

# DAY OF THE WEEK EFFECT IN THE EUROPEAN EMERGING STOCK MARKETS: RECENT EVIDENCE FROM THE FINANCIAL CRISIS PERIOD

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**Abstract:** *This paper reports the results of regression analysis of the day of the week effects using daily observations on the five indexes representing the European emerging stock markets, the Czech PX Index, the Hungarian Budapest SE Index, the Polish Warsaw SE WIG Index, the Slovak SAX Index, and the Turkish Istanbul SE National 100 Index. In order to investigate 2008 financial crisis of the weekday effect anomaly, the period is divided into sub-periods. The first sub-period is covering from Monday 3rd January 2005 to Friday 30th May 2008 while the second sub-period is from Monday 2nd June 2008 to Friday 26th November 2010. The paper new reports anomalies on the examined stock markets appear only during the period of financial crisis.*

**Keywords:** *Day of the Week Effect, Stock Market, Czech Republic, Hungary, Poland, Slovak Republic, Turkey, 2008 Financial Crisis.*

**JEL Classification:** *G12, G14.*

## 1. Introduction

Even many investors predicted that the mortgage crisis will break out from U.S., they did not take precautions because they could not predicted its certain time. Since the global markets tightly coupled, many investors around the world effected from this crisis. Contamination and effects of economic crisis have been shown differences by countries and behaviour of investors. Decision making and risk taking behaviour could have differences before, during and after economic crisis periods. There is risk taking behaviour differences between global and local investors. In terms of having more information about markets, global investors have advantages than local one. Before, during and after an economic crisis there can be divergences between investors behaviour. *Gottschalk and Griffith-Jones* (2003) have investigated investors' behaviour before and during financial crisis by using international and global emerging market funds data for 1996-1999 and 2000-2003 economic crisis. *Bandopadhyaya and Truong* (2010) searched investors' crisis prediction and behave for U.S. They used the breaking point of the Lehman Brothers bankruptcy as the onset of the financial crisis in 2008 and developed an index that measures investor sentiment. They report that this index declines during crisis. The researchers also reports investors behave as if a financial crisis was approaching.

“...in aggregate foreign equity investors did pull out heavily from countries where a crisis erupted, although they did not have a major role in causing the crises. It will also be seen that investors' behaviour pattern converged over time towards herding, and that the smaller funds based in small jurisdictions tended to be the most

speculative ones. Looking specifically at the individual global emerging market funds, we could observe some degree of divergence in their behaviour during the East Asian crisis. That is, whilst many funds pulled out quite heavily from the crisis countries both before and during the crises, a few others stayed in...”<sup>1</sup>

Decades ago the efficient market hypothesis was accepted by academic financial economists. The main influence had the *Fama's* survey (1970), “*Efficient Capital Markets*”, where the efficient capital markets were promoted. The efficient market hypothesis (EMH) suggests that all past financial information is already reflected in current stock market prices or returns. This theory divides the efficiency into three main variations, weak efficiency, semi-strong and strong efficiency. Weak form efficiency states that technical analysis, which is the study of past stock prices in an attempt to predict future prices, is ineffective and the prices are on a “random walk“. Random walk is a term used in the finance literature to characterize a price series where all price changes are represented by the random departures from previous price. That means, if the flow of information is unimpeded and information is immediately reflected in stock prices, then tomorrow's price change will reflect only tomorrow's news and will be independent of the price changes today (Malkiel, 2003).

We know that investors more strictly follow the markets before and after economic crisis. If we take into consider this phenomenon, we claim that markets information efficiency should different before and after economic crisis. Nowadays, both investors and academics disagree, on how well the model of the weak efficiency works. However, it is less controversial than its stronger variations. Semi-strong form efficiency suggests, that markets deal with almost all information (public information) and reflects it in prices immediately. Strong form efficiency suggests usage of all information on the market (both public and private information).

