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Volatility Spillovers Among the Gulf Arab Emerging Markets

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Abstract

This paper examines the volatility spillovers among Gulf Arab emerging markets. Multivariate VAR-GARCH model of daily returns, with BEKK specification based on the conditional variances and conditional correlations, is estimated for all six GCC equity markets of Saudi Arabia, Kuwait, UAE, Qatar, Oman, and Bahrain. The results show high own-volatility spillovers and a high degree of own-volatility persistence in all GCC markets. Moreover, there are significant cross-volatility spillovers and cross-volatitlity persistence among all GCC markets, with stronger evidence from all GCC markets to the Saudi market. Such evidence could be explained by the existence of uncertainties surrounding various Gulf bank exposures to certain Saudi business groups as well as the downward movement of oil prices.

Key words: Volatility spillovers, GCC equity markets, Multivariate GARCH

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1 Introduction

There have been numerous economic analysis based on classes of models of Engle's (1982) autoregressive conditional heteroskedastic (ARCH) and Bollerslev's (1986) generalized ARCH (GARCH). Such models have become increasingly prevalent in financial data. For instance, these models have been employed in the literature to explore the interdependence among national equity markets. Most of this literature, however, has focused on testing this relationship for the stock markets of the developed countries. Recently, East Asian countries have received some interest in the wake of Asian financial crises. The stock markets of the members of the Gulf Cooperative Council (GCC countries), however, have received little attention from researchers despite their rapid growth and liberalization. In fact, there are many differences between GCC markets and other emerging markets mainly in their large segmentation from international markets and their sensitivity to regional political events. In addition, GCC have similar economic structures as most of them are oil-based economies and where their stock markets represent a substantial proportion of all Arab capital markets. The market capitalization of the GCC region was about US$ 671 billion (this represents approximately 60% of all Arab capital markets) by the end of July 2009. Saudi market capitalization is the largest (about 44% of the total GCC market capitalization) followed by UAE market (representing 21% of the GCC market capitalization). The GCC stock markets have witnessed strong growth during the last eight years due to liberalization and high oil prices and therefore have strong future gain potential because of huge oil reserves in the GCC countries. In this paper, the concern is to investigate the stock market interdependencies of the GCC markets, which could represent a promising area for individual and institutional investors to make decisions on their regional and world portfolio diversification, and to policy makers to seek more effective regulations.

Grubel (1968), examines the co-movements and correlations between different markets and investigates the gains of international diversification. He concludes that portfolio efficiency could be improved through international diversification. If stock markets are interdependent (or integrated) then investing in these markets will provide no long-term gains to portfolio diversification. Therefore, the issue of stock market interdependence is of great interest for investors. This issue is also important for policy makers; if stock markets are found to be closely linked then there is a danger that shocks in one market may spill over to other markets. This may require closer cooperation among the authorities of these countries if these effects are to be avoided.

To investigate the stock market interdependence, many researchers initially focused on finding the interactions and interdependence of stock markets in terms of the conditional first moments of the distribution returns [for instance, Taylor and Tonks (1989) and Eun and Shim (1989)]. However, more recent studies investigate stock market interactions in terms of both first and second moments. Hamao, Masulis, and Ng (1990) use a univariate GARCH model to examine the volatility spillovers between the US, Japan and the UK stock markets. They find that there are significant spillover effects from the US and the UK stock markets to the Japanese market but not the other way round. Koutmos et al. (1995) investigate the transmission mechanism of price and volatility spillovers across the same stock markets using a multivariate EGARCH model. Their results reveal strong evidence of asymmetry volatility spillovers, especially for the period after 1987. In addition, Karolyi (1995) uses a multivariate GARCH model to document the dynamic interactions between the conditional means and variances of the US and Canadian market returns and reports short-lived price spillovers between the two markets.

