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Day of The Week Anomaly During Financial Crisis: Portugal, Italy, Greece, Spain and Ireland

Mine Aksoy
Department of Business Administration, Faculty of Economics and Administrative Sciences, Yalova University, 77100 Yalova Turkey
mine_aksoy@hotmail.com

Z.Oğuz Seçme
Department of Business Administration, Faculty of Economics and Administrative Sciences, Yalova University, 77100 Yalova Turkey
oguzsecme@yalova.edu.tr

Selin Karatepe*
Department of Business Administration, Faculty of Economics and Administrative Sciences, Yalova University, 77100 Yalova Turkey
skaratepe@yalova.edu.tr

Fatma Benli
Department of Economics, Faculty of Economics and Administrative Sciences, Yalova University, 77100 Yalova Turkey
fbenli@yalova.edu.tr

Abstract: Portugal, Italy, Greece, Spain and Ireland are the European countries having similar economic environments. Since the European sovereign debt crisis, they are referred as a group of European economies facing particular financial crisis. In this paper we analyze the price dynamics of these stock markets during the global financial crisis and European sovereign debt crisis period. We focus on the presence of days of the week effect in daily price returns and volatilities. Results show that calendar anomalies still exist and the volatility pattern across days of the week is statistically different for all indexes.

JEL Classification**:** G11, G12, G15

Keywords: Days of the week, volatility, GARCH, EGARCH

Introduction

The presence of calendar anomalies has been documented extensively for many years in financial markets. Among these, the most common ones are the weekend effect and the days of the week effect. The days of the week effect implies that the stocks return is not independent of the days of the week in which they are generated. On the other hand, weekend effect is a phenomenon in financial markets in which stock returns on Mondays are often significantly lower than those of the immediately preceding Friday.

An investor is expected to check the return of the stock before buying it. Nonetheless, return of the stock is not the only condition to be aware of and there is another condition which should not be underestimated, namely the volatility of the stock price. Whether volatility level of stock price is related with volatility level of a given day is quite important to know for the investors. Identifying a particular pattern for the days of the week would help the investors review their position in the stock market with a view to keep clear of high volatility in their portfolio.

Several researchers have argued that seasonalities in stock returns should diminish over time due to the improved market efficiency. Accordingly, our study investigates the days of the week effect on return and volatility for Portugal, Italy, Greece, Spain and Ireland stock markets with GARCH, EGARCH models from 2006 to 2011. The results show that calendar anomalies still exist, and the volatility pattern across the days of the week is statistically different for all indexes.

The remainder of this paper continues as follows. We discuss relevant literature in Section 1. Section 2 provides the data and Section 3 discusses methodological issues. We discuss our findings regarding days of the week for return and return volatilities. Finally, we finish by summarizing our main findings.

Literature

The days of the week effect as calendar anomaly has been widely studied in finance literature. Cross (1973), French (1980), Gibbons and Hess (1981), Lakonishok and Levi (1982), Keim and Stambaugh (1984), Rogalski (1984) and Balaban (1995) are researches who argue for the days of the week effect.

These studies were first carried out in U.S. Stock Market and later in other international financial markets. Researchers found interesting results for equity market for other countries. Among them are Theobald and Price (1984), Board and Sutchliffe (1988), Jaffe and Westerfield (1985), O'Hanlon et al (1987), Wong et al (1992), Chang et al (1993), Athanassakos and Robinson (1994), Dubois and Louvet (1996).

Hourvouliades N.L. and N. Kourkoumelis (2009) investigate the existence and nature of the days-of-the-week effect during the contemporary financial crisis for Turkey, Bulgaria, Romania, Ukraine, Cyprus, and Greece for the period between 2003 and 2009. They divide their study period in two parts: the first expands from January 2003 until November 2007, and the second from December 2007 until the end of January 2009. For Greece, they find evidence that the days-of-the-week effect in mean evaporates during the crisis days but the same does not happen in the series' variance.

Apolinaria, Santana, Sales Caro (2006), studies the existence of the days-of-the-week effect for Germany, Austria, Belgium, Denmark, Spain, France, The Netherlands, Italy, Portugal, The United Kingdom, The Czech Republic, Sweden and Switzerland starting from July 2, 1997 and ending on March 22, 2004. They find days of the week effect in all of the financial markets except Portugal and the Czech Republic for volatility.