By the start of the twenty-first century, the dominance of the efficient market hypothesis had become less universal. Many financial economists and statisticians began to believe, that stock prices are at least partially predictable (Malkiel, 2003). Examination of the calendar effects on the markets represents new way that markets can be shown to be inefficient, instantly increasing the vulnerability of EMH. Seasonality effects challenge the EMH because they imply that, in the absence of transaction costs, excess returns can be made simply by knowing what day of the week it is, whether it is January, if it is around the turn of the month, and so on. Moreover, any persistence over time of a seasonality effect is an additional threat to EMH, because in the efficient market, once a seasonal inefficiency comes to light it should immediately self-destruct as being part of the newly updated body of information available to the public which prices are supposed to full reflect (Doyle and Chen, 2009). However, if the weekday effect is found within the stock market, the inefficiency of the market is clear.

However, examining the same markets not always brings the same results, too. The explanation of this problem could be another challenge to EMH. Different results are to be expected if data have been sampled in different time frames (Doyle and Chen, 2009). According to this, the new challenge to EMH is that there is possibility of

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<sup>1</sup> Bandopadhyaya and Truong (2010), Who knew: Financial Crises and Investor Sentiment.

continual flux seasonality, rather than fixed one over time. As an example, Mehdian and Perry (2001) found that negative Monday returns during the time period before 1987 had become significant positive Monday returns during the examined period after 1987. Rogalski (1984) confirmed the phenomenon which changes over time, examining longer periods and choosing the DJIA index. Agathee (2008) argues, that one must consider the fact that those anomalies may not necessarily mean that these markets are inefficient. It may turn out that gains on a specific time period may be insignificant when transactions costs are taken into account. Also, one must control for risk premium which may be time varying such that high returns on a specific day may be associated with high risk on that same day.

Day seasonality (calendar effect, weekday effect, day of the week effect) has several formulations. It is generally talking about the Monday negative returns effect and Friday positive return effect. Since the results provided by Cross (1973) shows negative returns on the Standard and Poors index on Mondays, many researchers have detected a day effect on stock returns. On the different markets has been found different calendar effects. For instance, the standard Monday effect suggests that Monday's returns are lower than those for Tuesday through Friday (French 1980, Kamara 1997). Generally, weekday effect or day-of-week effect according to Ke et al. (2007) is simply that weekdays differ in their expected returns. Wide variety of assets has been examined for the week-day-effects, especially in the context of the Monday effect. They range from stocks (Chang et al. 1993; Tong, 2000; Basher and Sadorsky, 2006), to bonds (Jordan and Jordan 1991), to commodities (Gay and Kim, 1987; Crain and Lee, 1996) or even to exchange rates (Yamori and Mourdoukoutas, 2003).

The most studies are related to the stock indices. Aggarwal and Rivoli (1989) examine seasonal and daily patterns in equity returns of four markets: Hong Kong, Singapore, Malaysia and Philippines. Returns in the month of January were found higher than any other month in all markets except the Philippines and the low Monday returns effect was found as well. Brooks and Persaud (2001) tested weekday effect on five South East Asian stock exchanges and did find some evidence for positive Monday effects. Hui (2005) compares various Asia Pacific markets with the US and demonstrate significant evidence of day-of-the-week effects. Hourvoulides and Kourkoumelis (2010) investigate the nature of the day-of-the week effects during the contemporary financial crisis within five equity markets: Greece, Turkey, Bulgaria, Romania and Cyprus. Their results are mixed, according to the different level of maturity and interdependence of each market.

Previous studies generally detected daily abnormal returns by using an analysis of variance. This method is not fully satisfactory because returns are required to be normal, independent and stationary. However, studies, which used the non-normality and heteroskedasticity techniques, for instance Connolly (1991) and Chang et al. (1993) found out that the day of the week effect is weak (Dubois and Louvet, 1995). The aim of our paper is compared differences in changes of weekday effect between five selected European emerging stock markets. The two periods our concluded are from January 2005 to May 2008, and from June 2008 to November 2010 (divided due to start of the financial crisis in the United States). This study examines the daily earnings behaviour of the indexes of the Bratislava, Budapest, Istanbul, Prague, and

Warsaw stock exchange by the least squares regression method and the other econometrical describes.

## **2. Formulation of the problematic our estimated**

### **2.1 Literature review**

The weekday effect refers to the abnormality within the returns of the common stocks on the special days of the week. In general, there are usually negative returns on Mondays and positive returns on Friday. The standard economic theory says that stock prices should follow a martingale process and returns should not exhibit systematic patterns (Samuelson, 1972; Lucas, 1978).

