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Stock Market Anomalies in South Africa and its Neighbouring Countries

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Abstract

This study adopted the alternative approach called closure test principle which is proposed by Alt et al. (2011) to examine the stock market anomalies in South Africa and its Neighbouring Countries. Overall, Egypt is the only country that has a strong Monday effect. On the other hand, weak Monday effect is found in Mauritius, Nigeria and Tunisia stock markets. When the time-varying volatility in the market returns is taken into account by the EGARCH – M model, strong Monday volatility is found in Egypt while Kenya and Nigeria is found to have weak Monday volatility.

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1. Introduction

Since Fields (1931) observed that the US stock market consistently experienced significant negative Monday returns and positive Friday returns, this market anomaly remains one of the most popular research issues in finance. This issue embraces important implications for those participants who are actively trade in markets. From previous literature, market anomalies are found not only in developed markets such as United States, United Kingdom, Germany and Japan, but also in emerging markets like Malaysia, Taiwan and Hong Kong. (See examples, Cross, 1973; French, 1980; Gibbons and Hess, 1981; Keim and Stambaugh, 1984; Jaffe and Westerfiled, 1985; Wong *et al*., 1992; Arsad and Coutts, 1996; Lucey, 2000; Brooks and Persand, 2001; Apolonario *et al*., 2006.)

Among the emerging markets, one of the most appealing markets which grow rapidly in recent years is South Africa stock market. The stock exchange of South Africa is the largest market in Africa and it is situated at the corner of Maude Street and Gwen Lane in Sandton, Johannesburg, South Africa. In 1990, this market contributed a total of 123.19% of the GDP of the country and it archived market capitalization of US$281 billion at the end of 1995[1]. Recently, the market capitalization of the South Africa has increased up to US$1010 billion and presently this market is the 16th largest stock exchange worldwide. Therefore, due to the important role played by this market, it is worthwhile to re-examine the existence of Monday effect in the stock markets of South Africa and also its neighbouring countries.

Traditionally, the testing procedure for the Monday effect or day-of-the-week effect on the stock returns usually involves regression model with dummy variables. This traditional model has been replaced with the symmetrical GARCH model due to few limitations of the model. The traditional regression model with dummy variables assumed the residual term is constant through the time period. The regression model also fails to capture the time-varying volatility in the return series. To overcome the remaining ARCH effects in the model, few studies started to employ the ARCH/GARCH family to examine the Monday or day-of-the-week effect. Later, Nelson (1991) developed asymmetric Exponential GARCH or EGARCH model which is able to capture asymmetric effect. Since Engle and Ng (1993) observed that market reaction on bad and good news tends to be asymmetric in nature, the use of symmetrical GARCH model in testing market anomalies is inadequate because the GARCH model is unable to capture asymmetric effect[2]. Therefore, to incorporate the possible asymmetry effect of stock market behavior, the asymmetric Exponential GARCH or EGARCH model is a better approach to examine the Monday or day-of-the-week effect and its volatility.

In the speculation of Monday effect or day-of-the-week effect, the usual approach is to test the null hypothesis that all the mean daily returns are equal. If this null hypothesis is rejected, the common practice is to look at the values of the *t*-statistics for

[1] See, Appendix 1 for details.

[2] Among the few, Alexakis and Xanthaki (1995), Chia *et al*. (2008) and Chia and Liew (2010) are able to find evidence of the asymmetric behavior in day-of-the-week effect in the stock markets.

the regression coefficients. If the *t*-statistic of the coefficient for a given day is significant, then this would indicate that the mean returns of that given day and Monday are different. However, this testing procedures suffer from the so-called "multiplicity effect" as illustrated by Greenstone and Oyer (2000) and Alt *et al.* (2011). In particular, the traditional way of testing each null hypothesis at the significance level may lead to an inflated occurrence of multiple type 1 error. Greenstone and Oyer (2000) have suggested using Bonferroni procedure to overcome the problem. However, Alt *et al.* (2011) proposed an alternative approach called closure test principle which is introduced by Marcus *et al*. (1976) to replace the Bonferroni procedures for examine the Monday effect or day-of-the-week effect. This closed test procedure is different from the traditional approaches in the sense that the null hypotheses are tested in such a way that the probability of committing type 1 error is always kept smaller than or equal to a given significant level for each combination of true null hypotheses. Referring to the Monte Carlo study of Alt *et al*. (2011), the power of the closed F-test is greater and it is superior to the Bonferroni procedure. Besides, the closed test principle and its assumptions are well explained in the study of Alt *et al.* (2011).