Chukwuogor-Ndu (2006) studies fifteen European financial markets indexes from January 2nd, 1997 to December 31st 2004 in order to determine the daily returns, days-of-the-week effect and volatility of returns. The financial markets studied are: Austria, Belgium, Czech Republic, Denmark, Germany, France, Italy, Netherlands, Russia, Slovakia, Spain, Sweden, Turkey, Switzerland, and United Kingdom. The study finds evidence for the presence of the days of the week effect during the period 1997-2004. Seven of the European Financial markets experiences negative returns on Monday and seven others also experience negative returns on Wednesday. Additionally, the occurrence of the highest daily return is almost evenly spread across Monday, Thursday and Friday. The lowest return is generally experienced on Monday and Wednesday and the daily returns exhibit the greatest volatility on Monday for eleven of the markets.

Lucey (2000) studies the Iris stock market for the period 1973-1998. He couldn't find the evidence of a negative Monday or Tuesday effect for returns. By contrast, he finds some evidence of a persistent Wednesday effect.

Another study investigating the days of the week effect on return and volatility comes from Kenourgios and Samitas (2008) who concentrate on major Athens Stock Exchange (ASE) indexes. Using a conditional variance framework they observe that the days of the week effect in both the return and volatility equations is present over the period 1995-2000. However, this stock market anomaly seems to lose its strength and significance after the Greek entry into the Euro-Zone.

Data

The data used in this paper consists of daily data from the period 2006 to 2011. FTSEMIB Index for Italy, PSI20 Index for Portugal, FTASE Index for Greece, ISEQ20P Index for Ireland and IBEX Index for Spain were used as the blue chip stock market indexes for the analysis. Daily return is calculated as the percentage logarithmic change in the value of index compared to previous day's closing value as in the following:

$$Y_t = \ln (P_t / P_{t-1})$$

Skewness is a measure of asymmetry of the distribution of the series around its mean. The skewness of a symmetric distribution, such as the normal distribution, is zero. A positive (/negative) skewness suggests a higher (/lower) than normal distribution chance of higher (/lower) than mean return. Kurtosis measures the peakedness or flatness of the distribution of the return series. A normal distribution has a kurtosis value equal to three. If it exceeds three, the distribution is peaked relative to the normal; on the other hand, if it is less than three, the distribution is flat relative to the normal. Hence, it captures the excess probability of abnormal returns, regardless of the sign of the returns. Jarque-Bera is a statistic for testing whether the series are normally distributed and measures the difference of the skewness and kurtosis of the series with those from the normal distribution.

Table 1 gives the descriptive statistics for daily stock market returns for the entire period. In the appendix daily descriptive statistics for each index is given.

As it can be noticed from Table 1, the kurtosis for all indexes exceeds three. All series exhibit high Jarque-Bera test statistics which strongly suggests a rejection of normality. All the countries have negative returns. In addition, the volatility of the returns in terms of standard deviation is the highest for Greece and lowest for Portugal.

A visual perspective on the volatility of returns can be gained from the plots of daily returns for each series in Figure 1. All countries follow a similar pattern especially during the crisis periods (2008 and 2010). It should be noted that all returns are time varying with volatility clusters.

Table 1 . Summary statistics for index returns

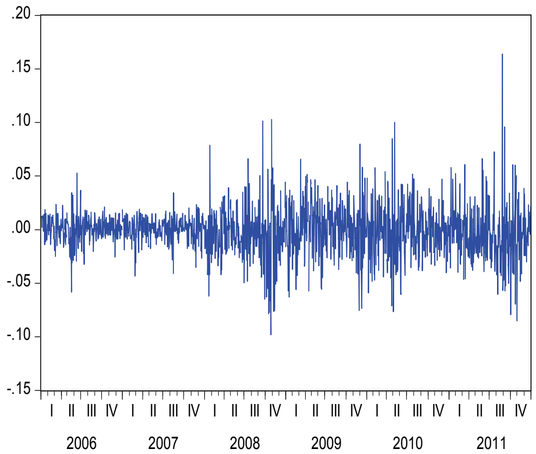
	Greece	Ireland	Italy	Portugal	Spain
Mean	-0.001354	-0.000597	-0.000570	-0.000292	-0.000151
Median	-0.000336	0.00461	0.000492	0.000267	0.000622
Maximum	0.163741	0.108228	0.108742	0.101959	0.134836
Minimum	-0.097963	-0.149554	-0.085591	-0.103792	-0.095859
Std. Dev.	0.022747	0.019428	0.017404	0.013617	0.016950
Skewness	0.268809	-0.464837	-0.027346	-0.061973	0.183622

