DLSU Business & Economics Review 25.2 (2016), pp. 41-52

Day-of-the-Week Effects in the Philippine Stock Exchange: Do They Exist Amid Modernization?

Cesar C. Rufino and Neriza M. Delfino
De La Salle University, Manila Philippines
cesar.rufino@dlsu.edu.ph

Calendar seasonality in returns of financial markets represents interesting departure from their informational efficiency. This is especially true for the popular "day-of-the-week" effect often seen in the stock markets of even the most developed economies, when in certain days of the week, particularly Mondays, returns of equity assets appear to be lower as compared to other days of the week. As this anomaly presents a distinct challenge to the Efficient Market Hypothesis (EMH), which has been demonstrated in the Philippine Stock Exchange during its still ongoing modernization period, the present study attempts to determine if this challenge exists in the PSE through this period. Employing cutting-edge non-parametric statistical procedures, including a level of significance correction to obviate the possibility of "false positive" outcomes in the pair-wise multiple comparison tests of trading day effects, the study is able to reach a conclusion that the Philippine Stock Exchange, including its six sectoral submarkets are free from the "day-of-the-week" effect. Hence, the potential challenge to the weak form market efficiency of the local stock market posed by this anomaly does not exist during the modern contemporary period.

JEL Classifications: C14; D53; G14; G15

Keywords: Day-of-the-week effects, Philippine Stock Exchange, Efficient Market Hypothesis, Stock Market Modernization

It is often believed that financial market returns exhibit uncanny behavior even if the market has been recognized to be highly efficient in its function of price formation. One of these tendencies is the well documented "day-of-the-week effect", sometimes referred to as the "weekend effect" or the "Monday effect". Early studies on the phenomenon in major asset markets—stocks, foreign exchange, and bonds—suggest a tendency for returns to be significantly negative during Mondays (e.g., Cross, 1973; French, 1980; Gibbons & Hess, 1981; Rogalsky, 1984; Jaffe & Westerfield, 1985). Pettengill (2003) provided a comprehensive survey of the literature relating to the magnitude and causes of the anomaly. In the 1990s, the day-of-the-week effect persisted as revealed by studies of returns of primary stocks and other financial markets (e.g., Dubois & Louvet, 1996; Wang, Li, & Erickson, 1997; and Chang, Pinegar, & Ravichandran, 1993).

During the first decade of 2000, studies on the anomaly continued, but the focus moved mostly to the dynamics of the weekend effects, particularly the apparent weakening in some asset markets (e.g., Tori, 2003; Gu, 2004; Kohers, Kohers, Pandey, & Kohers, 2004) and the significance of the correlation of Mondays' returns with prior Fridays' returns (e.g., Tong, 2000; Brusa, Liu, & Schulman, 2003). The current decade shows the shift towards the investigation of the wandering weekday effect in major stock and other asset markets, challenging the conventional wisdom of the fixity and robustness of the Monday effect (see Doyle & Chen, 2009).

It is generally believed that this unusual behavior of asset markets' returns represents a unique challenge to the informational efficiency (under Efficient Market Hypothesis (EMH)) of modern financial markets. The obvious reason is that the persistence of this irregularity implies the existence of arbitrage opportunities, which are incompatible with EMH. Under information efficient markets, once such inefficiency turns up, it will immediately self-destruct as it becomes included in the publicly available information set, wherein prices are expected to fully reflect. Hence in any well-functioning and highly efficient market, this type of calendar seasonality should not exist.

The Philippine Stock Exchange (PSE) has been on a massive modernization drive towards market efficiency. It started in 2005 when it adopted the Online Disclosure System—an online system access for the submission and announcement of all types of disclosures. In 2007, the PSE acquired the Advanced Warning and Control System, a state-of-the-art computerized surveillance system designed to further boost the integrity of the transactions in the market. These initiatives greatly enhanced the information efficiency of the exchange that led PSE to set the pace over most stock exchanges in Asia in terms of growth levels across key stock market indicators, which in 2012 culminating as a highly successful year when it was cited as one of the top 10 best performing stock markets in the world (CNNMoney, 2013), ranking number 9 with 26% gain from 2011.

Using data that covers this modernization era, Rufino (2013) empirically established the validly of the EMH in the Philippine stock market across its various sectors. The present study is devoted to look for further evidence of the information efficiency of PSE by answering the question of whether or not the day-of-the-week effect is present in the main index of the PSE and in its sub-markets using an updated daily data used in Rufino (2013).

