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Twist-of-the-Monday Effect: Evidence from United State and 18 Selected European Union Stock Markets

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Abstract

This study found evidence on the twist-of-the-Monday effect, where returns on Mondays are influenced by the previous week's returns in Finland, Greece, Hungary, Netherlands, Portugal and Sweden stock markets. Interestingly, the tendency to follow previous week return is not limited to Monday only. Friday returns are also found to be influenced by the market performance of the previous week in Finland and Poland stock markets. Thus, international investors may benefit from the twist-of-the-Monday effect in developing a suitable trading strategy to obtain extra returns from these markets.

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1. Introduction

Understanding the stock market behaviour, especially the price movement and the return generating mechanism, is always of great interest not only to the market participants, but also academicians. In this context, historical stock prices have become the main tool for academicians and non-academicians in studying and predicting the stock market movement. Important information, among others, that can be abstracted from historical stock prices is the twist-of-the-Monday effect. This term, twist-of-the-Monday effect is first proposed by Jaffe *et al*. (1989), indicate that negative returns on Monday actually follow a decline in the market during prior week and that they disappear when the market rises in the previous week.

Besides, the twist-of-the-Monday effect in Brazilian stock market is found in the study by Aggrawal and Tandon (1994) and Aggrawal and Leal (1996). Furthermore, Aggrawal and Tandon confirmed that the Monday returns are negative most of the time after a negative return on the previous Friday. Follow by Madureira and Leal (2001) and Fajardo and Ferreira (2008), both studies once again confirmed that the twist-of-the-Monday effect exist in the Brazilian stock market. In line with the earliest studies, Lim *et al*. (2010) and Lim and Chia (2010) found significant evidence of twist-of-the-Monday effect in Malaysia stock market. Besides, Lim and Chia (2010), in their study also found evidence on the twist-of-the-Monday effect, where the returns on Mondays are influenced by the previous week's returns in Indonesia and Philippines stock markets.

However, there is generally lack of research on this important theme in the European stock markets. Therefore, the purpose of this paper is to examine the twist-of-the-Monday effect in the selected EU countries (Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and United Kingdom) and also United State stock markets. Confirmation of this anomaly would add some value to the literature and market practitioners in developing investment strategies.

2. Data and Econometric Methodology

Daily closing stock values will be used for this study. They are 18 stock indices from EU countries (Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and United Kingdom) and also the stock index of United State. This study covers the period from June 3, 2002 to July 22, 2011 for all the countries except Bulgaria which covers from June 1, 2005. The data were obtained from Morgan Stanley Capital International (MSCI).

The daily percentage change or return, R_t, of a stock index is calculated as follows:

$$R_t = \ln(P_t / P_{t-1}) \times 100 \qquad (1)$$

where P_t and P_{t-1} are the closing prices of the index at period *t* and *t*-1, respectively. If there is a non-trading day (due to holiday) on a week, the returns for the following five trading days in a week are omitted. This omission will avoid possible influence from these non-trading days. Adopting the approach used by Madureira and Leal (2001), the sample of weekday returns was divided in two sub-samples, one corresponding to positive previous

week returns and the other to negative previous week returns. Previous week returns were calculated as average returns from the closing of Monday to the closing of Friday in that week.

Since the result of the Kolmogorov-Smirnov test indicates that the distribution of the return series are non normal, the nonparametric test, the Wilcoxon rank sum test will be employed to document the existence of the twist-of-the-Monday effect. This nonparametric test is used to verify whether the returns series of two sub-samples are significantly differ. Like other nonparametric tests, the Wilcoxon rank rum test is based on the ranks of the sample observations to compare the central locations of two independent samples. In particulars, two samples are pooled together and ranked in ascending order, with ties assigned the average of the next available ranks. The test statistic approaches a normal distribution as the number of sample observations increase and the approximation is adequate if each sample contains 10 observations.

