An Empirical Investigation of the Day-of- the-Week Effect on Stock Returns and Volatility: Evidence from Muscat Securities Market

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Abstract

This paper investigates the anomalous phenomenon of the day-of-the-week effect on Muscat securities market. The study uses a sample that covers the period from 1 December 2005 until 23 November 2011. It also utilizes a nonlinear symmetric GARCH (1,1) model and two nonlinear asymmetric models, TARCH (1,1) and EGARCH (1,1). The empirical findings provide evidence of no presence of the day-of-the-week effect. However, unlike other developed markets, Muscat stock market seems to start positive and ends also positive with downturn during the rest of the trading days. In addition, the parameter estimates of the GARCH model (α and β) suggest a high degree of persistent in the conditional volatility of stock returns. Furthermore, the asymmetric EGARCH, and TARCH models show no significant evidence for asymmetry in stock returns. The study concludes that Muscat securities market is an efficient market.

Keywords: day-of-the-week effect, volatility, stock market anomalies, GARCH, TARCH, EGARCH, muscat securities market

JEL Classification: D53, G14, G15

1. Introduction

The efficient market hypothesis (EMH) is considered one of the most debated and investigated issue in finance literatures. It states that a market is considered to be efficient if it reacts and responds quickly and accurately to all available information. Fama (1970) classified market efficiency into three forms: weak-form EMH, semi-strong form EMH, and strong form EMH. According to the weak-form EMH, everything is random and past historical sequences of data on stock prices are of no use in predicting future stock prices. As for the semi-strong form, it asserts that abnormal large returns cannot be earned consistently by investors using public information. On the other hand, the strong form of the EMH states that no information whether it is public or private will allow investors to consistently achieve abnormal high returns. However, the efficient market hypothesis was contradicted by some anomalies such as: calendar anomalies, fundamental anomalies and technical anomalies. Calendar anomalies refer to the tendency of securities to behave differently on a particular day-of-the-week, or month-of-the-year. However, this paper will concentrate only on the analysis of the day-of-the-week effect on returns and volatility of Muscat stock market. The results of previous researches on this phenomenon provided mixed conclusions. For instance, Cross (1973), French (1980), Gibbons and Hess (1981), Lakonishoke and Levi (1982), Rogalski (1984), Kim and Stambaugh (1984), and Balaban (1995) found a presence of the day-of-the-week effect on stock market returns in their studies. On the other hand, contradicting results were found by Santemases (1986), Marashdeh (1994), Pena (1996), Davidson and Peker (1996), Brooks and Persand (2001) and Demirer and Karan (2002) where no significant evidence of the day-of the-week effect were discovered.

The objective of this study is to examine the day-of-the-week effect on stock returns and volatility of Muscat securities market. This paper contributes to finance literature in several ways. First, it fills the gap created by the scarcity of researches that investigated this phenomenon on Muscat stock market. Second, it employs updated data for approximately the end of 2011. Third, it will lead to a conclusion regarding the efficiency of Omani stock market that is of value to decision makers.

This study is organized into six sections as follows: section 2 provides a brief overview of Muscat securities market, while section 3 introduces previous studies. Data and research methodology are addressed in section 4. Section 5 reports the empirical findings and discusses the related results. Finally, concluding remarks are provided in section 6.

2. Overview of Muscat Securities Market

Muscat securities market (MSM) was established as a public institution in 1988 and commenced its operations one year later in 1989. The main objective of MSM is to participate in the economic development of the country and strengthening the financial sector of Oman. In addition, its mission is to work tirelessly toward achieving market efficiency and providing investors with attractive investing environment. Thus, it increased investment awareness among investors and encouraged the listing of new securities. In 1998, MSM went through restructuring process that led to the establishment of two separate entities, the exchange (MSM) where all trading of listed securities must take a place, and the capital market authority (CMA) which regulates and supervises Muscat stock market. Currently, there are 123 companies listed on MSM classified according to their activities into three sectors: financial, industrial and services sectors.