A number of extant publications which feature the Philippine Stock Exchange, either in a single country analysis or cross country comparison, prior to the start of the modernization era (i.e., prior to 2005) found evidence of the existence of significant day-of-the-week effect (Basher & Sadorsky, 2006; Sakalauskas & Krikščiūnienė, 2007; Choudhry, 2000; Brooks & Persand, 2001; and Almonte, 2004). These works serve as the studies during the pre-modernization period that would benchmark the present study whose main concern is to empirically demonstrate the absence of any form of day-of-the week anomaly in the local stock market during its modernization period.

The remainder of the paper goes as follows: Section 2 discusses the data and the methodology employed in the study, focusing on the rationale of using the non-parametric approach instead of the more traditional parametric alternative. This section also features a descriptive presentation of the stylized facts revealed by the data. Section 3 explores the results of the empirical procedures implemented, and Section 4 wraps-up the study, highlighting on the conclusions suggested by the results.

DATA AND METHODOLOGY

The PSE index series is composed of the main index—the PSEi—and six sectoral indices. These indices which represent the major sectors under the revised industry classification of the Exchange are (1) Financials Index; (2) Industrial Index; (3) Holding Firms Index; (4) Property Index; (5) Services Index; and (6) Mining & Oil Index. The daily closing values of these indices over the period January 2, 2006 to June 7, 2013 constitute the database of the present study. These daily data are then transformed into continuously compounded daily returns r_{it} using the formula:

$$r_{it} = \log(p_{it} / p_{i(t-1)}) = \log(\mathrm{p}_{it}) - \log(p_{i(t-1)}) \qquad (1)$$

where p_{it} = index value for the *ith* PSE sector during trading day *t*.

The daily returns data will be constructed for all of the PSE index series across the entire sample period, segmented by sector and by trading day-of-the-week. The PSEi will be considered as one sector.

Tests for Normality

It is a well known stylized fact in financial markets that prices are non-stationary and are integrated of order 1, that is, each price series has a single unit root. The first difference (or the logarithmic first difference) of such series is deemed to be a white noise. The presence of the unit root component in the PSE series during the modernization era has been adequately established in Rufino (2013), hence, the return r_{it} can be seen as a white noise series. Parametric statistical tests on any white noise series should ensure that the series is also normally distributed, otherwise, a distribution-free (non-parametric) procedure should be applied. In this light, testing for the normality of any asset return series should precede any further tests. A battery of four standard normality tests are implemented in this study, namely: Jarque-Bera, Shapiro-Wilk, Anderson-Darling, and Lilliefors tests for normality.

Stylized Facts on PSE Returns

Significance of the day-of-the-week returns. Daily returns on the seven PSE series are computed via the continuously compounded returns formula (1) and the results are tabulated in Table 1, which shows the summary statistics for the different PSE index series across the various trading days of the week. It can be seen from the table that there is no indication of the "Monday effect" in all sectors of the PSE given that the average returns during Mondays are all insignificant (that is, not significantly different from zero) as revealed by the z-test in the last column. Thursday returns are significantly positive in five out of seven index series, including the PSEi. This test works on the assumption that the average return is asymptotically normal with mean of zero at the null and standard error equal to the return standard deviation divided by the square root of the number trading days, that is,

$$z_i = \frac{\bar{r}_i - R_i}{s_i / \sqrt{T_i}} \sim asy \quad N(0,1) \qquad (2)$$

where $\bar{r}_i$, s_i and T_i are respectively the average return, standard deviation of return and number of observations for day *i*. The true average return R_i is hypothesized as zero at null.

As this result may suggest a shift in the day-of-the-week effect from Monday to Thursday, this result should be taken with caution when returns across days-of-the-week are not normally distributed, hence, normally testing should be undertaken.