Kurtosis	6.8231179	8.966916	8.004210	11.36915	9.576337
Jarque-Bera	931.6083	2311.184	1590.365	4483.712	2760.248
Probability	0.000000	0.000000	0.000000	0.000000	0.000000

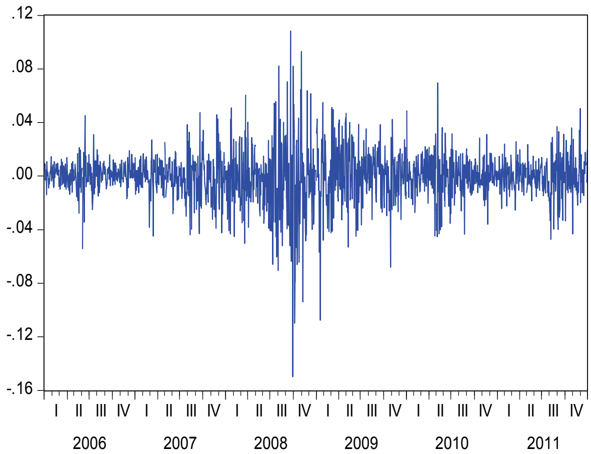
Note:1.Jarque-Bera test statistics is based on Jarque and Bera (1987) and is a normal distribution test.