MSM 30 index is the only available index that Muscat securities market has. It serves as a benchmark to investors in tracking the performance of the Omani stock market. It was established in 1992 with a base value of 1000 set in the year 1990. It is a value-weighted index of 30 high capitalized most liquid and profitable companies that are listed on MSM (13 financial, 11 industrial, and 6 services). This paper uses the MSM 30 index to analyze the day-of-the-week effect on return and volatility of Muscat securities market. The data covers approximately six years of market performance that spans from 1 December 2005 till 23 November 2011. However, examining the data uncover that MSM exhibited a strong volatility following in the footsteps of most Gulf Cooperation Council (GCC) countries. Thus, MSM witnessed positive returns until mid-2008 due to the increase in energy prices. However, the global financial meltdown drove the market downward until early 2009 where the market started to recover its losses slightly. (http://www.msm.gov.om)

3. Literature Review

There are extensive studies that investigated the anomaly of the day-of-the-week effect for different stock markets around the world. This section will shed some light on some of these studies.

Starting with most recent studies, Abdalla (2012) used ordinary least squares (OLS) and GARCH models to investigate the day-of-the-week effect on stock market returns and volatility of Khartoum stock exchange (KSE). His findings reveal no evidence of this phenomenon in KSE. On the other hand, Mbululu and Chipeta (2012) analyzed the day-of-the-week effect on a nine listed sector indices of South Africa stock market (JSE). Their findings exhibited also no evidence of the day-of-the-week effect for eight of the nine sector indices of JSE. However, Monday effect was found in the materials sector only.

Similar results were obtained by Hussain, Hamid, Akash, and Khan (2011) who tested the Karachi stock exchange (KSE-100) using a sample from January 2006 to December 2010 employing regression analysis. Their findings reveal that Tuesday returns were positive, significant and high compared to other days. On the other hand, Abdullah, Baharuddin, Shamsudin, Mahmood, and Sahudin (2011) examined the day-of-the-week effect on Malaysia shariah-compliant market. They utilized OLS on a data covering the period from 21 May 2007 to 19 September 2008. Their findings show a presence of the day-of-the-week effect in Kula Lumpur shariah index (KLSI). However, no presence of this phenomenon was found for FBM Emas shariah and FBM Hijrah Emas Shariah. Furthermore, KLSI exhibited a significant return on Monday while positive significant return was noticed on Friday. Also, Ulussever, Gurm Yumusak and Kar (2011) studied the Saudi stock exchange using the GARCH model. Their findings provide evidence of the presence of the day-of-the-week effect in the daily return of the Saudi stock market (TADAWUL).

Similarly, Al-Mutairi (2010) found evidence of presence of the day-of-the-week effect in Kuwait stock exchange. His findings show that Saturday returns were positive and higher than other days of the week except for Wednesday, suggesting that Kuwait stock market is inefficient. Also, Sutheebanjard and Premchaiswadi (2010) concluded that the stock exchange of Thailand (SET) showed a significant evidence of the day-of-the-week effect, where Monday and Friday found to have the highest and lowest percent of prediction error respectively.

Testing the Russian stock market using ARCH/GARCH models, McGowan, Jr., and Ibrihim (2009) found a presence of the day-of-the-week effect. They concluded that returns were the positive in everyday except on Wednesday where they were the lowest; the highest returns were observed on Friday. Similarly, Al-Barrak (2009) tested the day-of-the-week effect in some of the Gulf Cooperation Council (GCC) stock markets including the markets of Saudi Arabia, Kuwait and UAE (Dubai). He concluded that this anomaly is existed in Kuwait stock market only and the highest returns were observed on Saturday while the lowest returns were achieved on Sunday. Also, Rahman (2009) employed the regression analysis and the GARCH (1,1) model to examine the anomaly of Dhaka stock exchange (DSE). His results showed that returns were negative and significant on Sunday and Monday while positive significant returns were achieved on Thursday.