Park and Fatemi (1993) examine the linkages between the equity markets of the Pacific-Basin countries to those of the US, UK and Japan. The US market is the most influential compared to that of UK and Japan. It was found that Australia is most sensitive to the US market. However, Singapore, Hong Kong and New Zealand form the next group and exhibit moderate linkages. Whereas, Korea, Taiwan and Thailand exhibit little linkages to any of these markets. Moreover, Kanas (1998) focuses on the three European stock markets-London, Paris and Frankfurt-and reports-using a bivariate EGARCH model-reciprocal spillovers between London and Paris and Paris and Frankfurt, together with unidirectional spillovers from London to Frankfurt. Booth et al. (1997) look at the four Scandinavian markets and find significant price and asymmetric volatility spillovers between the Swedish, Danish, Norwegian and Finnish stock markets. Likewise, Ng (2000) examines the magnitude and changing nature of volatility spillovers from Japan and the US to six Pacific-Basin equity markets. The study finds that regional and world factors are important for market volatility in the Pacific-Basin region, though world market influence tends to be greater. Least but not last, Miyakoshi (2003) investigates how the Asian stock markets are influenced by Japanese stock market as well by the US stock market. He finds that there are return spillovers from the US to the Asian emerging markets and volatility spillover from Japan to Asian markets. Chan, Lien and Weng (2008) examine the interactions between Hong Kong and the US financial markets for the periods of the pre and post Asian financial crises.

Thus far only one study has examined the volatility spillover effects for the GCC markets. Al-Deehani (2005) applies the concept of stochastic volatility and structural time series modeling approach to investigate the volatility spillover among the stock markets of the GCC countries. Using daily price indices for the GCC countries covering the period January 1, 2000 to April 15, 2003, he finds strong evidence for bidirectional and unidirectional contemporaneous volatility spillover but weak evidence for lagged volatility spillover.

In this paper, we examine the issue of stock market interdependence using the multivariate VAR-GARCH model of daily returns of the GCC countries for the period January 6, 2003 to January 1, 2009. We employ BEKK specification based on the conditional variances and conditional correlations to estimate the multivariate VAR-GARCH model. While this approach has been widely used to explore the interdependence of stock markets, a VAR-GARCH-BEKK analysis has not been applied to study the interdependence of the GCC markets.

The remainder of this paper is organized as follows. Section 2 discusses the econometric methodology and Section 3 describes the data and presents the empirical findings. Finally, we give some concluding remarks in Section 4.

2 Methodology

For all of our six variables of interest, our system is represented by a VAR(1)-BEKK model. The mean equation is represented by autoregressive term, AR(1), as

$$\begin{aligned} R_t &= \alpha + \mu R_{t-1} + \epsilon_t, \qquad (1) \\ \epsilon_t &= H_t^{1/2} u_t, \end{aligned}$$

where R_t is a Nx1 vector of the return on indices between time $t-1$ and t, H_t is the conditional variance of returns at time t, and u_t are i.i.d innovations, with N being the number of variables.

It is believed that multivariate models allow for the possibility that some equity volatilities may share common persistent components. Therefore, adopting such models will allow the conditional variances and covariances of equity markets to influence each other. In this paper, we opt for the BEKK (named after Bollerslev, Engle, Kraft and Kroner) model presented by Engle and Kroner (1995). The specification of this model shows that the variance-covariance matrix of equations depends on the squares and cross products of innovation ϵ_t and volatility H_t for each market lagged one period, and guarantees positive semi-definiteness of the conditional variance-covariance matrix. The BEKK parameterisation for the multivariate GARCH model is written as:

$$H_t = C^{'}C + B^{'}H_{t-1}B + A^{'}\epsilon_t\epsilon_t^{'}A, \tag{2}$$

where C is a lower triangular matrix with $N(N+1)/2$ of constants, B is a square matrix with N^2 parameters $b_{i,j}$ that indicate the persistence in conditional volatility between market i and market j, and A is a square matrix with N^2 parameters $a_{i,j}$ that measure the degree of innovation from market i to market j.

Our system ensures that any historical patterns are removed and puts in evidence the volatility persistence and transmission among different GCC markets. The conditional mean in each market is a function of past returns and the conditional covariance matrix and conditional correlation matrix are linear.

To our knowledge, our system has not been used to GCC stock markets and eventhough there were some attempts by early scholars, e.g. Hammoudeh *et.al* (2009), the computational convergence was not reached.