Table 1. ***Summary Statistics of Returns by Sector and by Day-of-the-Week***

Variable	Observations	Minimum	Maximum	Mean	Std. dev.	CV	z-value*
Financials							
Mondays	341	-0.1112	0.0431	0.0003	0.0154	51.33	0.36
Tuesdays	371	-0.0879	0.0650	-0.0010	0.0136	-13.60	-1.42
Wednesdays	379	-0.0668	0.0392	0.0012	0.0128	10.67	1.83
Thursdays	371	-0.0433	0.0468	0.0016	0.0130	8.13	2.37
Fridays	358	-0.0596	0.0727	0.0006	0.0140	23.33	0.81
Holding Firms							
Mondays	341	-0.1131	0.0697	0.0002	0.0176	88.00	0.21
Tuesdays	371	-0.0574	0.1032	-0.0011	0.0165	-15.00	-1.28
Wednesdays	379	-0.0797	0.0538	0.0017	0.0151	8.88	2.19
Thursdays	371	-0.0535	0.0626	0.0025	0.0161	6.44	2.99
Fridays	358	-0.0690	0.0608	0.0015	0.0162	10.80	1.75
Industrials							
Mondays	341	-0.0930	0.0514	-0.0003	0.0154	-51.33	-0.36
Tuesdays	371	-0.0438	0.0975	0.0002	0.0138	69.00	0.28
Wednesdays	379	-0.0665	0.0411	0.0013	0.0124	9.54	2.04
Thursdays	371	-0.0755	0.0538	0.0014	0.0149	10.64	1.81
Fridays	358	-0.0901	0.0564	0.0005	0.0138	27.60	0.69
Mining & Oil							
Mondays	341	-0.1074	0.1161	0.0003	0.0247	82.33	0.22
Tuesdays	371	-0.1182	0.1131	-0.0008	0.0224	-28.00	-0.69
Wednesdays	379	-0.1190	0.0726	0.0025	0.0211	8.44	2.31
Thursdays	371	-0.1355	0.0872	0.0015	0.0228	15.20	1.27
Fridays	358	-0.1199	0.0834	0.0014	0.0245	17.50	1.08
Property							
Mondays	341	-0.1027	0.0606	-0.0004	0.0193	-48.25	-0.38
Tuesdays	371	-0.0819	0.0864	-0.0013	0.0192	-14.77	-1.30
Wednesdays	379	-0.0911	0.0590	0.0028	0.0185	6.61	2.95
Thursdays	371	-0.0626	0.0637	0.0019	0.0189	9.95	1.94
Fridays	358	-0.1006	0.0628	0.0001	0.0188	188.00	0.10
Services							
Mondays	341	-0.1421	0.0516	-0.0003	0.0160	-53.33	-0.35
Tuesdays	371	-0.0755	0.0912	-0.0003	0.0153	-51.00	-0.38
Wednesdays	379	-0.0871	0.1022	0.0003	0.0150	50.00	0.39
Thursdays	371	-0.0748	0.0457	0.0011	0.0150	13.64	1.41
Fridays	358	-0.0836	0.0839	0.0011	0.0151	13.73	1.38
PSEi							
Mondays	341	-0.1309	0.0530	-0.0002	0.0161	-80.50	-0.23
Tuesdays	371	-0.0567	0.0937	-0.0005	0.0140	-28.00	-0.69
Wednesdays	379	-0.0825	0.0438	0.0012	0.0129	10.75	1.81
Thursdays	371	-0.0619	0.0463	0.0018	0.0137	7.61	2.53
Fridays	358	-0.0870	0.0459	0.0008	0.0137	17.13	1.10

* $H_o : \mu_{day-of-the-week} = 0$ (mean return for each day-of-the-week is zero)

Normality of the day-of-the-week returns. Testing for the normality of the distribution of returns across days-of-the-week for each of the index series is crucial in determining the inference procedure that needed to be undertaken. When empirical data do not support the normal distribution, the parametric test like equation (2) may not be appropriate. In this study, the results of implementing the four normality tests are shown in Table 2. As gleaned from the table, all of the tests provide overwhelming evidence on the non-normality of returns across index series and across days-of-the-week, effectively putting a moratorium on the use of parametric testing procedures on making inference on the returns.