There have been a lot of researches done, examining the anomalies of the stock markets all around the world. However, there are few of them, which are focused on the countries, selected for our study, as the Czech Republic, the Hungary, the Poland, the Slovak Republic, and the Turkey.

The day of the week effect within the European stock markets was studied by Apolinario et al. (2006). Their study includes the Czech stock market and index PX-50 as well. According to their results, the Czech market shows no changes with regards to the day of the week and it was found asymmetric behavior in all selected markets except the Czech one. The Czech Republic was the one of the selected examining countries in the study of Chukwuogor-Ndu (2006), as well as the Slovak Republic. The results shown, that Slovakia, together with other selected countries, experienced lowest returns on Monday. On the other hand, Friday as highest daily return was found out for the Czech Republic.<sup>2</sup>

Patev et al. (2003) studies the day of the week effect of the Central European transition stock markets. Results of this study show that both the Slovak and the Polish stock markets have highest negative returns on Wednesday. The Hungary has significant and negative returns on Thursdays and the Czech stock markets do not exhibit any significant day-of-the-week effect. Similar research was done by Lyrودي et al. (2004), where different results were indicated. The Czech market has significant negative returns on Monday, while the Polish and the Slovak markets have no day-of-the-week effect anomaly.

Turkish stock market and its calendar anomalies were studied by Dicle and Hassan (2007). Paper shows that there is statistically significant day of the week effect for Mondays with negative returns. The general explanation of this effect is the release of new information over the weekend. On the other hand, for Thursdays and Fridays was found the day of the week effect with positive returns. Since Friday is the last working day, investors are optimistic and therefore cause positive returns.

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<sup>2</sup> Tonchev and Kim (2004) examined the calendar anomalies of the stock markets and their study includes both, the Czech Republic and the Slovak Republic. In the empirical analysis study found out very weak evidence for the calendar effects in these countries, and these effects have different characteristics in the different stock markets.

The weekday effect for all the countries, selected for our study, was examined by Yancil and Yucel (2003). Their research for the Slovak Republic, Mondays and Thursdays exhibits higher day of the week effects as compared to Wednesdays, for the Czech Republic dummies have significant negative coefficients in the variance specification, indicating that the variance of Friday returns is significantly lower than that of Wednesdays. For the Hungary, coefficient estimates for Monday dummies are negative and significantly different from those of Wednesdays. For the Poland on Tuesdays and Thursdays the variance is higher for the other days of the week. For the Turkey, Thursdays have a significant positive effect on returns and the highest return compared to Wednesdays occurs on that day.

The study of calendar effects is relevant for investors mainly for developing profitable trading strategies. According to their studies and results, the researchers try to advise the investors, which days of the week are more suitable for selling and which for buying the stocks. Nevertheless, there are not found out the same results within the researches focusing on the day of the week effect within the selected countries for this paper and the results differ study to study. This can be the problem of the various methods, used for the examining this kind of stocks returns behavior. Another explanation of these differences should be the diversity of the examined time periods. Borgers (2009) wrote in her study focused on the calendar effects in stock markets that her results are not immune to the critique that calendar effects may only be a “chimera” delivered by intensive data mining.

## 2.2 Data and Methodology

The approach used in this study is analyzing daily returns of stock market indexes, comparing the daily returns on specific days of the week with the daily returns of the remaining days. Calendar effects can be investigated either using observations of returns of individual stocks of a specific country, but Officer (1975) claims that calendar effects are likely to be detected in market indexes or large stock portfolios than within the individual stock prices.<sup>3</sup>

We used numerical data series from PATRIA statistical financial database, concrete, closing prices of our selected stock Exchange indexes were used. We chose five indexes representing the European emerging stock markets, the Czech PX Index, the Hungarian Budapest SE Index, the Polish Warsaw SE WIG Index, the Slovak SAX Index, and the Turkish Istanbul SE National 100 Index. We conducted using divided data in two periods to illustrate differences which may exist due to financial crises. The first sub-period is from Monday 3<sup>rd</sup> January 2005 to Friday 30<sup>th</sup> May 2008. The second sub-period is in form of daily data from Monday 2<sup>nd</sup> June 2008 to Friday 26<sup>th</sup>

