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Analysis of the Day of the Week Anomaly in the Eastern European Markets

Erkan ALSU
Assistant Professor,
Department of Business Administration,
Gaziantep University, Gaziantep/Turkey

Murat KARAHAN
Assistant Professor,
Department of Business Administration,
Gaziantep University, Gaziantep/Turkey

Abstract

According to the effective market hypothesis, it is not possible to predict the future price of a security by analyzing previous data. Investors may have losses from securities, which they hope to make a profit, due to existence of asymmetric information and adverse selection. On the other hand, they may make profit unexpectedly from a security which they expect to lose. The studies, which argue that individuals will get positive or negative returns on certain days of the week on the stock exchange, have the common opinion that the negative returns occur on Monday and Tuesday and the positive ones are usually on Friday.

In this study, the daily returns of stock markets in the Eastern European countries between 2002 and 2016 are examined and the day of the week anomaly is analyzed. Results of the analysis imply that there is the day of the week anomaly in Eastern European countries (excluding Czechia). In general, it is observed in the markets that Friday has an effect of reducing variance.

1. INTRODUCTION

Capital markets are medium and long term markets where securities are bought and sold. The main goal of investors in these markets is to make profit. Many factors, such as global crises, global volatility, monetary tightening, changes in macroeconomic variables, asymmetric information, moral hazard and malicious intent, have serious effects on the stock markets of countries. Investors or business owners may have fluctuations in profits they receive due to information that they mutually possess (or not) which increases the risk of both parties. According efficient-market hypothesis argued by Fama in 1950, markets with semi-strong-form and strong-form efficiencies would not be affected by the above-mentioned factors.

For transactions to take place in the stock exchanges buyers and sellers must mutually agree. Both parties want to make profit. Then what will be the best price for each party to reach equilibrium. Adam Smith argued that individuals seek for self-interest would pave way for such equilibrium. This view has been discussed in the literature for about 200 years.

There are buying and selling strategies for investors to trade in the stock market. These strategies which vary as long-short term investment, daily trading, short selling, cyclical trading, switch trading, are known as the preferred strategies of investors. Each investor who trades on the stock market tries to maximize the profit with the best strategy. If all information, those investors have, is already reflected in the prices according to efficient-market hypothesis, then how investors will make profit.

When we look at previous studies in the literature, according to Gibbons and Hess (1981), Rogalski (1984), Aggarwal and Rivoli (1989), Solnik and Bousguet (1990), Dubois and Louvet (1996), Athanassakos and Robinson (1994), Balaban (1994), Sias and Starks (1995), Berument and Kıymaz (2001), Kohers et.al. (2004), Ajayı et.al. (2004), Apolinario et.al. (2006), Atakan (2008), Ergül et.al. (2009), Brahmana et.al. (2012), Morse et.al. (2016), Akbalık and Özkan (2016) Chen et.al. (2016), Özarı and Turan (2016), Zhang et.al. (2016) Güç et.al. (2016) the lowest return on the stock markets is obtained on Monday. On the other hand, in the studies by Berument and Kıymaz (2001), Kohers et.al. (2004), Apolinario et.al. (2006), Morse et.al. (2016), Chen et.al. (2016), Güç et.al. (2016), Özarı and Turan (2016) it is argued that on Fridays there is a positive return unlike other days.

2. DATA

This study aims to examine the anomaly of the day in the markets of the East European countries such as Turkey, Czechia, Hungary, Poland and Russia. Country indices of Morgan Stanley Capital Investment (MSCI) are used to represent the country's stock markets. The analysis period is selected between 03/06/2002 and 31/05/2016 and daily closing prices of the indices are obtained from MSCI-Barra web address. The return series are taken into account in the analysis. Daily return series of indices are calculated by $R_t = 100 \times \ln\left(P_t / P_{t-1}\right)$ formula and descriptive statistics are given in Table 1.

Table 1. Descriptive Statistics

	TURKEY	CZECHIA	HUNGARY	POLAND	RUSSIA
Mean	0.031	0.005	0.003	0.001	0.002
Std. Dev.	2.461	0.295	0.358	0.298	0.373
Maximum	16.158	3.307	3.365	2.202	3.596
Minimum	-17.343	-2.688	-3.215	-2.057	-3.978
Skewness	-0.239	-0.141	-0.002	-0.213	-0.407
Kurtosis	8.106	14.675	11.808	8.194	17.557
Jarque-Bera	4001.520 [0.000]	20746.680 [0.000]	11800.860 [0.000]	4131.770 [0.000]	32335.61 [0.000]
ARCH F-Stat.	139.536 [0.000]	171.092 [0.000]	377.117 [0.000]	91.778 [0.000]	128.708 [0.000]
ADF	-18.450***	-12.833***	-16.507***	-56.814***	-9.579***

Notes: The figures in square brackets show the probability (p-values) of rejecting the null hypothesis.
*** indicate that the series in question is stationary at the 1% significance level.