Table 2. ***Test for Normality of Returns, by Day-of-the-Week, by Sector***

H_o : **Returns Distribution is Normal**

Property	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	142.511	152.492	43.957	29.848	119.236
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.964	0.959	0.986	0.979	0.971
	p-value	< 0.0001	< 0.0001	0.001	< 0.0001	< 0.0001
Anderson-Darling Test	A^2	2.310	3.072	0.515	2.278	2.058
	p-value	< 0.0001	< 0.0001	0.191	< 0.0001	< 0.0001
Lilliefors Test	D	0.064	0.064	0.033	0.060	0.065
	D (standardized)	1.183	1.236	0.637	1.162	1.234
	p-value	0.002	0.001	0.417	0.002	0.001

Services	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	6389.924	626.224	1191.509	160.979	619.154
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.831	0.919	0.911	0.948	0.910
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Anderson-Darling Test	A^2	+Inf	5.939	5.879	5.409	7.110
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Lilliefors Test	D	0.112	0.095	0.092	0.095	0.108
	D (standardized)	2.077	1.830	1.796	1.838	2.048
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

PSEi	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	2757.052	1155.217	515.957	114.320	519.145
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.872	0.901	0.945	0.965	0.939
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Anderson-Darling Test	A^2	7.786	5.363	2.633	2.391	3.331
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Lilliefors Test	D	0.116	0.090	0.064	0.058	0.066
	D (standardized)	2.145	1.729	1.246	1.122	1.252
	p-value	< 0.0001	< 0.0001	0.001	0.004	0.001

Financials	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	1002.784	724.851	160.721	22.814	232.876
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.924	0.920	0.961	0.985	0.949
	p-value	< 0.0001	< 0.0001	< 0.0001	0.001	< 0.0001
Anderson-Darling Test	A^2	4.140	5.025	3.213	1.498	3.516
	p-value	< 0.0001	< 0.0001	< 0.0001	0.001	< 0.0001
Lilliefors Test	D	0.097	0.077	0.078	0.057	0.063
	D (standardized)	1.788	1.482	1.522	1.090	1.194
	p-value	< 0.0001	< 0.0001	< 0.0001	0.006	0.002

Holding Firms	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	542.604	419.936	151.018	41.828	70.423
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.931	0.942	0.965	0.974	0.970
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Anderson-Darling Test	A^2	4.685	4.075	2.519	2.504	2.998
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Lilliefors Test	D	0.093	0.079	0.064	0.067	0.068
	D (standardized)	1.717	1.518	1.246	1.290	1.290
	p-value	< 0.0001	< 0.0001	0.001	0.000	0.000

Industrial	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	396.286	1758.774	345.228	431.179	642.107
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.925	0.876	0.943	0.922	0.930
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Anderson-Darling Test	A^2	6.620	8.276	3.678	5.763	4.304
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Lilliefors Test	D	0.118	0.108	0.072	0.096	0.080
	D (standardized)	2.180	2.089	1.402	1.853	1.511
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001

Mining & Oil	Statistics	Monday	Tuesday	Wednesday	Thursday	Friday
Jarque-Bera Test	χ^2	283.640	646.800	163.450	420.429	237.499
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Shapiro-Wilk Test	W	0.931	0.917	0.963	0.936	0.937
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Anderson-Darling Test	A^2	4.519	5.073	2.888	3.975	5.045
	p-value	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Lilliefors Test	D	0.075	0.084	0.068	0.078	0.096
	D (standardized)	1.393	1.622	1.316	1.493	1.811
	p-value	< 0.0001	< 0.0001	0.000	< 0.0001	< 0.0001

Non-Parametric Procedures

When parametric methods cannot be applied due to the breakdown of the normality assumption, distribution-free or non-parametric inference tools are often resorted to. The type of non-parametric procedure to use is dependent on a number of considerations—the number of populations (treatments) to be compared, the scale of measurement of the variables, the experimental layout (one-way or multi-way), and so forth. In the present context where the aim is to check for the existence of the day-of-the-week effect in the Philippine Stock Exchange using contemporary data, the experimental layout is a one-way classification where each treatment is the day-of-the-week, and the research objective is comparing the effects of these five treatments in all sub-markets of the PSE including the main index PSEi.

Kruskall-Wallis test. The non-parametric analogue of the one-way analysis of variance (ANOVA) is the so-called Kruskall-Wallis (*KW*) test. The aim of the test is to determine whether the effects of a set of *k*-treatments are the same as suggested by the ranks of the underlying measure (in this case, returns). This test is ideal per objective of the present study. The null hypothesis of interest to be tested is the equality of the treatment effects, that is:

$$H_o : \tau_{Monday} = \tau_{Tuesday} = \tau_{Wednesday} = \tau_{Thursday} = \tau_{Friday} \quad (k = 5) \ \textit{versus}$$
$$H_1 : \textit{Not all days-of-the-week effects are the same}$$

The test statistic involved is the Kruskall-Wallis *(KW)* statistic as applied to the study is given by the formula:

$$KW = \frac{12}{N(N+1)} \sum_{i=1}^{k} n_i \left[R_{.i} - \frac{N+1}{2} \right]^2 \quad (3)$$

where N is the total number of daily observations in all days-of-the-week , $r_{ij} =$ the rank of the *jth* return during *ith* day-of-the-week, and $R_i = \sum_{j=1}^{n_i} r_{ij} / n_i$ is the average rank of the return during the *ith* day-of-the-week (Hollander & Wolfe, 1999).