Therefore, this study attempts to fill in the gap in the literature of market anomalies in South Africa and its neighbouring countries by using the closure test principle in examining the day-of-the-week effect. Besides, this study also differentiates itself from others as it allows for conditional time-changing variance by using the asymmetric EGARCH – Mean model. Overall, this study considers stock market volatility and its asymmetric behavior which is more applicable in stock markets, with control on the multiple type 1 error. The paper is organized as follows, Section 2 states the data and Section 3 discusses the empirical methodology. Section 4 presents the results and the last section concludes the paper.

2. Data

The data of this study consists of the daily closing values of the Emerging Markets (Egypt, Morocco and South Africa) and Frontier Markets (Kenya, Mauritius, Nigeria and Tunisia), over the period 1st June 2002 to 18th August 2011. The daily returns are calculated as the first difference in the natural logarithms of the stock market index:

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

where I_t and I_{t-1} are the values for each index for periods t and $t-1$, respectively. In the case of a day following a non-trading day, the return is calculated using the closing price indices of the latest trading day.

3. Empirical Method

This study initially employs the following EGARCH – Mean specification on the conditional volatility to test the daily seasonality in stock market:

$$R_t = \alpha_1 + \sum_{i=2}^{5} \alpha_i \delta_{it} + \alpha_6 R_{t-1} + \alpha_7 \sigma_t^2 + \varepsilon_t \tag{2}$$

$$\log \sigma_t^2 = \beta_1 + \sum_{j=1}^{p} \gamma_j \log \sigma_{t-j}^2 + \sum_{i=1}^{q} \left(\pi_i \left| \frac{\xi_{t-i}}{\sigma_{t-i}} - \sqrt{\frac{2}{\pi}} \right| + \psi_i \frac{\xi_{t-i}}{\sigma_{t-i}} \right) + \sum_{i=2}^{5} \beta_i \delta_{it} \tag{3}$$

In Equation (2), or known as return equation, R_t is the logarithmic return of the market index at day *t*; R_{t-i} is the logarithmic return of the market index at day *t –i*; $\delta_{2t}, \delta_{3t}, \delta_{4t}$ and δ_{5t} are dummy variables which take on the value 1 if the corresponding return for day *t* is a Tuesday, Wednesday, Thursday and Friday respectively and 0 otherwise. Meanwhile, $\alpha_1, \alpha_2, ..., \alpha_7$ are the parameters to be estimated in Equation (2). Among them, α_1 measures the mean return (in percentage) on Monday; whereas $\alpha_2, ..., \alpha_5$ capture the difference of average return of the stock index for Tuesday, Wednesday, Thursday and Friday respectively as compared to the Monday's mean return. A lagged value of the return variable with its coefficient, α_6, is introduced in Equation (2) to avoid serial correlation error terms in the model, which may yield misleading inferences. In the equation, Monday dummy variable is excluded to avoid dummy variable trap.

Besides, α_7 measures the reward to risk ratio, ε_t is the error term with zero mean and conditional variance σ_t^2 . Equation (3) is the variance equation where left-hand side of the equation is the logarithm of the conditional variance. This implies that the leverage effect is exponential, rather than quadratic, and that forecasts of the conditional variance are guaranteed to be nonnegative. In this case, the presence of leverage effects can be tested by the hypothesis that $\psi_i > 0$, whereas the impact is asymmetric if $\psi_i \neq 0$.

Referring to our case, the closure principle is applied to the mean equation and variance equation and it works as follows. Apart from the global and primary null hypotheses, we have to add all possible intersections into the set of hypotheses. The complete set of hypotheses is listed in Table 1 as below.

Table 1: All primary, intersection and global hypotheses

Primary	Intersection		Global
H_{0i}	H_{0ij}	H_{0ijk}	H_0
$\alpha_2 = 0$	$\alpha_2 = \alpha_3 = 0$	$\alpha_2 = \alpha_3 = \alpha_4 = 0$	$\alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$
$\alpha_3 = 0$	$\alpha_2 = \alpha_4 = 0$	$\alpha_2 = \alpha_3 = \alpha_5 = 0$	
$\alpha_4 = 0$	$\alpha_2 = \alpha_5 = 0$	$\alpha_2 = \alpha_4 = \alpha_5 = 0$	
$\alpha_5 = 0$	$\alpha_3 = \alpha_4 = 0$	$\alpha_3 = \alpha_4 = \alpha_5 = 0$	
	$\alpha_3 = \alpha_5 = 0$		
	$\alpha_4 = \alpha_5 = 0$		

Source: Alt *et al*. (2011)

The closed test procedure started with the testing for the global null hypothesis. The closure principle states that if the global null hypothesis cannot be rejected, then none of the null hypotheses stating pairwise equality can be rejected. On the other hand, if the global null hypothesis is rejected, then there is a need to check all the primary null hypotheses, H_{0i}, and the corresponding sets of intersection hypotheses, H_{0ij} and H_{0ijk}. An adjusted p-value for H_{0i} is then introduced, which is defined as the maximum of all *p*-values corresponding to all the hypotheses contained in the given primary hypothesis. A given primary hypothesis is rejected if the adjusted *p*-value is smaller than 10%.