As for the Australian stock market, Marrett and Worthington (2008) utilized the regression analysis on a data covering the period from 9 September 1996 to 10 November 2006. Their findings showed no seasonality for the overall stock market. On the other hand, small cap showed higher returns on Thursdays and Fridays. The analysis of different sectors of the market provided a partial supportive evidence of the day-of-the-week effect. Also, Baker, Rahman and Saadi (2008) investigated the day-of-the-week effect and the conditional volatility on the S&P/TSX Canadian returns index. They found that the day-of-the-week effect is sensitive in both the mean and the conditional volatility and that the using of the regression analysis is a better way to investigate this effect. On the other hand, Agathee (2008) found the stock exchange of Mauritius exhibited support of this phenomenon and returns were higher on Friday. However, the mean returns of the five week days were jointly insignificant and differ from zero.

In Turkey, the Istanbul stock exchange indices were investigated by Dicle and Hassan (2007). Their findings showed that returns on Mondays were negative and significant while returns on Thursdays and Fridays were significantly positive. Similar results were obtained by Chukwuogor-Ndu (2007) where he found a presence of the day-of-the-week effect in some East Asian financial markets. Also, insignificant daily returns and volatility were existed in most of these markets. Apolinario, Santana, Sales, and Caro (2006) used the GARCH and T-GARCH models to examine 13 European stock markets. Their findings revealed a normal behavior of returns is present in these markets.

On the other hand, Gregoriou, Kontonikas and Tsitsianis (2004) used the GARCH model to measure the volatility of stock returns of the UK stock market utilizing the FTSE 100 index. Their results provide evidence of the day-of-the-week effect. However, when transaction costs are considered, no presence of this phenomenon was found, concluding that the UK stock market appears to be weak-form efficient. Moving to Egypt stock market, Aly, Mehdian, and Perry (2004) found that returns on Mondays were significant and positive but they were not significantly different from the other days of the week. Therefore, they concluded that no evidence of any daily seasonality is present in the Egyptian stock market. Contrary results were obtained by Al-Rajoub (2004) where he investigated this anomaly in Amman stock exchange. He found that returns on Thursday, the end of the week, were positive and the highest, while returns on Monday were negative and the lowest.

Also, Kiymaz and Berument (2003) found evidence of the day-of-the-week effect in both returns and volatility for major stock market indexes. The highest volatility was occurred on Mondays for Germany, and Japan; Fridays, for Canada and the United States; and Thursdays for the UK. On the other hand, the Korean stock market was tested by Kamath and Chusanachoti (2002) using the OLS and the GARCH model. They found conflicting results where a strong evidence of the day-of-the-week effect was found during the 1980's, however, the presence of this phenomenon disappeared in the 1990's. Similarly, Al-Loughani and Chappell (2001) utilized the GARCH model on Kuwait stock market and found that returns were higher on Friday and Lower on Monday providing supportive evidence of the day-of-the-week effect. On the other hand, Choudhry (2000) analyzed this phenomenon on seven emerging Asian stock markets to include India, Indonesia, Malaysia, The Philippine, South Korea, Taiwan, and Thailand. His findings proved a presence of the day-of-the-week effect on both returns and volatility. Similar results were concluded by Poshakwale (1996) regarding the Bombay stock exchange (BSE) in India. The findings showed that returns on Fridays were significantly higher compared with other days of the week.

4. Data and Research Methodology

4.1 Data

Daily data of Muscat securities market index 30 were obtained from the website of Muscat securities market (http://www.msm.gov.om). The data covers the period from 1 December 2005 to 23 November 2011. The logarithmic returns of trading days have been calculated, and the daily rate of change is computed as the natural logarithmic first difference of the daily closing price of the MSM:

$$R_t = \ln[p_t/p_{t-1}] \tag{1}$$

Where R_t represents the continuously compounded rate of return of MSM, p_t is the closing price in day t, while, p_{t-1} represents the closing price in the day before.