Since the average rank assigned in the joint ranking is equal to $\frac{1}{N}\sum_{i=1}^{k}\sum_{j=1}^{n_i} r_{ij} = \frac{N+1}{2}$, the Kruskall-Wallis (KW) statistic in (3) can be simplified to:

$$KW = \frac{12}{N(N+1)} \sum_{i=1}^{k} \frac{R_i^2}{n_i} - 3(N+1) \quad (4)$$

In large samples, (4) has a χ^2 sampling distribution with k - 1 degrees of freedom (Hollander & Wolfe, 1999).

The Steel-Dwass-Critchlow-Fligner multiple comparison procedure. In the event when the Kruskall-Wallis test is significant, a pair-wise multiple comparison procedure is implemented to determine the treatments that have significantly different effects. In this study, a powerful distribution-free method known as the *Steel-Dwass-Critchlow-Fligner Procedure* is used. In a one-way experimental layout involving *k* treatments, the procedure calls for the evaluation of all *k(k-1)/2* pair-wise treatment combinations. For each pair of treatments (*i,j*), the Wilcoxon rank W_{ij} is computed among the combined *ith* and *jth* samples using the formula:

$$W_{ij} = \sum_{s=1}^{n_j} R_{is} \ \text{ for } 1 \le i < j \le k \quad (5)$$

where $R_{i1},...,R_{in_j}$ are the ranks of returns $r_{1j},...,r_{n_j j}$, respectively, in the combined *ith and jth* samples (days-of-the-week). The standardized version of (5) is given by the formula:

$$W_{ij}^* = \sqrt{2}\left[\frac{W_{ij} - E_o(W_{ij})}{\sqrt{Var(W_{ij})}}\right] = \frac{W_{ij} - \frac{n_j(n_i + n_j + 1)}{2}}{\sqrt{n_i n_j (n_i + n_j + 1)/24}} \quad (6)$$

for $1 \le i < j \le k$

In large samples, the vector consisting of the W_{ij}^* for all *k(k-1)/2* (i.e., combination of k treatments taken 2 at a time) pair-wise treatment combinations as elements, has an asymptotic multivariate normal distribution with mean of **0** under the null hypothesis $H_o: \tau_i = \tau_j$. Thus, decision on whether to accept or to reject the null hypothesis is based on the following rule:

$$\text{Reject } H_o \text{ if } |W_{ij}^*| \geq q_\alpha \tag{7}$$

where q_α is the upper α^{th} percentile point of the distribution of the range of *k* independent *N (0, 1)* or standard normal variables (Hollander & Wolfe, 1999). Whenever there are ties among the ranks, the average ranks will be used in computing the Wilcoxon and the normalized Wilcoxon ranks with adjustments done on the variance of the Wilcoxon rank of each pair-wise combination.

The Bonferonni Correction. In performing multiple comparison testing procedures, whether parametric or non-parametric, incorrectly rejecting true hypotheses (type I error) is more likely to occur than in single inference procedure. Several statistical techniques have been developed to prevent this from happening. These techniques generally require a stronger level of evidence to be observed for individual comparison to be deemed "significant", so as to compensate for the number of inferences being made. Failure to do this can have important real-world consequences associated with the occurrence of type I error. The most often used $\alpha-$ level correction in multiple comparison tests is the so-called Bonferonni Correction (Hockberg, 1988) which employs the corrected significance level α^* for the conventional α through the formula:

$$\alpha^* = 1 - (1 - \alpha^{1/c}) \tag{8}$$

for c = number of multiple comparisons.