Suppose that T is the sum of the ranks of the observations from the first sub-samples. Assuming that the null hypothesis to be true, the Wilcoxon rank sum test statistic, T, has mean

$$E(T) = \mu_T = n_1(n_1 + n_2 + 1)/2 \tag{2}$$

and variance

$$Var(T) = \sigma_T^2 = n_1 n_2(n_1 + n_2 + 1)/12 \tag{3}$$

where n_1 observations are from the first sub-sample of positive previous week returns and n_2 observations from the second sub-sample of negative previous week returns. Then, the test statistic approximates the normal distribution as follows:

$$Z = T - \mu_T / \sigma_T \tag{4}$$

The following null and alternative hypotheses are tested on weekday returns for each stock market.

H_0 : There is no difference in the returns across the two sub-samples;

H_1 : There is a difference in the returns across the two sub-samples.

Rejection of null hypothesis for the two sub-samples of Monday returns shows evidence of twist-of-the-Monday effect in the stock market.

3. Empirical Findings

Descriptive statistics of the stock returns for all the countries are presented in Table 1. In addition to the computation of central tendency and dispersion of the stock returns, skewness and kurtosis is calculated to check the distribution. Besides that, the Kolmogorov-Smirnov test is conducted to check whether the series are follow normal distribution. The high kurtosis values in most of the return series and the rejection of the hypothesis of Kolmogorov-Smirnov test confirm that the series are non normal[1].

Table 1: Statistics on stock returns and normality test results

Country		Monday	Tuesday	Wednesday	Thursday	Friday
Austria	Mean	0.0288	-0.0476	0.0915	0.0029	-0.0041
	Median	0.1371	-0.0159	0.2440	0.1225	0.0403
	Std. Deviation	2.2666	1.9365	1.9304	1.8374	1.7897
	Skewness	-0.0093	-0.0434	-0.6738	-0.6025	0.1083
	Kurtosis	11.6502	5.7542	4.2234	4.3857	10.0949
	Kolmogorov-Smirnov	2.9596*	2.1642*	2.1554*	2.0600*	2.3373*
Belgium	Mean	-0.0273	-0.1151	0.0665	0.0215	-0.0314
	Median	0.1011	0.0057	0.2731	0.0300	0.0610
	Std. Deviation	1.8426	1.7503	1.6454	1.7156	1.5262
	Skewness	-0.5519	-1.6408	-0.4676	-0.0950	0.3738
	Kurtosis	8.5507	13.7823	4.8403	4.4895	7.4492
	Kolmogorov-Smirnov	2.5198*	1.9218*	1.6514*	1.6750*	2.0129*
Bulgaria	Mean	-0.1271	-0.2001	-0.0424	0.0290	0.0250
	Median	0.0389	-0.0748	0.0392	0.1558	0.0560
	Std. Deviation	2.1188	2.1981	1.7020	2.0195	1.9483
	Skewness	-2.2193	-0.9525	-1.3840	-0.4256	-2.9306
	Kurtosis	20.0982	10.4678	9.4643	4.2823	20.7140
	Kolmogorov-Smirnov	1.7147*	2.2218*	1.6724*	1.7367*	2.0753*
Denmark	Mean	0.0520	-0.0345	0.0676	-0.0095	0.0544
	Median	0.0346	-0.0323	0.1968	0.1248	0.0734
	Std. Deviation	1.7442	1.4995	1.6797	1.5243	1.3796
	Skewness	-0.4768	0.2506	-0.2577	-0.7648	-0.5340
	Kurtosis	13.7494	5.1489	6.5384	3.9615	6.1791
	Kolmogorov-Smirnov	2.5970*	1.6690*	1.7086*	1.7932*	1.8726*
Finland	Mean	0.0176	-0.1388	0.1404	0.0160	-0.0800
	Median	0.0356	-0.1004	0.2338	0.0048	-0.0808
	Std. Deviation	2.0269	1.9328	1.9705	2.2704	1.8272
	Skewness	0.0700	-0.7657	-0.1716	-0.2981	0.2036
	Kurtosis	4.7966	5.3355	1.9602	5.4308	3.1975
	Kolmogorov-Smirnov	2.0427*	1.6977*	1.0638	1.6074**	1.6282*
France	Mean	-0.0316	-0.0222	0.0475	0.0248	-0.0265
	Median	-0.0102	-0.0241	0.1989	0.0614	-0.0375
	Std. Deviation	2.0182	1.5784	1.7026	1.7147	1.5832
	Skewness	0.5047	-0.1551	0.0551	-0.2433	-0.3064
	Kurtosis	9.8947	2.6054	6.1810	3.2082	5.6525
	Kolmogorov-Smirnov	2.6125*	1.4753**	1.6726*	1.3013***	1.8906*
Germany	Mean	0.0211	0.0007	0.0405	0.0271	-0.0394

[1] The studies of Apolinario *et al*. (2006) and Chukwuogor-Ndu (2006) also confirmed that the return series of European stock markets are non normal.