4. Empirical Results and Discussions

A number of points emerge from the analysis of descriptive statistics. First, it shows the tendency of the lowest mean return in the Nigeria market and the highest mean return in Egypt market. Follow by the mean return, the descriptive statistics provide the standard deviation (Std. Dev.), skewness and kurtosis for respective stock markets. In addition, Jarque-Bera normality test statistics, together with its corresponding *p*-value are also presented in Table 2. From the descriptive statistics, we are able to observe the nature of the volatility and the distribution of the returns. In finance, standard deviation is a representation of the risk associated with stock price variation. The stock market of South Africa has the highest value of standard deviation among others, follow by Egypt stock market. This simply means that investing in these two markets has a higher risk than others. Moreover, the null hypothesis of the Jarque-Bera normality test is rejected implies that daily returns are not normally distributed.

Table 2: Descriptive Statistics for Daily Returns

	Egypt	Morocco	South Africa	Kenya	Mauritius	Nigeria	Tunisia
Mean	0.0848	0.0531	0.0490	0.0660	0.0818	0.0309	0.0438
Std. Dev.	1.8179	1.1386	1.9179	1.4759	1.2929	1.5987	1.0632
Skewness	-0.7299	-0.3126	-0.3660	-0.0386	0.2302	-0.0305	0.2196
Kurtosis	10.7831	6.8225	7.9709	12.4961	15.0038	7.8384	9.7184
Jarque-Bera	6278.5290	1502.1410	2527.7520	9029.5450	14448.3300	2344.3070	3556.4670
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

The results of the mean returns and variance equations of the asymmetric Exponential GARCH - Mean (EGARCH – M) model for the day-of-the-week effect are presented in Table 3. The estimated value of α_7 shows negative risk premium in Egypt, Morocco, Nigeria and Tunisia stock markets, but only Egypt market has a significant negative risk premium. On the other hand, the risk premium is positive in South Africa, Kenya and Mauritius stock markets. The leverage effect terms, ψ_i, are all statistically different from zero. Thus, this amounts to the evidence of asymmetrical market reactions towards positive and negative news, which reflects the presence of asymmetrical stock market in this study. Moreover, the diagnostic test results show that there is no remaining ARCH effect in all the estimated EGARCH – M models.

Table 3: Estimated Exponential GARCH – Mean Results

EGARCH – Mean Results For Day-of-the-Week Effect (Return Equation)			
Parameter	Egypt	Morocco	South Africa
(p, q)	(5, 3)	(5, 3)	(1, 1)
Constant, α_1	0.5786 (0.0000)*	0.0725 (0.2262)	0.1381 (0.0735)***
Tuesday, α_2	-0.3341 (0.0079)*	0.0444 (0.4869)	-0.2285 (0.0142)**
Wednesday, α_3	-0.3814 (0.0024)*	0.0363 (0.5688)	-0.0752 (0.4222)
Thursday, α_4	-0.2351 (0.0541)***	0.0380 (0.5456)	-0.0152 (0.8786)
Friday, α_5	-0.5768 (0.0000)*	0.0330 (0.5960)	-0.0874 (0.3362)
Return (-1), α_6	0.0019 (0.3858)	0.1658 (0.0000)*	0.0483 (0.0256)**
α_7	-0.0459 (0.0245)**	-0.0476 (0.1778)	0.0019 (0.9073)
EGARCH – Mean Results For Day-of-the-Week Effect (Variance Equation)			
Parameter	Egypt	Morocco	South Africa
Constant, β_1	6.9085 (0.0000)*	-0.5896 (0.0000)*	0.0655 (0.3961)
γ_1	0.9858 (0.0000)*	-0.7501 (0.0000)*	0.9761 (0.0000)*
γ_2	-0.0986 (0.1145)	-0.2304 (0.0000)*	-
γ_3	0.3752 (0.0000)*	0.7641 (0.0000)*	-
γ_4	-0.6618 (0.0000)*	0.5027 (0.0000)*	-
γ_5	0.3807 (0.0000)*	0.5855 (0.0000)*	-
π_1	-0.2691 (0.0000)*	-0.2276 (0.0849)***	-0.0913 (0.0000)*
π_2	0.0938 (0.0021)*	-0.0213 (0.2650)	-
π_3	0.1245 (0.0000)*	-0.0134 (0.3000)	-
ψ_1	0.1014 (0.0000)*	0.2794 (0.0000)*	0.1432 (0.0000)*
ψ_2	0.1777 (0.0000)*	0.4018 (0.0000)*	-
ψ_3	-0.1729 (0.0000)*	0.2321 (0.0000)*	-
Tuesday, β_2	-8.2177 (0.0000)*	-0.1007 (0.2104)	-0.1229 (0.3602)
Wednesday, β_3	-4.5944 (0.0000)*	-0.1751 (0.1846)	-0.2575 (0.0208)**
Thursday, β_4	-11.7515 (0.0000)*	-0.1477 (0.2562)	0.0133 (0.9054)