3 Data and Results

To evaluate the models, we use six equity indices of six GCC markets Abu Dhabi, Bahrain, Kuwait, Qatar, Saudi, and Oman. The daily closing prices for these indices for the period January 6, 2003 to January 1, 2009 were obtained from Zawya and respected stock markets. Due to differences in weekly holidays between the countries for some time period and due to country specific holidays some observations were deleted. Descriptive statistics of daily returns are presented in Table 1. The daily log returns are defined as

$$R_{i,t} = \log(p_{i,t} - p_{i,t-1}) * 100 \tag{3}$$

where $p_{i,t}$ is the daily closing value of the stock market index in country i on day t.

The highest averages of the daily returns during the sample period are in Kuwait (0.078%) and Qatar (0.072%). The highest standard deviation is seen in the Saudi market. According to the sample kurtosis estimates and the Bera and Jarque (1981) normality test statistics, the daily rate of returns are far from being normally distributed. The lowest kurtosis estimate is 6.62 (Kuwait) while the highest is 19.44 (Oman). Based on the sample kurtosis estimates, it may be argued that the return distributions in all the markets are fat tailed. The sample skewness shows that the daily returns have an asymmetric distribution in all the markets. The sample skewnesses are negative for all markets except the AbuDhabi market indicating that the asymmetric tail extends more towards negative values than positive ones. In addition to the descriptive statistics, we show the volatility clustering in Figure 1.

The estimated coefficients and standard errors for the conditional mean return equations are presented in Table 2. The estimates of the coefficients of Equation 1 can provide measures of the significance of the own-mean spillovers. For all markets, there are highly significant autoregressive effects of the innovations in the mean stock returns of one series on its own lagged returns.

Table 3 presents the estimation results of the BEKK model for the variance covariance[1]. There is a large and significant ARCH effect indicating the presence of own-volatility spillovers in all GCC markets. In fact, the own-volatility spillover effects are high for all the markets ranging from 0.228 ($a_{4,4}$) for Oman to 0.345 ($a_{6,6}$) for Saudi Arabia. Turning to the cross-volatility effects, the results show that past innovations in Saudi Arabia have only a highly negative effect on future volatility in the Abu Dhabi market ($a_{6,1} = -0.078$). The Abu Dhabi market, in return, is positively highly affected by past innovations in Qatar market ($a_{5,1} = 0.052$). With respect to Bahrain market, there is only one significant cross-volatility spillovers from Oman market. Seemingly, there is only one significant cross-volatility spillovers from Bahrain market to Kuwait market. However, and with respect to Oman market, Oman market's future volatility is affected negatively by past innovations in Bahrain and Qatar markets. In addition, and with respect to Qatar market, there are positive volatility spillovers from Abu Dhabi and Bahrain markets. Finally, and with respect to the Saudi market, there are significant positive cross-volatility spillovers from all GCC markets except Bahrain market, with higher effects coming from Abu Dhabi ($a_{1,6} = 0.05$) and Qatar ($a_{5,6} = 0.037$) markets.

[1]The estimations are made using the S-PLUS® statistical software with GARCH add-on module.

There are highly significant GARCH effects in all GCC markets indicating the presence of own-market volatility persistence. The own-market volatility spillover effects are high for all the markets ranging from 0.909 ($b_{2,2}$) for Bahrain to 0.970 ($b_{4,4}$) for Oman. This shows that all individual GCC markets show positive sensitivity to past own volatility. Turning to the cross-market volatility persistence, the results show that past volatility shocks in Saudi Arabia have only a highly positive effect on future volatility in the Abu Dhabi market ($b_{6,1} = 0.025$). The Abu Dhabi market, in return, is negatively affected by past volatility shocks in Qatar market ($b_{5,1} = -0.013$). With respect to Bahrain market, there are significant cross-market volatility persistence coming from Kuwait, Oman, and Qatar, with a highly negative persistence from Oman market ($b_{4,2} = -0.099$). Strikingly, there are no cross-market volatility persistence from any market to Kuwait market. However, and with respect to Oman market, Oman market's future volatility is affected positively by past volatility shocks in Bahrain and Qatar markets. In addition, and with respect to Qatar market, there are negative cross-market volatility persistence from Abu Dhabi and Bahrain markets and a positive persistence from Kuwait market. Finally, and with respect to the Saudi market, there are significant negative cross-market volatility persistence from all GCC markets, with higher effects coming from Abu Dhabi's past volatility ($b_{1,6} = -0.018$).