Figure 1. Time series plots of daily return

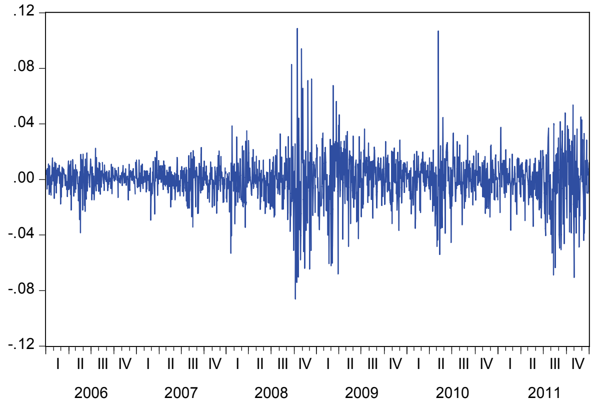
GREECE



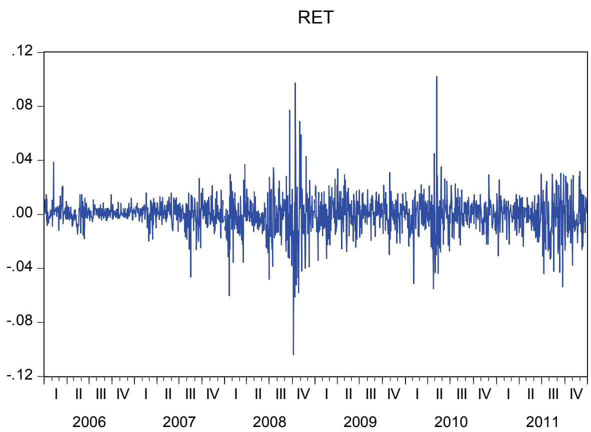
IRELAND



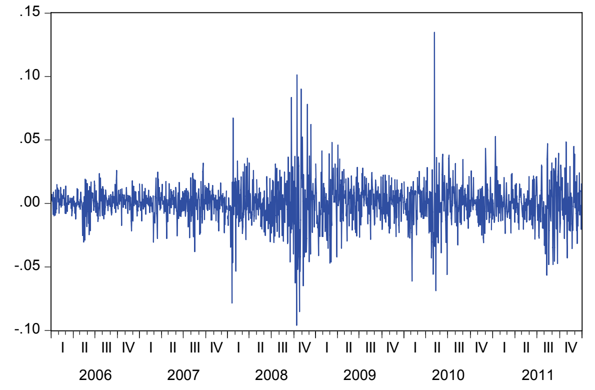
ITALY



PORTUGAL



SPAIN



Methodology

In our study we apply generalized autoregressive conditional heteroscedasticity (GARCH) model proposed by Bollerslev (1986) which allows for the conditional variance to be linearly dependent on the past behavior of the squared residuals and a moving average of the past conditional variances. The lagged squared error terms imply that if past errors have been large in absolute value, they are likely to be large in the present, leading to volatility clustering. The model used here will follow the simple GARCH (1,1).

Following Berument and Kiymaz (2001), the GARCH model with dummy variables representing the days of the week is adopted:

(1a)

$$Y_t = \beta_0 + B_1 Y_{t-1} + m_1 d_{1,t} + m_2 D_{2,t} + m_3 D_{3,t} + m_4 D_{4,t} + m_5 D_{5,t} + \varepsilon_t$$

$$Y_t = \beta_0 + B_1 Y_{t-1} + m_1 d_{1,t} + m_2 D_{2,t} + m_3 D_{3,t} + m_4 D_{4,t} + m_5 D_{5,t} + \varepsilon_t$$

(1b)

$$\varepsilon_t \mid \Omega_{t-1} \sim N(0, h_t) \quad \varepsilon_t \mid \Omega_{t-1} \sim N(0, h_t) \quad \varepsilon_t \mid \Omega_{t-1} \sim N(0, h_t)$$

γ_t is the index return on day t. D_1, t through D_5, t are days of the week dummies that are either 0 or 1 (D_1 t =1 for Monday and 0 otherwise and so on). ε_t is the random error term for day t. If M_1 is positive and significant, this suggests that the average return on Monday is significantly higher than zero. Similar interpretation is applied to M_1, M_2, M_3, M_4, M_5.

We model the conditional variability of index returns by incorporating the days of the week effect into our volatility equation. The coefficients V_1 through V_5 represent the volatility on Monday to Friday. If V is positive and significant, this suggests that the volatility on Monday is significantly higher than zero.

(2)

$$h_t = \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=i}^{p} \beta_j h_{t-j} + V_1 D_{1,t} + V_2 D_{2,t} + V_3 D_{3,t} + V_4 D_{4,t} + V_5 D_{5,t} + V_c$$

This specification requires $\alpha_i + \beta_j < 1$ in order to satisfy the non-explosiveness of the conditional variance. Each V_c, α_i, β_j has to be positive in order to satisfy the non-negativity of conditional variances for each given time t.

An important restriction of GARCH model is about the symmetric response of volatility to positive and negative shocks. However, it can be observed that "bad" news or a negative shock to financial time series has larger effects on volatility than "good" news or a positive shock does. The tendency of such a negative correlation between volatility and returns is often called the leverage effect. A model that allows this asymmetric effect of shocks is the exponential-GARCH (EGARCH) model. Nelson (1991) proposed a specification that does not require the non-negativity of model parameters which is another advantage over the standard GARCH model Enders (2004). The specification of the conditional variance equation can be expressed by

$$\log(\sigma_t^2) = \omega + \sum_{j=1}^{p}[\beta_j \log(\sigma_{t-j}^2)] + \sum_{i=1}^{q} \alpha_i \frac{|\varepsilon_{t-i}|}{\sqrt{\sigma_{t-i}^2}} + \sum_{i=1}^{q} \gamma_i \frac{\varepsilon_{t-i}}{\sqrt{\sigma_{t-i}^2}} \tag{3}$$

There are some important features of EGARCH model to be noticed:

Since the conditional variance equation is in log-linear form, regardless of the negativity of the model, parameters σ_t^2 can never be negative. Therefore, there is no need for any restrictions about the non-negativity of the estimated coefficients.