	Median	0.0698	0.0337	0.2595	0.1662	-0.0028
	Std. Deviation	2.0233	1.7125	1.6891	1.7383	1.5814
	Skewness	0.3801	0.4424	-0.6331	-0.2075	-0.4588
	Kurtosis	7.4319	6.1766	1.9357	3.1805	3.4242
	Kolmogorov-Smirnov	2.2578*	1.7230*	1.4520**	1.4864**	1.8763*
Greece	Mean	-0.2117	-0.0667	0.0314	0.0498	0.0518
	Median	-0.0957	0.0048	0.1052	0.1411	0.0901
	Std. Deviation	2.0696	2.1719	1.9921	2.0931	1.9522
	Skewness	0.1536	-0.1476	0.3289	-0.0463	-0.2233
	Kurtosis	3.7605	3.7430	5.8389	3.6538	6.3308
	Kolmogorov-Smirnov	2.0906*	2.0177*	1.7265*	1.7267*	1.9337*
Hungary	Mean	0.1815	0.0568	0.0183	-0.0076	-0.0015
	Median	0.1660	0.1610	0.1655	0.1079	0.0909
	Std. Deviation	2.4981	2.3279	2.7563	2.4450	2.0632
	Skewness	0.5865	0.0771	-0.1035	-0.8283	-0.0844
	Kurtosis	7.9992	4.3665	13.8930	6.0290	4.5663
	Kolmogorov-Smirnov	2.0872*	1.4075**	2.0842*	1.7372*	1.6066**
Ireland	Mean	-0.1330	-0.1101	-0.0980	0.0241	0.0202
	Median	0.0746	0.0158	-0.0864	0.0451	0.1056
	Std. Deviation	2.2767	2.0640	2.0910	2.0089	1.9910
	Skewness	-1.8393	-0.4841	-0.1441	-0.7817	0.2381
	Kurtosis	17.3264	3.5965	4.8745	7.8399	8.3846
	Kolmogorov-Smirnov	3.0382*	1.9077*	2.0143*	2.0013*	1.9363*
Italy	Mean	-0.0922	-0.0055	0.0969	-0.0134	-0.0703
	Median	0.0144	0.0199	0.1472	0.1030	0.0080
	Std. Deviation	2.0179	1.5689	1.6317	1.6052	1.5606
	Skewness	0.4465	-0.0222	0.4785	-0.4554	-0.5832
	Kurtosis	9.9387	5.3204	8.4356	3.7720	5.9139
	Kolmogorov-Smirnov	2.6329*	1.5892**	1.8448*	1.5168**	1.7118*
Netherlands	Mean	-0.0250	-0.0356	0.0257	0.0393	-0.0347
	Median	0.0399	-0.0005	0.1615	0.0876	-0.0020
	Std. Deviation	2.0475	1.5501	1.6693	1.6765	1.4985
	Skewness	-0.0097	0.1187	-0.1764	-0.0267	-0.4780
	Kurtosis	8.3176	3.0777	5.4086	2.7660	5.8124
	Kolmogorov-Smirnov	2.5796*	1.5969**	1.5161**	1.3603**	1.9412*
Poland	Mean	0.1571	-0.0608	-0.0152	-0.0095	0.0635
	Median	0.2519	0.0499	0.0029	0.0917	0.0985
	Std. Deviation	2.3128	2.0971	2.2016	2.1556	1.8706
	Skewness	-0.0215	-0.3378	-0.0146	-0.0212	-0.8556
	Kurtosis	4.1789	3.0601	7.0968	3.2119	4.8679
	Kolmogorov-Smirnov	1.7926*	1.2414***	1.4412**	1.2414***	1.4629**
Portugal	Mean	-0.0281	-0.0470	0.0964	-0.0108	-0.0228
	Median	-0.0132	0.0219	0.1756	0.0626	0.0260
	Std. Deviation	1.6710	1.3484	1.4611	1.3990	1.3470
	Skewness	-0.0102	-0.2177	0.4066	-0.2091	-0.3468
	Kurtosis	17.8260	3.6694	7.5612	3.7548	6.4673
	Kolmogorov-Smirnov	2.2297*	2.0204*	1.4314**	1.7741*	1.8139*
Solvenia	Mean	-0.0941	-0.1405	0.0315	0.0283	0.2540
	Median	-0.0406	-0.1030	0.0476	0.1210	0.2018
	Std. Deviation	1.7534	1.7487	1.3265	1.5789	1.4616
	Skewness	-0.2143	1.2370	-0.1204	-0.5888	0.1203
	Kurtosis	5.7203	15.8061	5.4665	7.5753	7.1980
	Kolmogorov-Smirnov	2.4215*	2.4297*	1.7202*	2.3881*	2.0992*