Numerous reasons could explain the results above. Perhaps, a most-likely reason behind the cross-volatility spillovers comes from banking sector, which is seen as the dominant sector in most GCC economies. In fact, concerning the Saudi market, there are still uncertainties surrounding some GULF bank exposures, mostly UAE banks, to certain Saudi groups, as well as the downward movements of oil prices. In addition, correlation between equities and oil in the gulf markets is largely based on the belief that rising crude prices will boost government revenues and therefore expenditure on infrastructure and development projects, enabling listed firms to benefit. Other reasons could be attributed to the existence of more sensitivity of other sectors to past volatilities or past shocks or news than the banking sector. There is more volatility coming from the service sector in Kuwait market, more from the industrial sector in Qatar market, and more from the insurance sector in UAE market (see Hammoudeh *et.al* (2009)) than other markets. Moreover, GCC stock markets may be susceptible to oil price shocks and, at the first price change, investors may liquidate their holdings. Other issues could also be linked to several structural and regulatory weaknesses in the gulf equity markets such as the small number of listed firms, low sectoral diversification, or large institutional holdings, and others microstructure-related facts like lack the ban on short-selling.

4 Conclusion

This paper examines the volatility spillovers among Gulf Arab emerging markets. Multivariate VAR-GARCH model of daily returns, with BEKK specification based on the conditional variances and conditional correlations, is estimated for all six GCC equity markets of Saudi Arabia, Kuwait, UAE, Qatar, Oman, and Bahrain. The results show high own-volatility spillovers and a high degree of own-volatility persistence in all GCC markets. Moreover, there are significant cross-volatility spillovers and cross-volatility persistence among all GCC markets, with stronger evidence from all GCC markets to the Saudi market. Such results would suggest to investors to focus more on volatility trading than the traditional trading, which is based on market movements of underlying equities. In doing so, investors would construct their portfolios using consistent measures of hedge ratios in order to minimize risk.

The paper could be extended in various ways. One approach would be to consider the fact that negative shocks may have impact on volatility than positive shocks and hence to account for asymmetry. This could be achieved with the use of the generalized BEKK model of Kroner and Ng (1995). Additionally, to account for oil prices movements in the mean dynamics, since GCC markets may be suceptible to oil price shocks.

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Figure 1: Daily returns of equity indices (Abu Dhabi, Bahrain, Kuwait, Qatar, Saudi, and Oman) from January 6, 2003 to January 1st, 2009.

