	p > .10	0,0265	-0,0240
R+	-0,2016	0,0154	p < .03	0,0843	0,3049

Figure 5: Kolmogorov-Smirnov test.

Similar tendency was valid for the other days of the week. Even more significant influence could be observed among Monday and Friday distributions.

By applying Mann-Whitney U test, used to explore location characteristics of two samples (means, average ranks, respectively), we also observed significant difference of variable **R+** values of Monday, compared to the other days of the week.

3 CONCLUSIONS

In this article the statistical analysis of data of the week effect was explored for the case of Lithuanian stock market. The application of traditional statistical analysis methods, such as regression analysis, t-test, ANOVA, Levene and Brown-Forsythe test of homogeneity of variances gave the results, which allowed us to conclude, that only the data set **R+** had a statistically significant difference between Monday and other days of the week. We have noticed that the average return of Monday trading was the lowest, and Friday trading was the highest during the week. As stock market news flow during the weekend is generally very low for small securities markets, it does not influence much the Monday trading turnover. We could rather conclude the effects of 'Monday somnolence' and 'Friday uplift' for the return of emerging markets.

The application of nonparametric Kolmogorov-Smirnov test, based on analysis of the higher moments of return distribution, did not indicate the day-of-the-week effect for the full set of historical data (variable **R**). This effect was indicated only for the variable **R+**, where significant difference among Monday and Friday compared pairwise to the other days of the week, has been observed.

The differences of the days of the week effect, studied in this article can advice us for further research directions: investigation of the differences between developed and emerging markets and to research more precisely the derived sets of variables **R+** and **R-**. This type of research could give us better insight to the behaviour of return data, and could lead us to more precise outcomes of analysis.

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