Hence, for a paired-comparison test in the current study to be deemed significant at the 5% level should have a p-value of less the $\alpha^* = 1 - (1 - 0.05^{1/10}) = 0.0050$ when applied to 10 paired-trading days (i.e., combination of 5 taken 2 at a time). This conservatism in post-hoc analysis on the significance of day-of-the-week effect is well taken since falsely concluding that there exists this type of effect in the market, which could mislead many market participants with speculative interests into taking more aggressive positions.

EMPIRICAL RESULTS OF THE NON-PARAMETRIC PROCEDURES

This section presents the results of both the Kruskall-Wallis (*KW*) and the Steel-Dwass-Critchlow-Fligner (*SDCF*) Multiple Comparison testing procedures as applied to the returns recorded for each PSE index series across days-of-the-week. To check if both procedures will confirm each other's results, it is deemed necessary to implement the *SDCF* procedure even for insignificant *KW* test outcomes. Moreover, the Bonferonni corrected significance level in (8) will be adopted in the multiple comparison tests.

Results of the Kruskall-Wallis Test

The extremely strong evidence against the non-normality of the returns of all index series of the Philippine Stock Exchange, including its main index, justifies the use of the Kruskall-Wallis test in examining the presence of the day-of-the-week effect. Summarized in Table 3 are the results of the application of the *KW* procedure to the returns of PSEi and its sub-indices—Financials, Industrial, Holding Firms, Property, Services Index, and Mining & Oil. Also included in the table, for comparison purposes, are the results of the parametric One-way Analysis of Variance (ANOVA) tests which

Table 3. ***Kruskal-Wallis Test of the Day-of-Week Effects in Philippine Stock Exchange vis-à-vis Parametric One-way ANOVA Test***

$H_o : \tau_{Mon} = \tau_{Tue} = \tau_{Wed} = \tau_{Thur} = \tau_{Fri}$ *for each PSE Sector (for KW test)*
(same day-of-the-week treatment effects)

Statistic	Financials	Holding Firms	Industrial	Mining and Oil	Property	Services	PSEi
KW	9.12	13.93**	9.30	7.55	13.04*	4.83	9.56*
p-value	0.0582	0.0075	0.0541	0.1095	0.0111	0.3057	0.04853
ANOVA F	1.87	2.83*	1.03	1.13	2.84*	0.79	1.67
p-value	0.1131	0.0236	0.3877	0.3402	0.0231	0.5326	0.1554
Bartlett's χ^2	15.0865	8.3670	19.8366	12.5314	0.8866	1.9723	20.0524
p-value	0.0050	0.0790	0.0010	0.0140	0.9260	0.7410	0.0000

$H_o : \mu_{Mon} = \mu_{Tue} = \mu_{Wed} = \mu_{Thur} = \mu_{Fri}$ *for each PSE Sector (for ANOVA test)*
(same mean returns across days-of-the-week)

* significant at 5% level
** significant at 1% level

address the same inference agenda. The ANOVA test is supplemented by Bartlett's test for equality of variances (homoscedasticity) of returns within each day-of-the-week—an implicit assumption in using ANOVA.

As seen in the table, there is generally weak evidence of the day-of-the-week effect in the PSE index series as indicated by the relatively large *p-values* of the *KW* statistics which range from 0.00753 for Holding Firms to 0.30566 for Services. When one uses the conventional level of significance $\alpha = 0.05$, three of the seven index series may be considered significant—the main index PSEi (p = 0.04853), Property (p = 0.01109) and Holding Firms (p = 0.00753); while the remaining four are insignificant (p > 0.05). These outcomes may suggest the presence of day-of-the-week effect in the Holding Firms sector but not so convincing in the other index series including PSEi.

When compared with the parametric ANOVA test, the results show an even weaker evidence of the anomaly detected by ANOVA. Day-of-the week effects are present in only two of the sub-markets of PSE, both at 5% level—Holding Firms and Property sectors. All other sub-markets submitted insignificant results, including the main index. Variance homogeneity is deemed binding only for Holding Firms, Property, and Services sectors as determined by the Bartlett's test. The heteroscedasticity of returns which prevail in most sectors give more credence to the Kruskall-Wallis test.