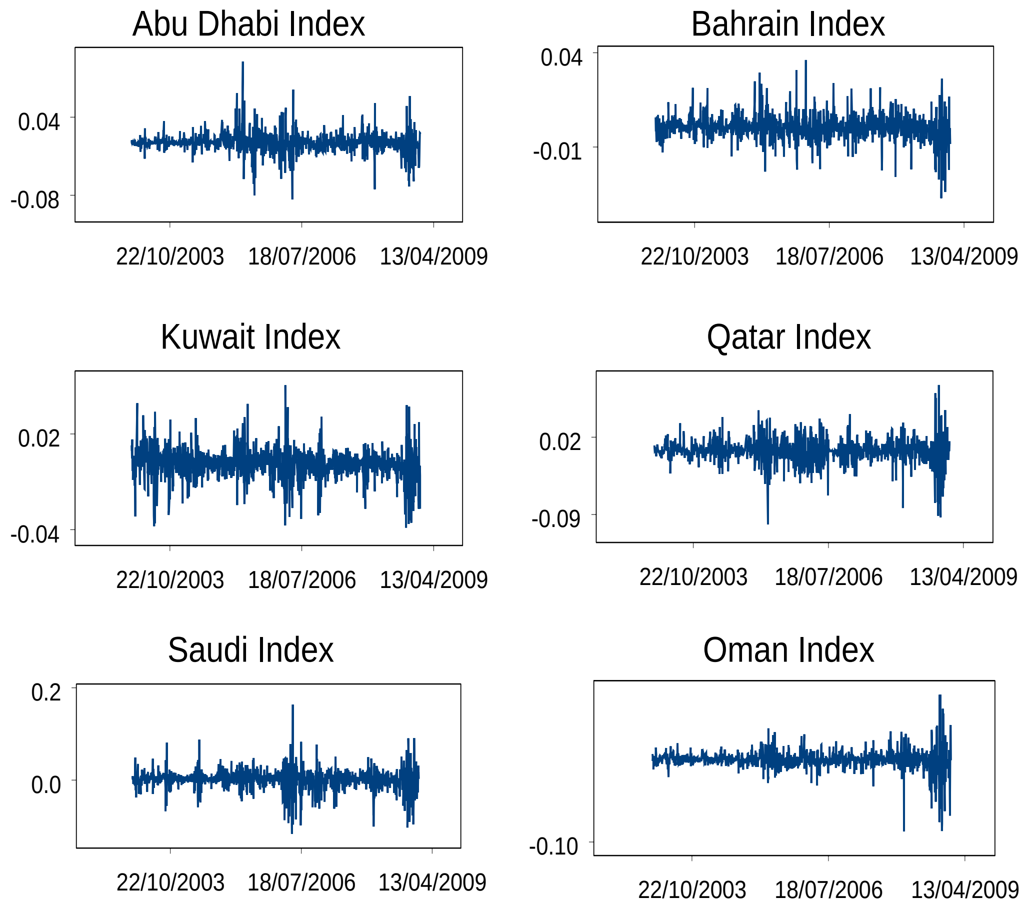

Table 1: Descriptive Statistics

Market	Mean(%)	SD(%)	Skewness	Kurtosis	Jarque-Bera
Abu Dhabi	0.0373	1.445	0.316	12.843	6065.315*
Bahrain	0.0366	0.619	-0.186	8.618	1976.282*
Kuwait	0.0784	0.929	-0.435	6.627	865.806*
Oman	0.0694	1.151	-1.176	19.440	17216.52*
Qatar	0.0720	1.648	-0.463	8.842	2180.958*
Saudi Arabia	0.0410	2.063	-0.532	10.642	3710.796*

*= 5% significance level.

Table 2: Estimation Results of the conditional mean.

Coefficient	Value	Std. Error	P-Value
α_1	0.353	0.293	0.113
α_2	0.318	0.146	0.015^{**}
α_3	1.235	0.211	0.000^{*}
α_4	0.770	0.246	0.000^{*}
α_5	0.897	0.353	0.005^{*}
α_6	1.845	0.430	0.000^{*}
μ_1	0.214	0.021	0.000^{*}
μ_2	0.179	0.021	0.000^{*}
μ_3	0.143	0.023	0.000^{*}
μ_4	0.261	0.024	0.000^{*}
μ_5	0.295	0.022	0.000^{*}
μ_6	0.048	0.026	0.035^{**}

Abu Dhabi (i=1), Bahrain (i=2), Kuwait (i=3), Qatar (i=4), Oman (i=5), and Saudi (i=6).

*= 1% significance level.