Friday, β_5	-10.3451 (0.0000)*	-0.0400 (0.6322)	-0.4016 (0.0025)*
EGARCH – Mean Results For Day-of-the-Week Effect (Diagnostic Checking)			
ARCH – LM Statistic (*p*-value)			
5 Lags	0.6068	0.2331	0.4464
10 Lags	0.7819	0.4506	0.6271
Ljung-Box Q^2 Statistic (*p*-value)			
5 Lags	0.6130	0.2220	0.4490
10 Lags	0.7690	0.4250	0.6520

Note: *, ** and *** denote significance at 1, 5 and 10% levels respectively. Numbers in parentheses depict *p*-value. The highest order of *p* and *q* considered in this study is 5. The selection of appropriate orders of *p* and *q* in this study to be determined by the smallest Schwarz Information Criterion (SIC) (Clare *et al*., 1998).

Table 3: Estimated Exponential GARCH – Mean Results (Cont.)

EGARCH – Mean Results For Day-of-the-Week Effect (Return Equation)				
Parameter	Kenya	Mauritius	Nigeria	Tunisia
(*p*, *q*)	(4, 4)	(3, 5)	(2, 2)	(3, 3)
Constant, α_1	0.0287 (0.4919)	0.0212 (0.5315)	-0.0204 (0.7113)	-0.0283 (0.5504)
Tuesday, α_2	0.0221 (0.7036)	-0.0007 (0.9880)	-0.0226 (0.7359)	0.0184 (0.7475)
Wednesday, α_3	0.0830 (0.1771)	0.0039 (0.9360)	0.0959 (0.1137)	0.0803 (0.1620)
Thursday, α_4	0.0339 (0.5443)	0.1111 (0.0200)**	0.0349 (0.5812)	0.1412 (0.0138)**
Friday, α_5	-0.0656 (0.2416)	0.0430 (0.3867)	0.2289 (0.0008)*	0.1891 (0.0009)*
Return (-1), α_6	0.2813 (0.0000)*	0.1381 (0.0000)*	0.3521 (0.0000)*	0.0466 (0.0579)***
α_7	0.0027 (0.8882)	0.0121 (0.5519)	-0.0191 (0.3532)	-0.0222 (0.5016)
EGARCH – Mean Results For Day-of-the-Week Effect (Variance Equation)				
Parameter	Kenya	Mauritius	Nigeria	Tunisia
Constant, β_1	-0.1832 (0.0209)**	-0.4963 (0.0000)*	-0.1837 (0.0529)***	-0.0002 (0.9991)
γ_1	-0.3545 (0.0000)*	-0.0770 (0.0000)*	1.7229 (0.0000)*	2.7628 (0.0000)*
γ_2	1.4135 (0.0000)*	0.0131 (0.0067)*	-0.7251 (0.0000)*	-2.7066 (0.0000)*
γ_3	0.4687 (0.0000)*	0.9625 (0.0000)*	-	0.9377 (0.0000)*
γ_4	-0.5549 (0.0000)*	-	-	-
π_1	-0.0278 (0.1430)	0.0144 (0.4675)	0.0163 (0.3557)	0.0459 (0.0029)*
π_2	-0.0064 (0.7256)	-0.0526 (0.0198)**	-0.0174 (0.3238)	-0.0773 (0.0076)*
π_3	0.0389 (0.0220)**	0.0085 (0.2466)	-	0.0338 (0.0314)**
π_4	0.0098 (0.6018)	0.0094 (0.6420)	-	-
π_5	-	0.0769 (0.0002)*	-	-
ψ_1	0.5216 (0.0000)*	0.5588 (0.0000)*	0.4639 (0.0000)*	0.3178 (0.0000)*
ψ_2	0.4676 (0.0000)*	0.3637 (0.0000)*	-0.4409 (0.0000)*	-0.5763 (0.0000)*
ψ_3	-0.3899 (0.0000)*	0.1779 (0.0000)*	-	0.3025 (0.0000)*
ψ_4	-0.4010 (0.0000)*	-0.3250 (0.0000)*	-	-
ψ_5	-	-0.1135 (0.0008)*	-	-