As can be seen from the Table 1 all countries have positive returns. The market with the highest return is the Turkish market (3.10%). The lowest return belongs to Poland markets (0.10%). Similarly, the highest historical volatility is seen in the Turkish market while the lowest is in the Czechian markets. Examining the maximum and minimum returns, it can be said that the highest variance belongs to the Turkish market. According to Jarque-Bera test statistic, indices do not show normal distribution. Also the autoregressive conditional heteroskedasticity (ARCH) effect is significant at 1% significance level in all country indices. The normal distribution of the series and the appearance of the ARCH effect in the series necessitate the use of GARCH methods in the model. According to the ADF unit root test results, all of the return series are stationary at 1% level of significance.

3. METHODS AND FİNDİNGS

The generalized ARCH (GARCH) model has been developed by Bollerslev (1986) and Taylor (1986). The model was developed to improve the deficiencies of the ARCH model (Yavuz, 2015: 449).

For the GARCH model, r_t represents the logarithmic return and $\varepsilon_t = r_t - \mu$, represents the shock at time t. While $\varepsilon_t = z_t \sigma_t$ for the GARCH model, the conditional variance of ε_t for (σ_t^2) equation is as follows.

$$\sigma_t^2 = \sigma_0 + \sum_{i}^{p} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j \sigma_{t-j}^2 \qquad 1.1$$

The conditional variance equation can be detailed as;

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \alpha_1 \varepsilon_{t-2}^2 + ...\alpha_p \varepsilon_{t-p}^2 + \beta_1 \sigma_{t-1}^2 + \beta_2 \sigma_{t-2}^2 + ...\beta_q \sigma_{t-g}^2 \qquad 1.2.$$

One of the biggest disadvantages of the ARCH and GARCH models is their assumption that the effect of the variance is constant. Since in the GARCH model ε_t^2 is included in the equation, the signs of residuals and shocks have the same effect on volatility. In other words, positive and negative shocks have the same effect on the variance. The GARCH models do not take into account the asymmetric effect which usually exist in financial series (Yavuz, 2015: 461).

The asymmetry which is not taken into account by the GARCH model, is taken into account the EGARCH model developed by Nelson (1991). The EGARCH model is shown as follows (Nelson, 1991).

$$\ln\left(\sigma_t^2\right) = \alpha_0 + \sum_{i=1}^{p} \beta_i \ln\left(\sigma_{t-i}^2\right) + \sum_{i=1}^{p} \alpha_i \left| \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \sum_{i=1}^{p} \gamma_i \frac{\varepsilon_{t-i}}{\sigma_{t-i}} \qquad 1.3.$$

In the equation numbered 1.3 the conditional variance of a time series in the EGARCH model is the nonlinear function of its own past values and the magnitude and sign of the delayed residuals (Yavuz, 2015: 462).

Three different EGARCH models are established in the study. The dummy variables created for the days of the week in Model 1 are added to the mean equation, to the variance equation in Model 2, and to the mean and variance equations in Model 3. Thus, the effect of the day of the week is examined both on the return and the volatility. When dummy variables are added to the models, to avoid falling into the dummy variable trap, they are not added to the model for Wednesday. For each of the 3 models, appropriate AR and MA processes are determined for the mean equation.

Table 2. Correlation Coefficients

	TURKEY	CZECHIA	HUNGARY	POLAND	RUSSIA
TURKEY	1.000				
CZECHIA	0.449***	1.000			
HUNGARY	0.482***	0.619***	1.000		
POLAND	0.537***	0.650***	0.706***	1.000	
RUSSIA	0.461***	0.526***	0.527***	0.576***	1.000

Note: *** indicates 1% significance level

The correlation between countries included in the analysis is shown in Table 2. All of the correlations between countries are statistically significant at 1% level. Negative correlations were not found, while the highest correlation was between Poland and Hungary (0.706), with the lowest correlation between Turkey and Czechia (0.449).