4.2 Research Methodology

For the model specification, two important issues must be considered. First, as it has been long pointed that the autocorrelation problem resulted from the violation of the assumption of no autocorrelation, which may result in misleading inferences. This problem can be addressed by including the lagged values of proper lagged values of returns as independent variables. The second issue is that the error variances may not be constant over time (heteroscedasticity problem). This can be handled by allowing variances of errors to be time dependent to include a conditional heteroskedasticity. Thus, error terms will have a mean of zero and a time-varying variance of h_t, i.e. ε_t

$\varepsilon_t \backsim (0, h_t)$. Different models for conditional variances were developed. Engle (1982) allows the forecasted variances of return to change with the squared lagged values of the error terms from the previous periods, which is known as Autoregressive Conditional Heteroskedastic Model (q) (ARCH (q)). The generalized version of ARCH (q) is suggested by Bollerslev (1986) and makes the conditional variance, h_t, a function of lagged values of both h_t and ε_t^2. This specification is known as GARCH (p, q) modeling. However, it is possible that the conditional variance, as a proxy for risk, can affect stock market returns.

The GARCH model that previously discussed is symmetric and does not capture the asymmetry effect "leverage effect". However, asymmetry effect is a common characteristic inherent in most stock returns time series. In financial time series analysis, the asymmetry effect refers to the characteristic of times series on asset prices and implies that bad news tends to increase volatility more than good news (Black, 1976).

To absorb the possible asymmetry effect of the stock market behavior, the threshold ARCH or TARCH (advanced by Zakoian, 1994) and the Exponential GARCH or EGARCH (proposed by Nelson, 1991) models are also used in the current research. The general model used in this study may be expressed as:

$$R_t = \varphi_1 + \sum_{i=2}^{5} \varphi_i D_{it} + \sum_{i=1}^{n} \theta_i R_{t-1} + \varepsilon_t \tag{2}$$

In this equation R_t as defined before represents the continuously compounded rate of return, where φ_1 is the constant term; φ_i Coefficients 2 to 5 denotes the difference of mean returns of Monday to Wednesday with the mean returns of Sunday; R_{t-1} is the series of lagged explanatory variables; θ_i are the coefficients of the lagged return terms; D_{it} is the matrix with dummies for Monday, Tuesday, Wednesday, and Thursday. Saturday dummy is excluded to avoid the dummy variable trap. Values of one and zero are assigned to these dummy variables. The variable D_{it} is assigned value of "one" if return for that day is there. A value of "zero" is assigned for returns of rest of the week days. ε_t denotes the disturbance term.

The three specifications of the model, i.e., GARCH, TARCH and EGARCH deviated from each other in the way they specified the conditional variance h_t. The three conditional variance equations fit into daily returns to model the MSM data are:

Conditional Variance Equation GARCH:

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \beta h_{t-1} \tag{3}$$

Conditional Variance Equation TARCH:

$$h_t = \omega + \alpha \varepsilon_{t-1}^2 + \gamma \varepsilon_{t-1}^2 I_{t-1} + \beta h_{t-1} \tag{4}$$

Conditional Variance Equation EGARCH:

$$\log(h_t) = \omega + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{h_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta \log(h_{t-1}) \tag{5}$$

Specification allows the conditional variance to be dependent on past information, which will induce variability over time. More specifically, the conditional variance is explained by past shocks and past variances.

According to equation 3, the conditional variance is stated as a function of past shocks and past variances. The ARCH term, α, indicates the short-run persistence of shocks, while the GARCH term, β, stands for the contribution of shocks to long-run persistence.

It is worth mentioning that the GARCH model assumes a symmetric response of volatility to past shocks. This implies that both good and bad news have the same impact on the market. Whereas in reality, it is commonly observed in the context of stock market returns, there is the possibility of leverage effects. In that case negative shock has more impact on volatility than the positive shock of the same magnitude (Christie, 1982; Zakoian, 1994). Thus, it would be more useful to re-investigate the calendar anomalies in Muscat stock market by taking asymmetrical market reactions into account.