Tuesday, β_2	0.1065 (0.3096)	0.0251 (0.7454)	0.5537 (0.0021)*	-0.1635 (0.6519)
Wednesday, β_3	0.3289 (0.0269)**	0.1561 (0.1282)	-0.2876 (0.0217)**	0.1644 (0.5591)
Thursday, β_4	-0.0637 (0.6545)	0.1119 (0.1197)	0.3068 (0.0200)**	-0.2707 (0.2386)
Friday, β_5	-0.1167 (0.1466)	0.0977 (0.1335)	0.2640 (0.1285)	0.1038 (0.8077)
EGARCH – Mean Results For Day-of-the-Week Effect (Diagnostic Checking)				
ARCH – LM Statistic (*p*-value)				
5 Lags	0.4460	0.9181	0.2989	0.9477
10 Lags	0.7396	0.8474	0.6469	0.9708
Ljung-Box Q^2 Statistic (*p*-value)				
5 Lags	0.4340	0.9160	0.2800	0.9420
10 Lags	0.7380	0.8470	0.6230	0.9680

Note: *, ** and *** denote significance at 1, 5 and 10% levels respectively. Numbers in parentheses depict *p*-value. The highest order of *p* and *q* considered in this study is 5. The selection of appropriate orders of *p* and *q* in this study to be determined by the smallest Schwarz Information Criterion (SIC) (Clare *et al*., 1998).

For all the markets in this study, the closure test principle is applied. For the mean equation, *p*-values for hypotheses of pairwise equality of Monday returns with other day of the week returns are presented in Table 4. For each primary hypothesis, the first value is the adjusted *p*-value, while the other values are traditional *p*-values. For example, in testing the hypotheses of Monday returns are equal to Tuesday returns (MON=TUE) in Egypt stock market, the adjusted *p*-value is 0.0296, which is the maximum of the *p*-values for all the hypotheses of H_{02}. Then, the adjusted *p*-values for all the hypotheses H_{0i} are summarized in Table 5. In determining Monday effect from the closed test results, we followed the definition of Monday effect as defined by Alt *et al.* (2011). The term “weak Monday effect” is used when Monday returns are statistically different from at least one other day of the week, while “strong Monday effect” refers to the case where Monday returns are statistically different from all other days of the week. Referring to Table 5, Egypt is the only country that has a strong Monday effect as the Monday returns differ from all other weekdays. Besides that, three out of four of the Frontier Markets (Mauritius, Nigeria and Tunisia) have a weak Monday effect.

Table 4: Adjusted p-value and traditional p-values for the complete set of hypotheses of EGARCH-Mean mean equation