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<sup>3</sup> According to the Doyle and Chen (2009), the standard way to analyze weekday effect was using regression model with daily returns as the dependent variables and weekday dummy variables as the independent variables it was preferred by some of the researchers (Kamara, 1997), but nowadays there are more sophisticated econometrics methods for analyzing this kind of development within the stocks markets. According to their work, the ARCH/GARCH family of models has become standard. On the other hand, some of the researchers are still using the regression model (Agathe, 2008), which is used in our study as well. Al-Rjoub (2004) explains, that it is well known in the econometrics literature that full information maximum likelihood estimation (FIML), such as GARCH models, is more efficient than instrumental variables estimators, such as the two-step regression, although both estimators can be used if the model is correctly specified.

November 2010, which represents the financial crises period. The impact of this crisis on stock markets of selected European emerging markets could be investigated through these time series. Totally there were used more than 1400 observations (it depends on free days of each country in the estimated period).

We adjusted selected time series to make them homogenous within the time, while we chose five day week. To complete the data series, which are necessary for our model, the dummy variables for all week series are estimated. Our model will operate with logarithm values for day to day stock percentages earnings (rate of the returns) according next equation (1).

$$R_i = \log (i_t / i_{t-1}) * 100 \quad (1)$$

So daily logarithmic earnings of the all our selected indexes are used for our model. We create regression model with dummy variables where the return of each index is depend variable, which explore just the time effect through dummy regressors. Our theoretical model is described with next equation (2):

$$R_{t\ Stock} = \beta_1 * D_{MON} + \beta_2 * D_{TUE} + \beta_3 * D_{WED} + \beta_4 * D_{THU} + \beta_5 * D_{FRI} + \varepsilon \quad (2)$$

*Explanation:*

$R_{t\ Stock}$  ...dependent variable, stock day to day earnings of each country,

$D_X$  ...time regressors by dummy variables of each day of week,

$\beta$  ...our calculated coefficients for regressors,

$\varepsilon$  ...residuals of regression model.

***Our hypotheses:***

$H_0$ : Rates of the returns are not significantly different across the five trading days.

$H_1$ : Rates of the returns are significantly different across the five trading days.

### 3. Empirical results

Analyzing the day of the week effect by the regression with dummy variables brings the several results, which differs for individual countries. In Table 1 we can see selected statistics descriptions of time series of stock indexes earnings, and also of each weekday earnings in percentages. We can see one common attribute for all of our selected stock indexes in negative mean or average of all Tuesday earnings.