**= 5% significance level.

Table 3: Estimation Results of the BEKK specification

Coef	Value	Std.Err	P-Value	Coef	Value	Std.Err	P-Value	Coef	Value	Std.Err	P-Value
$c_{1,1}$	2.286	0.196	0.000*	$a_{1,1}$	0.283	0.017	0.000*	$b_{1,1}$	0.940	0.006	0.000*
$c_{2,1}$	-0.019	0.254	0.469	$a_{2,1}$	-0.002	0.086	0.384	$b_{2,1}$	0.003	0.003	0.211
$c_{3,1}$	0.433	0.325	0.091***	$a_{3,1}$	-0.014	0.012	0.130	$b_{3,1}$	0.001	0.006	0.428
$c_{4,1}$	0.240	0.258	0.176	$a_{4,1}$	0.0005	0.015	0.482	$b_{4,1}$	-0.0004	0.006	0.469
$c_{5,1}$	0.552	0.448	0.100***	$a_{5,1}$	0.052	0.026	0.022**	$b_{5,1}$	-0.013	0.010	0.101***
$c_{6,1}$	0.218	0.519	0.336	$a_{6,1}$	-0.078	0.029	0.003*	$b_{6,1}$	0.025	0.010	0.006*
$c_{2,2}$	1.747	0.140	0.000*	$a_{1,2}$	-0.018	0.044	0.339	$b_{1,2}$	0.010	0.023	0.331
$c_{3,2}$	-0.225	0.290	0.218	$a_{2,2}$	0.279	0.019	0.000*	$b_{2,2}$	0.909	0.011	0.000*
$c_{4,2}$	1.044	0.241	0.000*	$a_{3,2}$	0.018	0.032	0.281	$b_{3,2}$	0.031	0.021	0.068***
$c_{5,2}$	0.621	0.498	0.106	$a_{4,2}$	0.096	0.038	0.006*	$b_{4,2}$	-0.099	0.020	0.000*
$c_{6,2}$	0.410	0.545	0.226	$a_{5,2}$	0.051	0.057	0.186	$b_{5,2}$	-0.056	0.038	0.070***
$c_{3,3}$	1.981	0.194	0.000*	$a_{6,2}$	0.063	0.073	0.191	$b_{6,2}$	-0.003	0.040	0.464
$c_{4,3}$	0.344	0.271	0.100***	$a_{1,3}$	0.008	0.028	0.385	$b_{1,3}$	-0.013	0.014	0.172
$c_{5,3}$	-1.030	0.477	0.015**	$a_{2,3}$	0.018	0.012	0.065***	$b_{2,3}$	-0.004	0.008	0.269
$c_{6,3}$	-0.004	0.570	0.496	$a_{3,3}$	0.274	0.018	0.000*	$b_{3,3}$	0.924	0.010	0.000*
$c_{4,4}$	0.379	0.742	0.304	$a_{4,3}$	0.018	0.022	0.197	$b_{4,3}$	-0.012	0.012	0.143
$c_{5,4}$	-2.331	5.433	0.334	$a_{5,3}$	-0.016	0.035	0.321	$b_{5,3}$	0.010	0.021	0.311
$c_{6,4}$	1.564	3.648	0.334	$a_{6,3}$	0.032	0.042	0.224	$b_{6,3}$	0.005	0.024	0.405
$c_{5,5}$	1.345	9.531	0.443	$a_{1,4}$	0.011	0.022	0.297	$b_{1,4}$	0.0001	0.007	0.492
$c_{6,5}$	3.506	35.590	0.460	$a_{2,4}$	-0.021	0.010	0.019**	$b_{2,4}$	0.011	0.003	0.000*
$c_{6,6}$	0.053	2296.000	0.500	$a_{3,4}$	-0.017	0.016	0.147	$b_{3,4}$	0.005	0.005	0.162
				$a_{4,4}$	0.228	0.018	0.000*	$b_{4,4}$	0.970	0.005	0.000*
				$a_{5,4}$	-0.044	0.031	0.080***	$b_{5,4}$	0.031	0.011	0.002*
				$a_{6,4}$	0.031	0.034	0.174	$b_{6,4}$	-0.004	0.012	0.368
				$a_{1,5}$	0.048	0.015	0.001*	$b_{1,5}$	-0.011	0.007	0.061***
				$a_{2,5}$	0.023	0.008	0.003*	$b_{2,5}$	-0.005	0.003	0.09***
				$a_{3,5}$	-0.008	0.011	0.235	$b_{3,5}$	0.014	0.005	0.002*
				$a_{4,5}$	0.002	0.013	0.420	$b_{4,5}$	0.001	0.006	0.393
				$a_{5,5}$	0.324	0.021	0.000*	$b_{5,5}$	0.930	0.009	0.000*
				$a_{6,5}$	-0.029	0.026	0.134	$b_{6,5}$	0.012	0.013	0.174
				$a_{1,6}$	0.050	0.013	0.000*	$b_{1,6}$	-0.018	0.005	0.000*
				$a_{2,6}$	0.004	0.005	0.210	$b_{2,6}$	-0.005	0.002	0.012**
				$a_{3,6}$	0.030	0.008	0.000*	$b_{3,6}$	-0.011	0.003	0.000*
				$a_{4,6}$	0.016	0.009	0.039**	$b_{4,6}$	-0.007	0.004	0.032**
				$a_{5,6}$	0.037	0.014	0.004*	$b_{5,6}$	-0.018	0.006	0.002*
				$a_{6,6}$	0.345	0.016	0.000*	$b_{6,6}$	0.920	0.006	0.000*

Abu Dhabi (i=1), Bahrain (i=2), Kuwait (i=3), Qatar (i=4), Oman (i=5), and Saudi (i=6).
*= 1% significance level.
**= 5% significance level.
**= 10% significance level.