Results of the Steel-Dwass-Critchlow-Fligner Procedure

Usually, post-hoc analysis of multiple treatment comparison is undertaken, only when the one-way test for treatment differences is

Table 4. ***P-values of the Multiple Pairwise Comparison Tests Using the Steel-Dwass-Critchlow-Fligner Procedure for PSE Sectoral Indices and PSEi***

Financials				
Day-of-the-Week	**Tuesdays**	**Wednesdays**	**Thursdays**	**Fridays**
Wednesdays	0.08333			
Thursdays	0.06189	0.99960		
Fridays	0.33273	0.97971	0.93316	
Mondays	0.24138	0.99745	0.98844	0.99913
Industrials				
Day-of-the-Week	**Tuesdays**	**Mondays**	**Fridays**	**Wednesdays**
Mondays	0.07533			
Fridays	0.07342	0.99977		
Wednesdays	0.77777	0.69815	0.61934	
Thursdays	0.78564	0.73850	0.64970	1.00000
Holding Firms				
Day-of-the-Week	**Tuesdays**	**Wednesdays**	**Thursdays**	**Fridays**
Wednesdays	0.06333			
Thursdays	0.00613	0.88417		
Fridays	0.03489	0.99710	0.98726	
Mondays	0.29406	0.98625	0.65971	0.91511
Property				
Day-of-the-Week	**Tuesdays**	**Wednesdays**	**Thursdays**	**Fridays**
Wednesdays	0.01457			
Thursdays	0.06234	0.97874		
Fridays	0.68887	0.33435	0.65827	
Mondays	0.82784	0.22078	0.53099	0.99855
Mining and Oil				
Day-of-the-Week	**Tuesdays**	**Mondays**	**Thursdays**	**Fridays**
Mondays	0.08503			
Thursdays	0.23491	0.99779		
Fridays	0.24992	0.99648	1.00000	
Wednesdays	0.59990	0.87746	0.97933	0.97729
Services				
Day-of-the-Week	**Tuesdays**	**Mondays**	**Wednesdays**	**Fridays**
Mondays	0.98577			
Wednesdays	0.44313	0.73726		
Fridays	0.44094	0.81068	0.99997	
Thursdays	0.99565	0.99995	0.68775	0.73389
PSEi				
Day-of-the-Week	**Tuesdays**	**Mondays**	**Fridays**	**Wednesdays**
Mondays	0.12888			
Fridays	0.02808	0.96302		
Wednesdays	0.38779	0.98647	0.80575	
Thursdays	0.50256	0.97045	0.73809	0.99995

significant; in order to pinpoint the treatment(s) that is (are) different from the rest. In this study, the Steel-Dwass-Critchlow-Fligner Procedure is implemented even for index series that have insignificant Kruskall-Wallis statistics. The summary results of the *SDCF* procedure for the seven index series are presented in Table 4.

Careful examination of Tables 4 is made to finer focus the results of the *KW* tests. For one, it corroborates the *KW* findings of the non-existence (statistically) of the day-of-the-week effects in four of the six sub-sectors of the exchange—Financials, Industrials, Services, and Mining & Oil sectors—confirming the outcomes of the *KW* tests. Significant pair-wise differences in effects were noted using the uncorrected α in the Holding firms and Property sectors, as well as in the main index. However, when the Bonferonni correction is applied to the *SDCF* results, all PSE sectors, including the main PSEi index show no evidence of the day-of-the-week effect at the conventional 5% level of significance (since all p-values in all pair-wise comparisons are greater than the corrected level of significance $\alpha^* = 0.005$).

CONCLUDING REMARKS

Financial markets are often found to exhibit uncanny behavior despite being recognized as highly efficient. One well documented behavior pertains to the day-of-the-week effect. Earlier studies reveal significant negative returns of Mondays, prompting some researchers to call the phenomenon “Monday” or “Weekend” effect. This occurrence supports the existence of inefficient markets, which can provide investors and speculators opportunities for arbitrage. This anomaly poses a distinct challenge to the Efficient Market Hypothesis (EMH) as applied to the behavior of stock prices in the Philippine Stock Exchange (PSE), particularly in a period spanning the ongoing modernization when the PSE started embarking on state-of-the-art systems improvement aimed at enhancing information disclosure and integrity of market transactions. Three non-parametric procedures are utilized to test the existence of the day-of-the-week effect using contemporary data via a one-way classification experimental lay-out applied on the overall PSE index and on the indices of all of its six subsectoral markets. These procedures include the Kruskall-Wallis, Steel-Dwass-Critchlow-Fligner Multiple Comparison Procedures, and the Bonferonni Correction approach. These techniques employ cutting-edge non-parametric statistical procedures that include a level of significance correction to obviate the possibility of “false positive” outcomes in the pair-wise multiple comparison tests of trading day effects. Results reveal the non-existence of the day-of-the-week effects on the main index, as well as on the sub-sectoral indices. The findings further support the empirical validity of the EMH, lending credence to the efficacy of the modernization program. Hence, the potential challenge to the weak form market efficiency of the local stock market posed by day-of-the-week effect does not exist during the modern contemporary period.