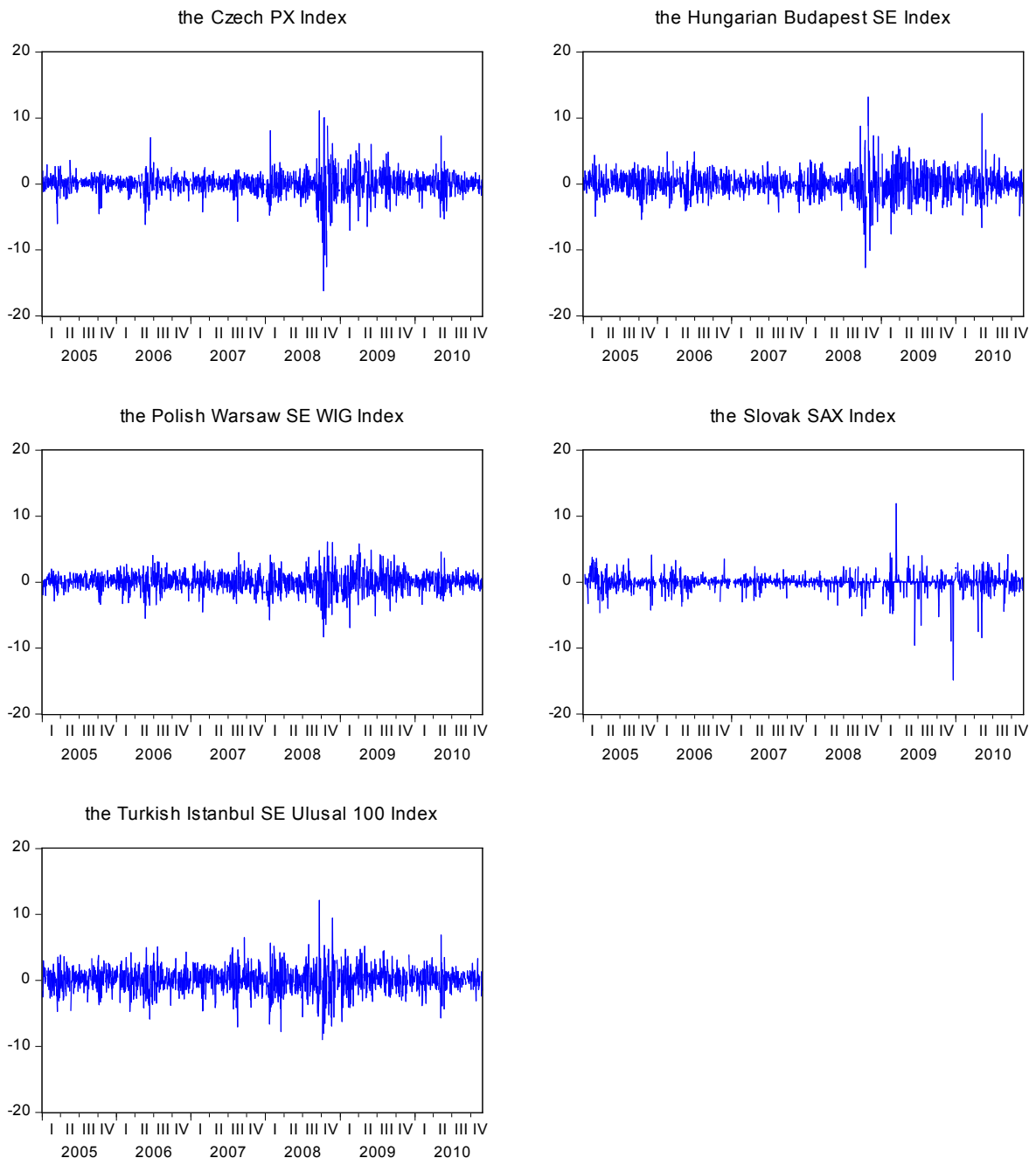
***Tab. 1: Descriptive statistics***

		ALL	MON	TUE	WED	THU	FRI
	<i>Mean</i>	-	0.1283	<b>-0.0893</b>	-	0.0638	-0.1233
<b>Czech</b>	<i>Std. Dev.</i>	1.7665	0.8068	0.6985	0.7361	0.8061	0.8880
	<i>Maximum</i>	11.0931	9.9547	10.0345	3.5834	8.7716	11.0931
	<i>Minimum</i>	-	-	-7.0373	-	-	-16.1855
	<i>Mean</i>	0.0155	0.2297	<b>-0.0418</b>	-	-	0.0020
<b>Hungar</b>	<i>Std. Dev.</i>	1.8734	0.7869	0.7679	0.9559	0.8660	0.7968
	<i>Maximum</i>	13.1778	10.6743	8.8386	13.1778	5.2417	8.7572
	<i>Minimum</i>	-	-	-6.3358	-	-	-6.6132
	<i>Mean</i>	0.0243	0.0919	<b>-0.0319</b>	0.0321	0.0461	-0.0168
<b>Poland</b>	<i>Std. Dev.</i>	1.4464	0.6835	0.6494	0.6570	0.6571	0.5828

	<i>Maximum</i>	6.0837	6.0204	4.1246	6.0837	5.7991	4.7581
	<i>Minimum</i>	-8.2888	-	-6.8813	-	-	-8.2888
	<i>Mean</i>	-0.0276	-	<b>-0.0473</b>	-	0.0458	-0.0791
<b>Slovak</b>	<i>Std. Dev.</i>	1.2397	0.6242	0.5461	0.4766	0.4351	0.6579
	<i>Maximum</i>	11.8803	11.8803	3.7348	2.9125	3.9228	4.3890
	<i>Minimum</i>	-	-	-8.9254	-	-	-14.8101
	<i>Mean</i>	0.0532	0.0408	<b>-0.0100</b>	0.0388	0.1455	0.0511
<b>Turkey</b>	<i>Std. Dev.</i>	1.8825	0.8915	0.7696	0.8365	0.8706	0.8369
	<i>Maximum</i>	12.1272	9.4253	5.2929	6.4843	5.6468	12.1272
	<i>Minimum</i>	-9.0137	-	-5.8351	-	-	-8.0306