		Egypt	Morocco	South Africa	Kenya	Mauritius	Nigeria	Tunisia
MON = TUE								
Adjusted p-value	$H_{02}:\alpha_2=0$	0.0296	0.9656	0.1084	0.8283	0.9947	0.7359	0.7475
Traditional p-values	$H_{02}:\alpha_2=0$	0.0080	0.4869	0.0143	0.7037	0.9880	0.7359	0.7475
	$H_{023}:\alpha_2=\alpha_3=0$	0.0073	0.7685	0.0411	0.3862	0.9947	0.1316	0.3319
	$H_{024}:\alpha_2=\alpha_4=0$	0.0296	0.7561	0.234	0.8283	0.0242	0.6985	0.0182
	$H_{025}:\alpha_2=\alpha_5=0$	0.0000	0.7749	0.0459	0.3359	0.6041	0.0002	0.0010
	$H_{0234}:\alpha_2=\alpha_3=\alpha_4=0$	0.0149	0.9023	0.0558	0.5925	0.0482	0.2498	0.0359
	$H_{0235}:\alpha_2=\alpha_3=\alpha_5=0$	0.0001	0.9109	0.0925	0.1446	0.7907	0.0006	0.0031
	$H_{0245}:\alpha_2=\alpha_4=\alpha_5=0$	0.0000	0.9042	0.0572	0.4128	0.0569	0.0006	0.0012
	$H_{02345}:\alpha_2=\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9656	0.1084	0.2399	0.0879	0.0014	0.0031
MON = WED								
Adjusted p-value	$H_{03}:\alpha_3=0$	0.0149	0.9656	0.7204	0.5925	0.9947	0.2836	0.3319
Traditional p-values	$H_{03}:\alpha_3=0$	0.0024	0.5688	0.4223	0.1773	0.9360	0.1139	0.1622
	$H_{023}:\alpha_2=\alpha_3=0$	0.0073	0.7685	0.0411	0.3862	0.9947	0.1316	0.3319
	$H_{034}:\alpha_3=\alpha_4=0$	0.0095	0.7992	0.6943	0.4015	0.0356	0.2836	0.0473
	$H_{035}:\alpha_3=\alpha_5=0$	0.0001	0.8234	0.5921	0.0682	0.6448	0.0035	0.0038
	$H_{0234}:\alpha_2=\alpha_3=\alpha_4=0$	0.0149	0.9023	0.0558	0.5925	0.0482	0.2498	0.0359
	$H_{0235}:\alpha_2=\alpha_3=\alpha_5=0$	0.0001	0.9109	0.0925	0.1446	0.7907	0.0006	0.0031
	$H_{0245}:\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9252	0.7204	0.1391	0.0822	0.0057	0.0082
	$H_{02345}:\alpha_2=\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9656	0.1084	0.2399	0.0879	0.0014	0.0031
MON = THU								
Adjusted p-value	$H_{04}:\alpha_4=0$	0.0543	0.9656	0.8786	0.8283	0.0879	0.6985	0.0473
Traditional p-values	$H_{04}:\alpha_4=0$	0.0543	0.5457	0.8786	0.5444	0.0201	0.5813	0.0138
	$H_{024}:\alpha_2=\alpha_4=0$	0.0296	0.7561	0.0234	0.8283	0.0242	0.6985	0.0182
	$H_{034}:\alpha_3=\alpha_4=0$	0.0095	0.7992	0.6943	0.4015	0.0356	0.2836	0.0473
	$H_{045}:\alpha_4=\alpha_5=0$	0.0000	0.8072	0.5828	0.2691	0.0656	0.0019	0.0032
	$H_{0234}:\alpha_2=\alpha_3=\alpha_4=0$	0.0149	0.9023	0.0558	0.5925	0.0482	0.2498	0.0359
	$H_{0245}:\alpha_2=\alpha_4=\alpha_5=0$	0.0000	0.9042	0.0572	0.4128	0.0569	0.0006	0.0012
	$H_{0345}:\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9252	0.7204	0.1391	0.0822	0.0057	0.0082
	$H_{02345}:\alpha_2=\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9656	0.1084	0.2399	0.0879	0.0014	0.0031
MON = FRI								
Adjusted p-value	$H_{05}:\alpha_5=0$	0.0001	0.9656	0.7204	0.4128	0.7907	0.0057	0.0082
Traditional p-values	$H_{05}:\alpha_5=0$	0.0000	0.5960	0.3363	0.2417	0.3867	0.0008	0.0009
	$H_{025}:\alpha_2=\alpha_5=0$	0.0000	0.7749	0.0459	0.3359	0.6041	0.0002	0.0010
	$H_{035}:\alpha_3=\alpha_5=0$	0.0001	0.8234	0.5921	0.0682	0.6448	0.0035	0.0038
	$H_{045}:\alpha_4=\alpha_5=0$	0.0000	0.8072	0.5828	0.2691	0.0656	0.0019	0.0032
	$H_{0235}:\alpha_2=\alpha_3=\alpha_5=0$	0.0001	0.9109	0.0925	0.1446	0.7907	0.0006	0.0031
	$H_{0235}:\alpha_2=\alpha_4=\alpha_5=0$	0.0000	0.9042	0.0572	0.4128	0.00569	0.0006	0.0012
	$H_{0345}:\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9252	0.7204	0.1391	0.0822	0.0057	0.0082
	$H_{02345}:\alpha_2=\alpha_3=\alpha_4=\alpha_5=0$	0.0000	0.9656	0.1084	0.2399	0.0879	0.0014	0.0031

Table 5: Closed F-Test results (Mean Equation)

Primary hypothesis	MON=TUE (adjusted *p*-value)	MON = WED (adjusted *p*-value)	MON = TUE (adjusted *p*-value)	MON = FRI (adjusted *p*-value)
Egypt	0.0296**	0.0149**	0.0543***	0.0001*
Morocco	0.9656	0.9656	0.9656	0.9656
South Africa	0.1084	0.7204	0.8786	0.7204
Kenya	0.8283	0.5925	0.8283	0.4128
Mauritius	0.9947	0.9947	0.0879***	0.7907
Nigeria	0.7359	0.2836	0.6985	0.0057*
Tunisia	0.7475	0.3319	0.0473**	0.0082*

*, ** and *** indicate significance at the 1%, 5% and 10% level. If the Monday return is different from all other days of the week, it can be concluded as strong Monday effect. If the Monday return is different from at least one other day of the week, it can be concluded as weak Monday effect.

Table 6 and Table 7 present the closure test results for the variance equation of the EGARCH-Mean model. In a similar manner, we determine the adjusted *p*-values for the complete set of hypotheses for the variance equation. In the following, we will use the term "weak Monday volatility" when Monday volatility is distinguishable from at least one other days of the week. On the other hand, if Monday volatility is statistically different from all other days of the week, then this can be concluded as "strong Monday volatility". Referring to Table 7, Egypt has a strong Monday volatility while Kenya and Nigeria have a weak Monday volatility. No significant result is found for the other countries.