The asymmetries are allowed under the EGARCH specification. If γ_i is not equal to zero, then this means that there is an asymmetric effect on the log of the conditional variance. If there is a leverage effect, γ_i will be negative, which means the effect of a negative shock has greater effects on the log of the conditional variance than does a positive shock of the same magnitude.

The EGARCH model uses the standardized value of ε_{t-i} instead of using , ε_{t-i}^2 , which is argued by Nelson that this standardization allows for a better interpretation of the magnitude and persistence of shocks (Enders 2004).

To eliminate the possible multicollinearity problems we dropped one of the dummies in regression equations for days of the week.

Empirical Results

For GARCH (1,1) model, Vc must be positive and the sum of the coefficients in the conditional variance equation, (α + β), must be less than unity for the process to be stationary. This sum also indicates the level of persistence in the volatility shocks. A sum close to unity is favorable for providing evidence of a persistent volatility process (Bollerslev 1986). For Greece and Portugal α + β is greater than one, and for Ireland Vc is negative. Additionally, for Italy and Spain results are meaningful.

The results of GARCH (1,1) and modified GARCH (1,1) analyses are reported for Italy on Table 4. We dropped dummy for Wednesday in regression equation. All days are significant as well as negative. The returns on Friday are higher than the returns on Monday. When the modified GARCH (1,1) is estimated for Italy, all the coefficients for volatility equation are insignificant. The results of EGARCH (1,1) and modified EGARCH (1,1) analysis are reported for Italy on Table 4 and the results appear to be consistent with GARCH (1,1) results for Italy.

The results of GARCH (1,1) and modified GARCH (1,1) analyses are reported for Spain on Table 6. We dropped dummy for Wednesday in regression equation. Only Monday and

Tuesday are significant and negative. Although insignificant, the returns on Friday are higher than the returns on Monday. When the modified GARCH (1,1) is estimated for Spain, all the coefficients for volatility equation except Thursday are insignificant. The results of EGARCH (1,1) and modified EGARCH (1,1) analyses are reported for Spain in Table 6, as well. Results are consistent with GARCH (1,1) results for Spain.

The results of EGARCH (1,1) and modified EGARCH (1,1) analyses are reported for Greece in Table 2. We dropped dummy for Wednesday in regression equation. Only Monday and Tuesday are significant. For volatility equation all days are significant. The highest volatility is observed on Tuesday followed by Monday whereas the lowest volatility is observed on Friday.

The results of EGARCH (1,1) and modified EGARCH (1,1) analyses are reported for Ireland on Table 3. We dropped dummy for Wednesday in regression equation. The results indicate that only Tuesday is significant both for return and volatility.

Finally, the results of EGARCH (1,1) and modified EGARCH (1,1) analyses are reported for Portugal on Table 5. We dropped dummy for Wednesday in regression equation. While only Tuesday and Thursday are significant for return Monday stands out as significant for volatility.

Table 2. Regression results for GREECE

	GARCH(1,1)		Modified GARCH(1,1)			EGARCH(1,1)			Modified EGARCH(1,1)	
Return Equation	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**
m_1	-0.0035	0.0051	-0.0035	0.0022	m_1	-0.0031	0.011		-0.0030	0.009
m_2	-0.0030	0.0066	-0.0028	0.0237	m_2	-0.0028	0.006		-0.0025	0.022
m_4	0.0036	0.9758	0.0002	0.8569	m_4	-0.0001	0.929		-0.0032	0.976
m_5	0.0002	0.8510	0.0001	0.9049	m_5	0.0004	0.716		0.0004	0.707
β_0	0.0019	0.0288	0.0001	0.0288	β_0	0.0010	0.243		0.0009	0.242
β_1	0.0351	0.1657	0.0369	0.1270	β_1	0.0435	0.094		0.0518	0.047
Variance Equation										
V_c	0.0002	0.018	-0.0043	0.007						
α	0.1078	0.000	0.1081	0.000						
β	0.8965	0.000	0.8957	0.000						
V_1			0.0041	0.073	**Variance Equation**			**Variance Equation**		
V_2			0.0095	0.000	V_c	-0.248	0.000	V_c	-0.524	0.000
V_4			0.0052	0.055	α	0.166	0.000	α	0.160	0.000
V_5			0.0039	0.094	β	0.985	0.000	β	0.984	0.000
					γ	-0.082	0.000			
								γ	-0.086	0.000
								V_1	0.317	0.010
								V_2	0.515	0.000
								V_4	0.299	0.032
								V_5	0.230	0.071