*Source: (Authors calculations)*

In Table 1 we can also see and compare rate risk of investing of each weekday in form of standard deviation value. The highest rate risk is detected in the Turkey, the second in the Hungary for all time series. The financial crisis impacts and changes in volatility of indexes we can see in Graph 1. For understandable presentation of the output of volatility for indexes returns, it is better to use the graph demonstrating day to day returns. We can also see that the lowest decrease of indexes earning was in the Czech Republic and the higher volatility due to financial crises is detected in the Hungary and the Slovak Republic.



**Fig. 1: The volatility of earnings on the stock indexes**

*Source: (Authors calculations)*

We can also see positive Monday mean in all countries except the Slovak Republic. In this stage of our research we are not able to confirm statistical significant differences between the days' returns. In Table 1 we just investigate all earnings on indexes in undivided time series, but for the construction of our regression models we use both, whole time period data and sub-periods separately. We will see if some weekday trend does really exist and if it is statistical significant in context of the financial crisis. In statistical descriptions we can see in which day of the week reached indexes earnings their minimum and maximum values, too. Maximum and minimum returns during the period are observed in different days within the countries. The highest and the lowest return appears on Friday for the Czech stock exchange and on



Friday there is the highest risk as well. For the Hungarian stock exchange extreme returns are observed on Wednesday, what is connected with the highest standard deviation value observed this day. The Polish stock exchange is different, because the maximal return appears on Wednesday and the minimal return appears on Friday. The highest risk is on Monday. The highest return is detected on Monday and the lowest on Friday in the Slovak stock exchange. Friday is the day with the highest standard deviation. Finally, in the Turkish stock exchange, there is the maximal return found out on Friday and minimal on Monday, so the results are opposite those in the Slovak Republic. The highest risk in the Turkish stock exchange is detected on Monday.

Table 2 included in Appendix chart of our paper is divided into 3 parts. We can see that in period before financial crisis there is no weekday effect in all our selected European stock markets. One of the most important indicators of the regression model Adjusted R squared (which would reveals the effectivity of the model) has even reached negative values or close to zero values. It is due to the fact, that we explain differences between earnings of stock indexes without any fundamental exogenous variables, only through time dummy variables in form of the day of the week. Our model is not explaining the returns of the indexes but only the calendar anomalies, so the indicator Adjusted R-squared is not important for the findings of our research. Durbin-Watson stat value (which would reveal the correctness of the model and indicate autocorrelations) is not important for us as well, because we do not examine autocorrelations in time series, but in all cases its value is close to number 2. We illustrate error of our regression models as well, because our opinion is that in crises we will have worse models with higher value of SE of regression.

In the second part of period (in our second sub-period) including the financial crisis, we see some differences in the weekday effect of stock market earnings development in two countries. In the Czech Republic we found out Friday decreased weekday effect at 10 % statistical significance level. In the Hungary we found out Monday increased weekday effect at 5 % level. These facts may exist due to financial crisis and its impacts on the stock markets. In the other selected countries, the Poland, the Slovak Republic, and the Turkey, there are no statistical significant developments between indexes returns in any day of the week. Adjusted R-squared is near to zero again. Our hypothesis that error value of regression models will be worse in this period is reflected in all cases.

In the third part of Table 2 we can see that the period of the financial crisis influences the output of the model for all time series. The Hungarian Monday increase effect is still detected on 5 % statistical significance with lower coefficient in percentage of growth.

According to the comparison of the results in Table 1 and Table 2 we would say, that Monday Hungarian increasing has the second lowest rate risk of the weekdays. In the Czech Friday decreasing there is the highest rate risk of the weekdays. From our results we should strongly reject hypothesis that the stock returns in selected countries are significantly different across the five trading days only in the period before the global financial crisis.