Spain	Mean	-0.0818	0.0081	0.0582	0.0800	0.0115
	Median	-0.0131	0.0334	0.1318	0.1068	-0.0087
	Std. Deviation	2.0219	1.6688	1.8347	1.7654	1.7160
	Skewness	1.3011	-0.3819	0.1500	-0.1075	-0.6784
	Kurtosis	13.9008	3.4828	7.9645	3.5833	7.2081
	Kolmogorov-Smirnov	2.4468*	1.8551*	1.8151*	1.5382**	1.9266*
Sweden	Mean	0.0574	-0.1269	0.1697	0.0108	-0.0008
	Median	0.1417	-0.0486	0.2642	0.0444	-0.0467
	Std. Deviation	2.2780	1.9779	2.0381	1.8935	1.8033
	Skewness	0.7102	0.0482	-0.1658	-0.1137	-0.0044
	Kurtosis	8.5158	3.3553	2.8104	2.6324	3.7594
	Kolmogorov-Smirnov	2.4437*	1.6084**	1.5528**	1.6924*	1.5969**
United Kingdom	Mean	-0.0160	0.0021	-0.0477	0.0313	0.0069
	Median	0.0123	-0.0001	0.0611	0.1075	0.0156
	Std. Deviation	1.8380	1.4500	1.5790	1.5422	1.4267
	Skewness	0.1752	0.2010	0.1349	-0.4232	-0.7118
	Kurtosis	10.3410	2.0560	11.1221	3.9179	12.3653
	Kolmogorov-Smirnov	2.7445*	1.3094***	1.7175*	1.8169*	1.9216*
United State	Mean	0.0019	0.0445	0.0159	-0.0070	-0.0113
	Median	0.0296	0.0206	0.1242	0.1129	0.0870
	Std. Deviation	1.5671	1.4439	1.3681	1.4444	1.1385
	Skewness	0.7603	1.2949	-1.5421	-0.6326	0.1218
	Kurtosis	12.6077	9.4075	10.1078	5.4940	3.7473
	Kolmogorov-Smirnov	2.4375*	2.2886*	2.2204*	1.9476*	1.5722*

Notes: *, ** and *** denote significant at the 1%, 5% and 10% level. Rejection of the null hypothesis of Kolmogorov-Smirnov test indicates non normality.