In equation 4, TARCH model, the specification of the conditional variance equation has ω as intercept, α, β and γ are parameters and I is a dummy variable that takes the value 1 if $\varepsilon_{t-1} < 1$ and zero otherwise. Where $\varepsilon_{t-1} < 0$ stands for the bad news and $\varepsilon_{t-1} > 0$ represents the good news, under the assumption that bad news and good new have different impact on the conditional variance. In this model, good news has an impact of α, while bad news has an impact of (α+γ). Hence, if γ is significant and positive, negative shocks have a larger effect on h_t than positive shocks (Hill, Griffiths and Lim, 2007). The parameter γ, which captures the asymmetric effect, is expected to be positive.

The EGARCH specification in equation 5 ensures that the conditional variance is always positive even if the parameter values are negative. Thus, there is no need for imposing a non negative constraint as was the case in TARCH model. In this model, the presence of leverage effects can be tested by the hypothesis that $\gamma > 0$, whereas if $\gamma \neq 0$ positive and negative shocks have the same effect on volatility.

The null hypothesis as mean returns of all the day of a week are equal to each other and are equal to zero which means that there is no calendar anomaly effect:

$$H_0: \varphi_0 = \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = 0$$

Against the alternative that all the coefficients $\varphi_0 : \varphi_4$ are not equal and are not equal to zero. If the null hypothesis is rejected then the stock returns must display some form of the day-of-the-week anomaly, since the returns differ from each trading day.

5. The Empirical Results

Table 1 reports the descriptive statistics for the returns of the entire studied period as well as the return for each day of the week. The average return for the entire studied period is 0.00006. The standard deviation of the return is 0.0130, and the skewness is -0.91. The kurtosis is 14.530, different from 3 and statistically significant at the 1 percent level. The Jarque-Bera normality test rejects the normality of returns at the 1 percent significant level. A closer look at each day statistics shows that two out of five days have mean return of negative signs. In addition, all-days, but not Thursday, summary statistics are likely to be shaped by those of Sunday. In comparison to the remaining weekday, Monday has the highest return, In comparison to the remaining weekdays; Thursday has the highest return, kurtosis as well as the sum return and almost the standard deviation.

Table 1. Descriptive statistics of continuously compounded daily returns of MSM

	Sunday	Monday	Tuesday	Wednesday	Thursday	Overall
Mean	0.0010	-0.0007	-0.0021	4 E-05	0.0021	6. E-05
Median	0.0005	-6. E-05	0.0005	0.0010	0.0010	0.0005
Maximum	0.0629	0.0517	0.0804	0.0572	0.2961	0.0804
Minimum	-0.0865	-0.0774	-0.3080	-0.0748	-0.0591	-0.0870
Std. Dev.	0.0134	0.0124	0.0226	0.0132	0.0223	0.0130
Skewness	-0.6166	-1.4297	-8.5367	-1.5011	9.2945	-0.9096
Kurtosis	13.416	14.594	115.83	12.748	123.57	14.530
Jarque-Bera	1443.9	1847.8	162247	1265.9	152551.0	8350.7
Probability	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Sum	0.3160	-0.2230	-0.6181	0.0138	0.5921	0.0965
Sum Sq. Dev.	0.0566	0.0473	0.1519	0.0508	0.1223	0.2500
Observations	300	297	293	295	287	1472

Furthermore, the overall data as well as those of particular days all are not normally distributed as tested by Jarque-Bera. The empirical distribution confirms the presence of a non-constant variance or volatility clustering.

We now discuss the empirical findings of the complete model incorporating GARCH process for the conditional variance, as specified in equations (3) to (5). It is worth noting that the three models were estimated, under the assumption of Generalized Error Distribution (GED) since the errors are not normally distributed as it was shown by Jarque-Bera test. In testing for the optimal lag length using Akaike Info Criterion, as well as the significance of the estimated parameter. However, the results reveal that one lag is the most appropriate.