## 4. Conclusions

Our paper provides the empirical research of weekday effect in five our selected European countries stock exchanges and impacts of the financial crisis on them. The aim of the article was compared differences in changes of weekday effect between our selected European emerging stock markets and during the two sub-periods: before and after the global financial crisis. Our findings for the remaining countries are not united. The results of the regression models with dummy variables proved that there are some differences in two countries in form of the Czech Friday decreasing effect, and stronger the Hungarian Monday increasing effect on stock returns' differences. These statistically significance differences of returns on stock emerging markets exist due to our results only in period affected by global financial crisis. Our results found out calendar effects that are rather different from those, founded by the previous researches. In generous, if the difference on returns on Monday is statistically significant, the decreasing earnings are expected while if the difference on return is significant on Friday, the increasing earnings are expected

According to our results, anomalies on the examined stock markets of the selected countries appear only during the period of financial crisis. Selected stocks markets seem to be efficient, except the period of the global financial crisis, so the crisis brings the inefficiency into the behavior of stock markets. However, to confirm the efficiency for some of the selected markets, the trading activity has to be considered. For example, the Slovak stock market is known as market with very low level of trading activity.

Our opinion is that regression analysis with dummy variables to estimate day of the week effect on the capital markets is not usable to reflect impacts on the real management and production of companies. It is usable for individual advice to investors but not to whole market, because some weekday effect won't exist in future due to behaviour of investors. Also we demonstrate that through using selected stock indexes data, and also some of our selected markets, are definitely not typical for that kind of analysis due to their business properties. Therefore our work is useable maybe for speculation of some investors on the secondary capital markets.

To evaluate our research and to confirm our results we could also use other econometrical and statistical methods than the regression method. GARCH method or Kruskal-Wallis tests are two of the possible alternative methods, which could be used for our research. It could be interesting to compare empirical results using other methods from the same data for these countries.

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## Appendix 1

*Tab. 2: Modeling of the day effect in regression models*

Period before 1 <sup>st</sup> June 2008						
	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$	$\beta_5$	S.E. of reg.
<b>Czech Republic</b>	0.0017	0.0451	-0.0113	0.0847	0.1061	1.2381
<b>Hungary</b>	0.0407	0.0717	-0.0661	0.0222	0.1633	1.4117
<b>Poland</b>	0.0524	-0.0183	0.0430	0.0571	0.1107	1.2354
<b>Slovak Republic</b>	0.0156	0.0348	-0.0077	0.0899	0.0662	0.9301
<b>Turkey</b>	-0.1437	0.0854	0.0172	0.1203	0.1437	1.7782

Period after 1 <sup>st</sup> June 2008						
	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$	$\beta_5$	S.E. of reg.
<b>Czech Republic</b>	0.3086	-0.2739	-0.0605	0.0332	<b>-0.4348</b> <sup>***</sup>	2.2958
<b>Hungary</b>	<b>0.5208</b> <sup>**</sup>	-0.1884	-0.0558	-0.1445	-0.2315	2.3524
<b>Poland</b>	0.1491	-0.0496	0.0158	0.0305	-0.1958	1.6946
<b>Slovak Republic</b>	-0.0515	-0.1585	-0.0942	-0.0144	-0.2708	1.5621
<b>Turkey</b>	0.2937	-0.1417	0.0675	0.1819	-0.0806	2.0217

All periods						
	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$	$\beta_5$	S.E. of reg.
<b>Czech Republic</b>	0.1317	-0.0903	-0.0318	0.0630	-0.1217	1.7664
<b>Hungary</b>	<b>0.2460</b> <sup>**</sup>	-0.0427	-0.0616	-0.0476	0.0019	1.8727
<b>Poland</b>	0.0934	-0.0319	0.0313	0.0458	-0.0171	1.4477
<b>Slovak Republic</b>	-0.0127	-0.0476	-0.0443	0.0450	-0.0794	1.2407
<b>Turkey</b>	0.0414	-0.0099	0.0383	0.1461	0.0513	1.8844

*Explanation: symbols \*\*\* and \*\* mean statistical significance of probability on 10 %, and strictly 5 % threshold.*

*Source: (Author's calculations).*