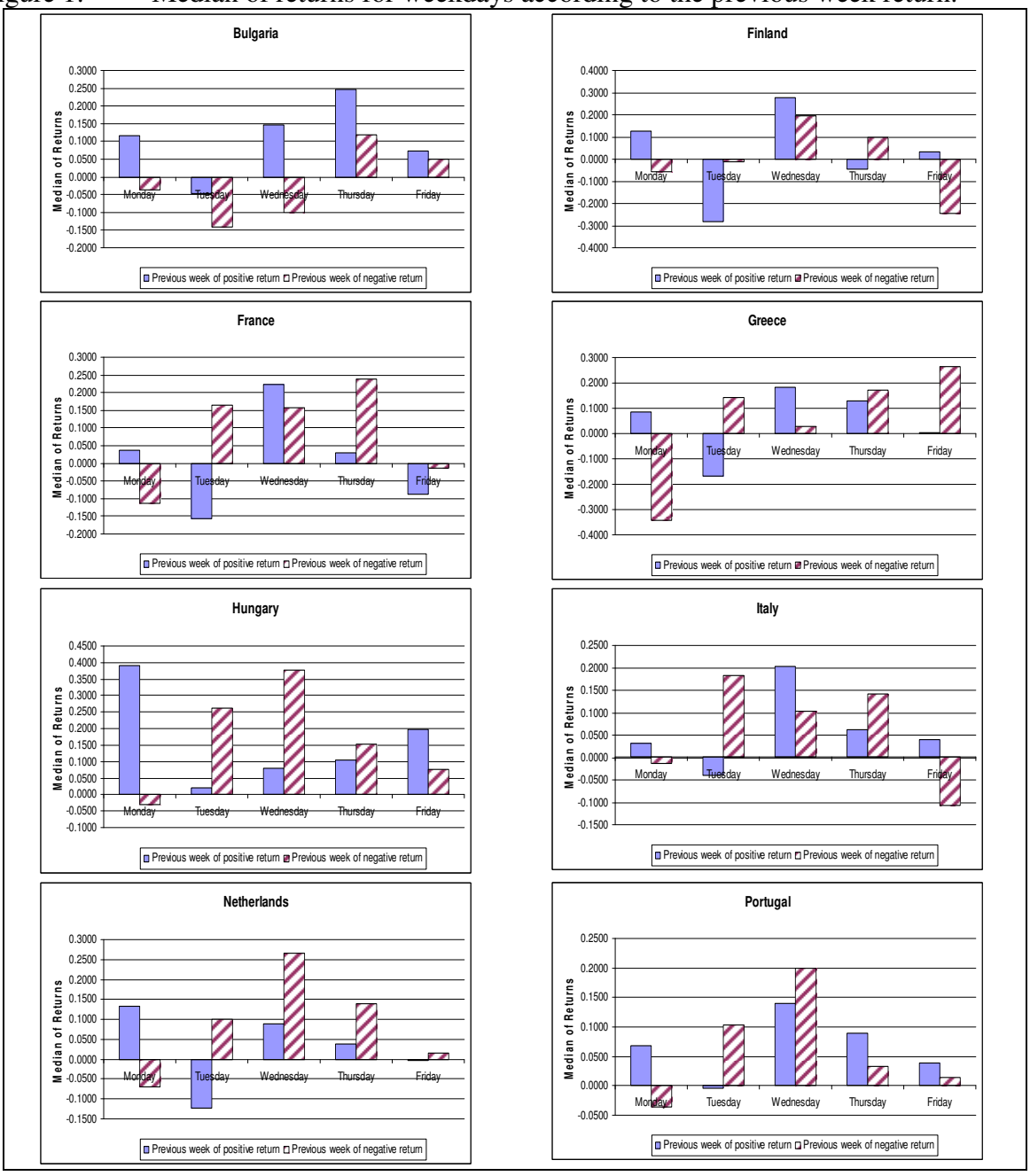
Before the findings based on statistical test are reported, the chart for the median returns for each day of the week is drawn to illustrate the tendency of the existence of twist-of-the-Monday effect. The charts for selected countries where the Monday's return are strongly influence by previous week returns are presented in Figure 1. From the charts, we observe that the median return on Monday following positive previous week return is positive and it is different from the return on Monday that following negative previous week return. For example, in Greece, the median return on Monday following a decline in the market during the previous week is negative and relatively low compare to the median return of rising previous week. The returns on the other days of the week do not have the tendency to follow the returns over the previous week. Moreover, there is no a fix pattern for the returns on other weekdays following positive or negative previous week returns.

Table 2 shows the median day of the week returns following positive and negative previous week returns and the test results of Wilcoxon rank sum test. Among the European countries, the results from the statistical test found that the two sub-samples on Monday are significantly different in Finland, Greece, Hungary, Netherlands, Portugal and Sweden. In other words, the findings obtained from the test support the existence of the twist-of-the-Monday effect and this also indicates that negative returns on Monday are influenced by the decline in the market during the previous week in these six European stock markets.