Table 3. Descriptive Statistics of Day of the Week

		TURKEY	**CZECHIA**	**HUNGARY**	**POLAND**	**RUSSIA**
Monday	Mean	-0.146	0.010	0.021	0.014	0.002
	Std. Dev.	2.822	0.304	0.367	0.319	0.403
Tuesday	Mean	0.045	-0.008	0.007	-0.005	-0.008
	Std. Dev.	2.444	0.278	0.339	0.282	0.373
Wednesday	Mean	0.015	0.002	-0.007	-0.008	0.000
	Std. Dev.	2.335	0.302	0.396	0.300	0.364
Thursday	Mean	0.133	0.018	-0.004	-0.004	0.004
	Std. Dev.	2.512	0.303	0.363	0.317	0.376
Friday	Mean	0.105	0.005	-0.001	0.008	0.010
	Std. Dev.	2.137	0.290	0.321	0.268	0.349

Descriptive statistics for the days of the week are given in Table 3. When average returns are examined, Turkey has a negative return on Monday, with the highest return on Thursday. Turkey has the highest volatility on Monday and the lowest volatility on Friday. The lowest volatility for the Czechia is also on Friday. The highest return is on Thursday, the lowest on Tuesday. For Hungarian market while the highest return is on Monday, a negative return is seen on Wednesday, Thursday and Friday. The highest volatility in Hungary is occurred on Wednesday. In the Polish market, the highest volatility and the highest return are realized on Monday, while Tuesday, Wednesday and Thursday have negative returns. While the highest return in Russian market occurred on Friday, negative returns are experienced on Tuesday. The highest volatility occurred on Monday and the lowest on Friday.

In different countries, different days seem to have high returns and volatility. EGARCH and GARCH models which are formed to see which day in the Eastern European country is the day of the week anomaly are shown in Tables 4, 5 and 6.

Table 4. EGARCH and GARCH Results for Model-1

Mean Equation	TURKEY	CZECHIA	HUNGARY	POLAND	RUSSIA
Constant	0.077	0.008	0.004	-0.010	0.015*
Monday	-0.024	0.015	0.015	0.031***	0.004
Tuesday	-0.046	-0.016	0.011	0.011	-0.012
Thursday	0.125	-0.002	0.003	0.007	-0.004
Friday	0.026	0.009	-0.001	0.018	0.007
AR(1)	0.196***	0.089**	0.121	-0.072	-0.629***
AR(2)	0.242***	-0.897***	0.491***	-0.256***	0.215***
AR(3)	0.149***		-0.238*	0.529***	-0.905***
AR(4)	-0.823***		-0.742***	0.616***	-0.770***
AR(5)					0.029
AR(6)					-0.019
MA(1)	-0.154**	-0.063	-0.090	0.094	0.683***
MA(2)	-0.249***	0.880***	-0.496***	0.268***	-0.198***
MA(3)	-0.168***		0.215	-0.526***	0.879***
MA(4)	0.824***		0.761***	-0.630***	0.816***
MA(5)	0.036**			-0.013	
MA(6)	-0.028*				
Variance Equation					
Constant	-0.073***	-0.210***	-0.143***	-0.114***	0.002***
ARCH	0.173***	0.179***	0.140***	0.113***	0.106***
EGARCH	-0.074***	-0.044***	-0.051***	-0.046***	
GARCH	0.963***	0.974***	0.986***	0.990***	0.887***
Students-t	6.119***	8.009***	9.274***	7.189***	5.397***

Table 5. EGARCH and GARCH Results for Model-2

Mean Equation	TURKEY	CZECHIA	HUNGARY	POLAND	RUSSIA
Constant	0.091***	0.010***	0.010**	0.003	0.015***
AR(1)	0.193***	0.090*	0.097	-0.377***	-0.623***
AR(2)	0.237***	-0.879***	0.516***	-0.080*	0.218***
AR(3)	0.159***		-0.244*	0.336***	-0.905***
AR(4)	-0.821***		-0.752***	0.901***	-0.765***
AR(5)					0.033*
AR(6)					-0.018
MA(1)	-0.151**	-0.062	-0.068	0.400***	0.680***
MA(2)	-0.245***	0.861***	-0.520***	0.093**	-0.198***
MA(3)	-0.177***		0.221*	-0.329***	0.880***
MA(4)	0.822***		0.770***	-0.918***	0.813***
MA(5)	0.036**			-0.012	
MA(6)	-0.029*				
Variance Equation					
Constant	-0.039	-0.235***	-0.077	-0.066	-0.002
ARCH	0.176***	0.178***	0.140***	0.111***	0.107***
EGARCH	-0.074***	-0.044***	-0.051***	-0.046***	
GARCH	0.963***	0.974***	0.986***	0.990***	0.886***
Monday	0.222*	0.020	0.012	0.135	0.004
Tuesday	-0.080	0.105	-0.033	-0.162	0.017**
Thursday	0.060	0.187	-0.081	0.098	0.007
Friday	-0.379***	-0.184	-0.224**	-0.302**	-0.008
Students-t	6.319***	8.114***	9.309***	7.528***	5.447***