Table 3. Regression results for IRELAND

	GARCH(1,1)		Modified GARCH(1,1)			EGARCH(1,1)			Modified EGARCH(1,1)	
Return Equation	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**
m_1	-0.0011	0.2893	-0.0012	0.1946	m_1	-0.0007	0.4839		-0.0009	0.3581
m_2	-0.0020	0.0217	-0.0021	0.0476	m_2	-0.0024	0.0061		-0.0024	0.0147
m_4	-0.0003	0.7348	-0.0002	0.7885	m_4	-0.0385	0.9680		0.0002	0.9979
m_5	0.0003	0.7169	0.0001	0.8817	m_5	0.0003	0.7323		0.0003	0.7164
β_0	0.0000	0.1732	0.0012	0.0778	β_0	0.0005	0.4196		0.0005	0.4763
β_1	0.0360	0.2026	0.0405	0.1511	β_1	0.0368	0.1793		0.0373	0.1710
Variance Equation										
V_c	0.0000	0.0038	-0.0133	0.3334						
α	0.1044	0.000	0.1077	0.000						
β	0.8942	0.000	0.8889	0.000						
V_1			0.0119	0.4843	**Variance Equation**			**Variance Equation**		
V_2			0.0571	0.0024	V_c	-0.2536	0.000	V_c	-0.3221	0.0006
V_4			0.0582	0.8159	α	0.1687	0.000	α	0.1663	0.0000
V_5			0.0549	0.7611	β	0.9853	0.000	β	0.9843	0.0000
					γ	-0.0807	0.000	γ	-0.0869	0.0000
								V_1	0.0674	0.5778
								V_2	0.3267	0.0319
								V_4	0.0027	0.9857
								V_5	-0.0879	0.4831

Table 4. Regression results for ITALY

	GARCH(1,1)		Modified GARCH(1,1)			EGARCH(1,1)			Modified EGARCH(1,1)	
Return Equation	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**
m_1	-0.0030	0.0003	-0.0029	0.0029	m_1	-0.0027	0.0007		-0.0027	0.0044
m_2	-0.0025	0.0034	-0.0024	0.0095	m_2	-0.0025	0.0020		-0.0024	0.0036
m_4	-0.0021	0.0167	-0.0022	0.0149	m_4	-0.0022	0.0107		-0.0022	0.0124
m_5	-0.0019	0.0260	-0.0020	0.0293	m_5	-0.0018	0.0313		-0.0018	0.0256
β_0	0.0021	0.0006	0.0020	0.0016	β_0	0.0015	0.0092		0.0015	0.0144
β_1	-0.0377	0.1880	-0.0365	0.2059	β_1	-0.0213	0.4668		-0.0207	0.4804
Variance Equation										
V_c	0.00184	0.0037	0.0002	0.8404						
α	0.1124	0.0000	0.1153	0.0000						
β	0.8874	0.0000	0.8843	0.0000						
V_1			0.0009	0.4756	**Variance Equation**			**Variance Equation**		
V_2			-0.0002	0.8787	V_c	-0.2552	0.000	V_c	-0.2084	0.0420
V_4			-0.0109	0.5699	α	0.1391	0.000	α	0.1485	0.0000
V_5			0.0003	0.8205	β	0.9829	0.000	β	0.9817	0.0000
					γ	-0.1113	0.000	γ	-0.1156	0.0000
								V_1	0.1954	0.1497
								V_2	-0.2512	0.1276
								V_4	-0.0949	0.6120
								V_5	-0.1726	0.1846