REFERENCES

Almonte, C. (2004). *Day-of-the-week effect in the Philippine Stock Market January 3, 2000 to July 23, 2004* (CBERD Working Paper Series 2004-010). Manila: De La Salle University.

Basher, S., & Sadorsky, P. (2006). Day-of-the-week effects in emerging stock markets. *Applied Economics Letters*, *13*(10), 621-628.

Brooks, C., & Persand, G. (2001). *Seasonality in Southeast Asian stock markets: Some new evidence on day-of-the-week effects. Applied Economics Letters*, *8*(3), 155-158.

Brusa, J., Liu, P., & Schulman, C. (2000). The weekend effect, ‘reverse’ weekend effect, and firm size. *Journal of Business Finance & Accounting, 27*(5), 555-574.

Chang, E, Pinegar, J., & Ravichandran, R. (1993). International evidence on the robustness of the day-of-the-week effect. *Journal of Financial and Quantitative Analysis, 28*(4), 497-513.

Choudhry, T. (2000). Day of the week effect in emerging Asian stock markets: Evidence from the GARCH model. *Applied Financial Economics, 10*(3), 235-242.

CNNMoney. (2013). World's top 10 performing stock markets in 2012. Retrieved from www.number-10.net/CNN-Money-Top-Ten-Stocks.html

Cross, F. (1973). The behavior of stock prices on Fridays and Mondays. *Financial Analysis Journal, 29*(6), 67-69.

Doyle, J., & Chen, C. (2009). The wandering weekend effect in major stock markets. *Journal of Banking and Finance, 33*(8), 1388-1399.

DuBois, M., & Louvet, P. (1996). The day-of-the-week effect: The international evidence. *Journal of Banking & Finance, 20*(9), 1463-1484.

French, K. (1980). Stock returns and the weekend effect. *Journal of Financial Economics, 8*(1), 55-69.

Gibbons, M., & Hess, P. (1981). Day of the week effects and asset returns. *Journal of Business, 54*(4), 579-596.

Gu, A. (2004). The reversing weekend effect: Evidence from the U.S. equity markets. *Review of Quantitative Finance and Accounting*, *22*(1), 5−14.

Hockberg, Y. (1988). A sharper Bonferroni procedure for multiple test of significance. *Biometrika, 75*(4), 800-802.

Hollander, M., & Wolfe, D. (1999). *Nonparametric statistical methods* (2nd ed.). New York: John Wiley and Sons.

Jaffe, J., & Westerfield, R. (1985). The weekend effect in common stock returns: The international evidence. *Journal of Finance, 40*(2), 433-454.

Kohers, G., Kohers, N., Pandey, V., & Kohers, T. (2004). The disappearing day-of-the-week effect in the world's largest equity markets. *Applied Economics Letters*, *11*(3), 167−171.

Pettengill, G. (2003). A survey of the Monday effect literature. *Quarterly Journal of Business and Economics*, *42*(3), 3-27.

Rogalski, R. (1984). New findings regarding day-of-the-week returns over trading and non-trading periods: A note. *Journal of Finance, 39*(5), 1603-1614.

Rufino, C. (2013). Random walks in the different sub-markets of the Philippine Stock Exchange amid modernization. *Philippine Review of Economics 19*(1), 57-82.

Sakalauskas, V., & Krikščiūnienė, D. (2007). The impact of trade volume on the day-of-the-week effect in emerging stock markets. *Information Technology and Control*, *36*(1A), 152-157.

Tong, W. (2000). International evidence on weekend anomalies. *The Journal of Financial Research, 23*(4), 495-522.

Tori, C. (2003). Re-examining return autocorrelation and Monday returns. *Quarterly Journal of Business and Economics, 42*(3), 29−47.

Wang, K., Li, K., & Erickson, J. (1997). A new look at the Monday effect. *The Journal of Finance, 52*(5), 2171-2186.