Table 2. Parameter estimates for the GARCH models with generalized error distribution

	ESTIMATED MODELS					
	GARCH		EGARCH		TARCH	
Mean Equation						
Coefficient	*Value*	*Z-stat.*	*Value*	*Z-stat.*	*Value*	*Z-stat.*
C	0.00035	1.23882	0.00034	1.21418	0.00043	1.53853
Monday	-0.00067	-1.68156	-0.00064	-1.63545	-0.00076	-1.90400
Tuesday	-0.00027	-0.67089	-0.00026	-0.65047	-0.00036	-0.88838
Wednesday	-0.00003	-0.08730	-0.00002	-0.04091	-0.00002	-0.06036
Thursday	0.00057	1.43119	0.00059	1.53342	0.00048	1.20075
θ	0.31016	21.3069[*]	0.30858	20.653[*]	0.31221	21.4195[*]
Variance Equation						
ω	0.00000	4.26941[*]	-0.76742	-6.5823[*]	0.00000	4.26933[*]
$ARCH(\alpha)$	0.27930	7.12158[*]	0.42599	9.82221[*]	0.30741	5.69901[*]
$GARCH(\beta)$	0.72305	24.41916[*]	0.951237	88.97674[*]	0.72318	24.4527[*]
γ			0.00755	0.28006	-0.05107	-0.82978
$AdjR^2$	0.044491		0.044024		0.050002	
AIC	-0.831931		-6.829108		-6.841017	
SIC	-6.7690003		-6.789587		-6.791496	
	8.620832		7.783381		7.700272	
F-test	(0.0000)		(0.0000)		(0.0000)	
LL	5045.133		5044.052		5045.459	
D.W	2.122301		2.119445		2.125762	

*Notes: * and ** imply significance at 1% and 5% levels respectively. AIC and SIC refer to Akaike info criterion and Schwarz criterion; LL is Log likelihood and D.W refers to Durbin-Watson stat.*

Table 2 shows that in the three models, AR (-1) coefficients are all significant at α=1%.   It also   reveal that in the three models Monday, Tuesday and Wednesday have negative signs, only the opening and the closing days of the week are positive. However, all the parameters turn to be insignificant. The ARCH variable is positive and statistically significant at 1% significant level, in the three models. This means that the returns on a particular day are affected by the returns on the previous day. Therefore, high return in day t is followed by high return in day t+1.

The estimated GARCH term β is always positive and significant. Also, in all models, the sum of the coefficients on the lag of squared residuals and lag of the conditional variance close to unity implying that the shocks to the conditional variance will be highly persistent. The significant of ARCH and GARCH coefficients indicate that news about volatility from the previous period have an explanatory power on current volatility.

Asymmetric (leverage) term in the EGARCH model is positive but insignificant while it is, unexpectedly, negative and insignificant in TARCH model. This indicates that negative and positive news has the same impact on volatility. The results of the GARCH models for the parameters of the dummy variables indicate the non existence of any patterns of the day-of-the-week effect.

6. Conclusion

This study examined the day-of-the-week effect on stock returns and volatility of Muscat securities market. It utilized the MSM 30 index from 1 December 2005 to 23 November 2011, and employed a nonlinear symmetric GARCH (1,1) model and nonlinear asymmetric models of TARCH (1,1) and EGARCH (1,1). The empirical findings reveal that in the three models, Monday, Tuesday and Wednesday have negative signs while the opening and the closing day of the week have a positive signs, but all parameters are insignificant. Therefore, the study

concluded that the day-of-the-week effect is not present and MSM is an efficient stock market. Furthermore, the asymmetric EGARCH, and TARCH models show no significant evidence for asymmetry in stock returns, confirming the absence of the leverage effect in the returns series.

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