In the case of Finland, the tendency to follow previous week return is not limited to Monday. Beside Monday returns, Friday returns are also found to be influenced by the market performance of the previous week in Finland. For Sweden, the median returns of Monday follow a rising and declining market during the previous week are 0.2341% and

0.0082%, respectively. Although the returns for declining previous week is positive, the return is relatively low compare to the return of rising previous week. Therefore, we conclude that the returns on the Monday follow the returns of the previous week in Sweden.

Figure 1: Median of returns for weekdays according to the previous week return.



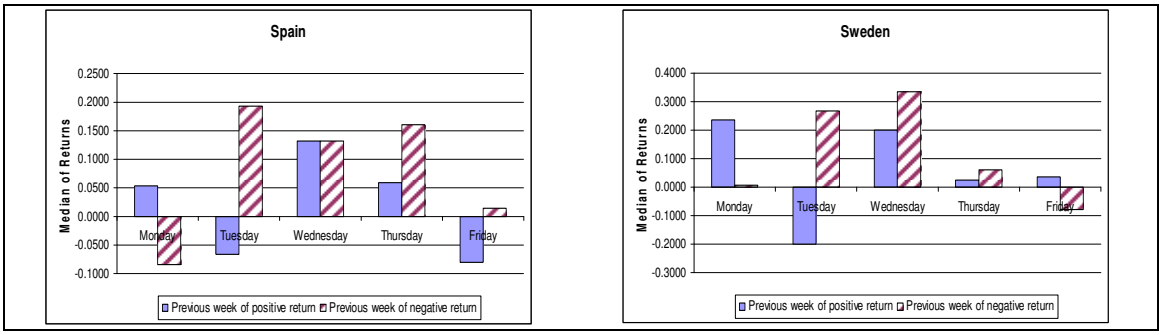


Table 2: Median of returns following positive or negative previous week returns

Country		Median return				
		Monday	Tuesday	Wednesday	Thursday	Friday
Austria	Previous week positive	0.1352	-0.1028	0.2720	0.1168	0.0603
	Previous week negative	0.1635	0.0853	0.2189	0.1320	-0.0115
		(-0.035)	(-0.809)	(-0.269)	(-0.731)	(-0.939)
Belgium	Previous week positive	0.1042	0.0428	0.3184	0.0054	0.0499
	Previous week negative	0.0950	-0.0810	0.2292	0.1692	0.1170
		(-1.133)	(-0.587)	(-0.594)	(-0.535)	(-0.391)
Bulgaria	Previous week positive	0.1165	-0.0479	0.1477	0.2477	0.0718
	Previous week negative	-0.0376	-0.1416	-0.1011	0.1177	0.0509
		(-0.912)	(-1.132)	(-1.372)	(-2.164**)	(-0.008)
Denmark	Previous week positive	0.0555	-0.0050	0.1337	0.0494	-0.0417
	Previous week negative	0.0199	-0.0548	0.3008	0.1744	0.2288
		(-0.684)	(-0.836)	(-0.963)	(-1.154)	(-2.382**)
Finland	Previous week positive	0.1278	-0.2800	0.2768	-0.0467	0.0337
	Previous week negative	-0.0581	-0.0142	0.1965	0.0969	-0.2439
		(-2.123**)	(-1.025)	(-0.670)	(-0.332)	(-1.680***)
France	Previous week positive	0.0361	-0.1572	0.2225	0.0301	-0.0886
	Previous week negative	-0.1129	0.1646	0.1579	0.2383	-0.0136
		(-1.584)	(-1.526)	(-0.425)	(-1.304)	(-0.603)
Germany	Previous week positive	0.0844	-0.0439	0.2484	0.1693	-0.0391
	Previous week negative	0.0439	0.1786	0.2723	0.1642	0.0730
		(-1.320)	(-1.246)	(-0.112)	(-0.269)	(-0.526)
Greece	Previous week positive	0.0874	-0.1665	0.1804	0.1295	0.0040
	Previous week negative	-0.3419	0.1424	0.0270	0.1703	0.2627
		(-3.718*)	(-1.756***)	(-0.180)	(-1.068)	(-1.378)