Table 6: Adjusted p-value and traditional p-values for the complete set of hypotheses of EGARCH-Mean variance equation

		Egypt	Morocco	South Africa	Kenya	Mauritius	Nigeria	Tunisia
MON = TUE								
Adjusted p-value	$H_{02}:\beta_2=0$	0.0000	0.4805	0.5352	0.3825	0.7454	0.0168	0.7549
Traditional p-values	$H_{02}:\beta_2=0$	0.0000	0.2105	0.3603	0.3097	0.7454	0.0021	0.6520
	$H_{023}:\beta_2=\beta_3=0$	0.0000	0.3933	0.0685	0.0105	0.1914	0.0000	0.4492
	$H_{024}:\beta_2=\beta_4=0$	0.0000	0.3428	0.4805	0.3519	0.1701	0.0080	0.4655
	$H_{025}:\beta_2=\beta_5=0$	0.0000	0.3366	0.0047	0.2215	0.3007	0.0061	0.4271
	$H_{0234}:\beta_2=\beta_3=\beta_4=0$	0.0000	0.3300	0.1266	0.0000	0.0003	0.0000	0.6254
	$H_{0235}:\beta_2=\beta_3=\beta_5=0$	0.0000	0.4213	0.0105	0.0006	0.2812	0.0000	0.6179
	$H_{0245}:\beta_2=\beta_4=\beta_5=0$	0.0000	0.5352	0.0097	0.3825	0.0002	0.0168	0.5967
	$H_{02345}:\beta_2=\beta_3=\beta_4=\beta_5=0$	0.0000	0.4885	0.0190	0.0000	0.0000	0.0000	0.7549
MON = WED								
Adjusted p-value	$H_{03}:\beta_3=0$	0.0000	0.1266	0.5646	0.0270	0.2812	0.0218	0.7549
Traditional p-values	$H_{03}:\beta_3=0$	0.0000	0.1848	0.0209	0.0270	0.1283	0.0218	0.5591
	$H_{023}:\beta_2=\beta_3=0$	0.0000	0.3933	0.0685	0.0105	0.1914	0.0000	0.4492
	$H_{034}:\beta_3=\beta_4=0$	0.0000	0.4142	0.0643	0.0010	0.0003	0.0074	0.4276
	$H_{035}:\beta_3=\beta_5=0$	0.0000	0.4145	0.0079	0.0169	0.1802	0.0000	0.7003
	$H_{0234}:\beta_2=\beta_3=\beta_4=0$	0.0000	0.3300	0.1266	0.0000	0.0003	0.0000	0.6254
	$H_{0235}:\beta_2=\beta_3=\beta_5=0$	0.0000	0.4213	0.0105	0.0006	0.2812	0.0000	0.6179
	$H_{0245}:\beta_3=\beta_4=\beta_5=0$	0.0000	0.5646	0.0105	0.0008	0.0000	0.0000	0.6314
	$H_{02345}:\beta_2=\beta_3=\beta_4=\beta_5=0$	0.0000	0.4885	0.0190	0.0000	0.0000	0.0000	0.7549
MON = THU								
Adjusted p-value	$H_{04}:\beta_4=0$	0.0000	0.9054	0.5646	0.6545	0.1701	0.0432	0.7549
Traditional p-values	$H_{04}:\beta_4=0$	0.0000	0.2563	0.9054	0.6545	0.1198	0.0201	0.2388
	$H_{024}:\beta_2=\beta_4=0$	0.0000	0.3428	0.4805	0.3519	0.1701	0.0080	0.4655
	$H_{034}:\beta_3=\beta_4=0$	0.0000	0.4142	0.0643	0.0010	0.0003	0.0074	0.4276
	$H_{045}:\beta_4=\beta_5=0$	0.0000	0.3748	0.6943	0.2510	0.0019	0.0432	0.4228
	$H_{0234}:\beta_2=\beta_3=\beta_4=0$	0.0000	0.3300	0.1266	0.0000	0.0003	0.0000	0.6254
	$H_{0245}:\beta_2=\beta_4=\beta_5=0$	0.0000	0.5352	0.0097	0.3825	0.0002	0.0168	0.5967
	$H_{0345}:\beta_3=\beta_4=\beta_5=0$	0.0000	0.5646	0.0105	0.0008	0.0000	0.0000	0.6314
	$H_{02345}:\beta_2=\beta_3=\beta_4=\beta_5=0$	0.0000	0.4885	0.0190	0.0000	0.0000	0.0000	0.7549
MON = FRI								
Adjusted p-value	$H_{05}:\beta_5=0$	0.0000	0.6943	0.6322	0.3825	0.3007	0.1286	0.8078
Traditional p-values	$H_{05}:\beta_5=0$	0.0000	0.6322	0.0025	0.1466	0.1336	0.1286	0.8078
	$H_{025}:\beta_2=\beta_5=0$	0.0000	0.3366	0.0047	0.2215	0.3007	0.0061	0.4271
	$H_{035}:\beta_3=\beta_5=0$	0.0000	0.4145	0.0079	0.0169	0.1802	0.0000	0.7003
	$H_{045}:\beta_4=\beta_5=0$	0.0000	0.3748	0.6943	0.2510	0.0019	0.0432	0.4228
	$H_{0235}:\beta_2=\beta_3=\beta_5=0$	0.0000	0.4213	0.0105	0.0006	0.2812	0.0000	0.6179
	$H_{0235}:\beta_2=\beta_4=\beta_5=0$	0.0000	0.5352	0.0097	0.3825	0.0002	0.0168	0.5967
	$H_{0345}:\beta_3=\beta_4=\beta_5=0$	0.0000	0.5646	0.0105	0.0008	0.0000	0.0000	0.6314
	$H_{02345}:\beta_2=\beta_3=\beta_4=\beta_5=0$	0.0000	0.4885	0.0190	0.0000	0.0000	0.0000	0.7549