Table 5. Regression results for PORTUGAL

	GARCH(1,1)		Modified GARCH(1,1)			EGARCH(1,1)			Modified EGARCH(1,1)	
Return Equation	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**
m_1	-0.0005	0.3498	-0.0007	0.2946	m_1	-0.0005	0.3862		-0.0006	0.3059
m_2	-0.0016	0.0031	-0.0016	0.0087	m_2	-0.0017	0.0019		-0.0019	0.0016
m_4	-0.0009	0.0836	-0.0011	0.0530	m_4	-0.0012	0.0450		-0.0013	0.0385
m_5	-0.0005	0.3809	-0.0007	0.2420	m_5	-0.0003	0.5761		-0.0005	0.3524
β_0	0.0015	0.0002	0.0015	0.0008	β_0	0.0010	0.0108		0.0011	0.0077
β_1	0.0619	0.0171	0.0598	0.0249	β_1	0.0708	0.0070		0.0692	0.0097
Variance Equation										
V_c	0.00136	0.0001	0.0004	0.3640						
α	0.1679	0.0000	0.1684	0.000						
β	0.8422	0.0000	0.8412	0.000						
V_1			0.0005	0.4460	**Variance Equation**			**Variance Equation**		
V_2			-0.0003	0.6641	V_c	-0.4679	0.0000	V_c	-0.4426	0.0000
V_4			-0.0014	0.1248	α	0.2274	0.0000	α	0.2230	0.0000
V_5			-0.0003	0.5497	β	0.9680	0.0000	β	-0.9673	0.0000
					γ	-0.1315	0.0000			
								γ	-0.1312	0.0000
								V_1	0.3136	0.0099
								V_2	-0.1335	0.3574
								V_4	-0.1137	0.4878
								V_5	-0.2134	0.0852

Table 6. Regression results for SPAIN

	GARCH(1,1)		Modified GARCH(1,1)			EGARCH(1,1)			Modified EGARCH(1,1)	
Return Equation	**Coefficient**	**p-value**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**	**Return Equation**	**Coefficient**	**p-value**
m_1	-0.0022	0.0149	-0.0023	0.0168	m_1	-0.0015	0.0783		-0.0016	0.0735
m_2	-0.0021	0.0112	-0.0022	0.0206	m_2	-0.0018	0.0331		-0.0019	0.0397
m_4	-0.0014	0.1433	-0.0017	0.0614	m_4	-0.0009	0.2838		-0.0009	0.2887
m_5	-0.0010	0.2326	-0.0013	0.1800	m_5	-0.0006	0.4379		-0.0080	0.3757
β_0	0.0020	0.0007	0.0022	0.0014	β_0	0.0009	0.1003		0.0010	0.0966
β_1	-0.0019	0.9446	-0.0011	0.9665	β_1	0.0167	0.5354		0.0186	0.4980
Variance Equation					β_2	-0.0250	0.3639		-0.0256	0.3557
V_c	0.0004	0.0000	0.0014	0.2457						
α	0.1294	0.0000	0.1294	0.0000						
β	0.8627	0.0000	0.8641	0.0000						
V_1			-0.0013	0.3646	**Variance Equation**			**Variance Equation**		
V_2			-0.0000	0.9671	V_c	-0.3101	0.0000	V_c	-0.2904	0.0058
V_4			-0.0043	0.0469	α	0.1168	0.0000	α	0.1202	0.0000
V_5			0.0006	0.6660	β	0.9743	0.0000	β	0.9733	0.0000
					γ	-0.1413	0.0000	γ	-0.1443	0.0000
								V_1	0.0581	0.6557
								V_2	-0.0341	0.8296
								V_4	-0.0856	0.6104
								V_5	-0.0947	0.4626

Conclusion

This study examined the possible existence of days of the week effect on return and volatility. Regressions were run using dummy variables for days of the week. The empirical results provide evidence for the existence of the days of the week anomaly for all indexes.

Portfolio rebalancing, information processing, and lack of information seem to be effective on higher volatility and lower returns of Mondays. Days of the week anomaly in these countries is especially interesting as it could support the proposition that these anomalies are general, world-wide phenomena rather than the result of a special type of institutional arrangement in these countries and did not disappear during the financial crisis period.

In conclusion, the findings of these calendar anomalies in all indexes have important implications for practitioners and academics. For practitioners, it affects the asset allocation, hedging decisions and the timing of security issuances by firms. For academics, it has implications for asset pricing and performance evaluation.

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