Hungary	Previous week positive	0.3911	0.0204	0.0796	0.1059	0.1982
	Previous week negative	-0.0302	0.2615	0.3782	0.1535	0.0765
		(-1.841***)	(-1.114)	(-0.067)	(-0.456)	(-1.084)
Ireland	Previous week positive	0.1511	-0.1021	-0.0873	-0.0150	0.0332
	Previous week negative	0.0225	0.1980	-0.0488	0.0756	0.2101
		(-1.286)	(-1.878***)	(-0.038)	(-1.029)	(-0.674)
Italy	Previous week positive	0.0306	-0.0401	0.2026	0.0626	0.0398
	Previous week negative	-0.0131	0.1823	0.1021	0.1417	-0.1080
		(-1.188)	(-0.814)	(-0.530)	(-0.114)	(-0.764)
Netherlands	Previous week positive	0.1334	-0.1221	0.0887	0.0379	-0.0021
	Previous week negative	-0.0685	0.1004	0.2644	0.1404	0.0156
		(-1.953***)	(-1.506)	(-1.416)	(-0.389)	(-0.282)
Poland	Previous week positive	0.2511	-0.1804	0.0233	0.0750	0.3697
	Previous week negative	0.2609	0.2457	0.0011	0.1007	-0.1241
		(-0.933)	(-1.663***)	(-0.356)	(-0.350)	(-1.939***)
Portugal	Previous week positive	0.0681	-0.0034	0.1400	0.0892	0.0382
	Previous week negative	-0.0360	0.1029	0.1987	0.0325	0.0146
		(-1.780***)	(-1.038)	(-0.759)	(-0.362)	(-0.342)
Slovenia	Previous week positive	0.0126	-0.0956	0.0066	0.1373	0.0873
	Previous week negative	-0.0666	-0.1302	0.1026	0.0828	0.2575
		(-1.001)	(-0.379)	(-0.862)	(-0.524)	(-1.348)
Spain	Previous week positive	0.0533	-0.0656	0.1313	0.0594	-0.0809
	Previous week negative	-0.0834	0.1933	0.1324	0.1600	0.0152
		(-1.640)	(-1.355)	(-0.237)	(-0.576)	(-0.273)
Sweden	Previous week positive	0.2341	-0.1993	0.1985	0.0266	0.0363
	Previous week negative	0.0082	0.2695	0.3360	0.0602	-0.0801
		(-1.749***)	(-2.058**)	(-0.922)	(-0.083)	(-1.507)
United Kingdom	Previous week positive	0.0200	-0.0520	0.1033	0.0471	0.0999
	Previous week negative	0.0121	0.1640	0.0462	0.2310	-0.0300
		(-0.487)	(-1.447)	(-0.240)	(-0.998)	(-0.759)
United State	Previous week positive	0.0234	-0.0174	0.1211	0.1488	0.0744
	Previous week negative	0.0406	0.1961	0.1266	0.0114	0.1443
		(-0.627)	(-2.419**)	(-0.211)	(-0.584)	(-0.445)

Notes: *, ** and *** denote significant at the 1%, 5% and 10% level. Figure in the parenthesis denotes the test statistic of Wilcoxon rank sum test. Rejection of the null hypothesis indicates that the two sub-samples for that day are different.

4. Conclusion

This study examines the twist-of-the-Monday effect for the selected EU countries (Austria, Belgium, Bulgaria, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Poland, Portugal, Slovenia, Spain, Sweden, and United Kingdom) and also United State stock markets for the period from June 3, 2002 to July 22, 2011 for all the countries except Bulgaria which covers from June 1, 2005. This study found evidence on the twist-of-the-Monday effect, where returns on Mondays are influenced by the previous week's returns in Finland, Greece, Hungary, Netherlands, Portugal and Sweden stock markets. Interestingly, the tendency to follow previous week return is not limited to Monday only. Friday returns are also found to be influenced by the market performance of the previous week in Finland and Poland stock markets. Thus, international investors may benefit from the twist-of-the-Monday effect in developing a suitable trading strategy to obtain extra returns from these markets.

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