Table 8: Closed F-Test results (Variance Equation)

Primary hypothesis	MON=TUE (adjusted *p*-value)	MON = WED (adjusted *p*-value)	MON = TUE (adjusted *p*-value)	MON = FRI (adjusted *p*-value)
Egypt	0.0000*	0.0000*	0.0000*	0.0000*
Morocco	0.4805	0.1266	0.9054	0.6943
South Africa	0.5352	0.5646	0.5646	0.6322
Kenya	0.3825	0.0270**	0.6545	0.3825
Mauritius	0.7454	0.2812	0.1701	0.3007
Nigeria	0.0168**	0.0218**	0.0432**	0.1286
Tunisia	0.7549	0.7549	0.7549	0.8078

*, ** and *** indicate significance at the 1%, 5% and 10% level. If the Monday volatility is different from all other days of the week, it can be concluded as strong Monday volatility. If the Monday volatility is different from at least one other day of the week, it can be concluded as weak Monday volatility.

5. Conclusion

This study examined the existence of a daily pattern of day-of-the-week effect in the South Africa and its neighbouring countries stock markets by using the asymmetric Exponential GARCH – Mean model with closure test principle which proposed by Alt *et al*. (2011). Generally, Egypt is the only country that has a strong Monday effect as the Monday returns differ from all other weekdays. Besides, weak Monday effect is found in Mauritius, Nigeria and Tunisia stock markets. When the time-varying volatility in the market returns is taken into account by the EGARCH – M model, strong Monday volatility is found in Egypt while Kenya and Nigeria is found to have weak Monday volatility. However, there is no significant Monday volatility is found in the other markets. Lastly, the leverage effect terms are all significant, which reflects the presence of asymmetrical behavior in these markets.

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Appendix 1

Market capitalization of listed companies (% of GDP)						
Country Name	**Country Code**	**1990**	**1995**	**2000**	**2005**	**2010**
Egypt, Arab Rep.	**EGY**	4.0806	13.4443	28.7879	88.8348	37.6839
Morocco	**MAR**	3.7412	18.0409	29.4408	45.7295	75.8284
South Africa	**ZAF**	123.1990	185.6398	154.2414	228.8505	278.3963
Kenya	**KEN**	5.2732	20.8482	10.1100	34.0699	46.0411
Mauritius	**MUS**	10.0999	32.9428	29.0499	41.6520	66.8703
Nigeria	**NGA**	4.8117	7.2326	9.2139	17.2436	26.2732
Tunisia	**TUN**	4.3367	21.7793	14.5434	9.9287	24.1173
Total		155.5423	299.9279	275.3873	466.3091	555.2105
United States	**USA**	53.2100	93.4485	152.5845	134.9068	117.5319
Market capitalization of listed companies (current US$)						
Egypt, Arab Rep.	**EGY**	1.76E+09	8.09E+09	2.87E+10	7.97E+10	8.25E+10
Morocco	**MAR**	9.66E+08	5.95E+09	1.09E+10	2.72E+10	6.92E+10
South Africa	**ZAF**	1.38E+11	2.81E+11	2.05E+11	5.65E+11	1.01E+12
Kenya	**KEN**	4.53E+08	1.89E+09	1.28E+09	6.38E+09	1.45E+10
Mauritius	**MUS**	2.68E+08	1.33E+09	1.33E+09	2.62E+09	6.51E+09
Nigeria	**NGA**	1.37E+09	2.03E+09	4.24E+09	1.94E+10	5.09E+10
Tunisia	**TUN**	5.33E+08	3.93E+09	2.83E+09	2.88E+09	1.07E+10
Total		1.43E+11	3.04E+11	2.54E+11	7.04E+11	1.25E+12
United States	**USA**	3.06E+12	6.86E+12	1.51E+13	1.70E+13	1.71E+13

Source: The World Bank - World Development Indicators.