Note: ***, ** and * indicates 1%, 5% and 10% significance level

Table 6. EGARCH and GARCH Results for Model-3

Mean Equation	TURKEY	CZECHIA	HUNGARY	POLAND	RUSSIA
Constant	0.077	0.008	0.005	-0.011	0.015
Monday	-0.027	0.014	0.014	0.033***	0.004
Tuesday	-0.048	-0.016	0.010	0.012	-0.012
Thursday	0.139	-0.002	0.003	0.008	-0.003
Friday	0.022	0.009	-0.002	0.018	0.005
AR(1)	0.191***	0.082**	0.119	0.060	-0.624***
AR(2)	0.240***	-0.900***	0.495***	-0.239	0.219***
AR(3)	0.156***		-0.244*	0.282	-0.905***
AR(4)	-0.823***		-0.739***	0.730	-0.766***
AR(5)					0.034*
AR(6)					-0.017
MA(1)	-0.149**	-0.057	-0.087	-0.039	0.681***
MA(2)	-0.247***	0.884***	-0.500***	0.241	-0.199***
MA(3)	-0.174***		0.220*	-0.276	0.880***
MA(4)	0.823***		0.758***	-0.734	0.814***
MA(5)	0.037**			-0.012	
MA(6)	-0.028*				
Variance Equation					
Constant	-0.037	-0.227**	-0.078	-0.081	-0.002
ARCH	0.176***	0.179***	0.140***	0.111***	0.106***
EGARCH	-0.074***	-0.045***	-0.051***	-0.048***	
GARCH	0.962***	0.974***	0.986***	0.990***	0.887***
Monday	0.220*	0.006	0.014	0.148	0.003
Tuesday	-0.081	0.089	-0.033	-0.140	0.017*
Thursday	0.057	0.178	-0.079	0.118	0.006
Friday	-0.384***	-0.194	-0.225**	-0.277**	-0.008
Students-t	6.326***	8.029***	9.257***	7.420***	5.437***

Note: ***, ** and * indicates 1%, 5% and 10% significance level

First of all, EGARCH models were formed as they take into account the existence of asymmetric information in the market. As the EGARCH parameter was not significant for Russia, GARCH model is used for analyzing Russia. In the models, as the error distributions are not normally distributed, the Student-t distribution is used. As can be seen from Tables 4, 5 and 6, for all indices, the student-t coefficient is significant at 1% significance level.

According to Table 4, which summarizes the results of Model 1, the effect of the day of week on the average return, is only valid for Poland. Monday appears to have a positive effect on the average return in the Polish market. According to the results of Model 2, Monday has positive and Friday has a negative effect on variance in the Turkish market. For Hungary and Poland, Friday has mitigating effect on the variance. In Russia, Tuesday seems to have a positive impact on the variance. Findings in Model 3 support the findings in Models 1 and 2. As the mean and variance equations were formed together there has been changes in the coefficients, but in general there are no findings that may change the results.

4. CONCLUSION

According to the efficient market hypothesis, if excess returns cannot be earned in the long run by using investment strategies based on historical share prices then this market is considered as weak-form efficiency. Anomalies are situations which cannot be explained by efficient market hypothesis. In this study, the anomaly of the day of the week, which is one of the frequently studied topics in the literature, is examined. EGARCH and GARCH models are used as the analysis method. Through the models, the existence of the effect of the day of the week on the average return and variance in the Eastern European countries is examined.

Analysis results show that the anomaly of the day of the week is not valid for Czechia. In other Eastern European countries, the existence of this anomaly is seen in different forms. While there was no effect on the average return in Turkey on a weekly basis, it is observed that Monday increased the variance and Friday has a decreasing effect. In the Hungarian market Friday has decreasing effect on the variance. For Poland, Monday has an increasing effect the average return, and Friday has a decreasing effect on the variance. For Russia, Tuesday has increasing effect on the variance.

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