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Does U.S. Equity market uncertainty and implied stock market volatility affect the GCC stock markets?

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Abstract

The existing finance literature does not provide sufficient evidence of the impact of market volatility on emerging stock markets, including the equity markets in the Gulf region. To address the gap, this paper attempts to examine the Granger causality between the U.S. equity market uncertainty (EQU), the implied equity market volatility (VIX), global oil prices, and the stock market prices of each GCC country. By using daily data spanning from January 5, 2009 to August 16, 2018, the VAR-based Granger causality test reveals that U.S. Equity market uncertainty and implied equity market volatility are capable of transmitting shocks to most GCC stock markets. In particular, EQU and VIX significantly Granger cause larger shocks in Bahraini and Qatari stock markets compared to other GCC countries. EQU and VIX only weakly Granger cause stock prices in Kuwaiti and UAE markets whereas Saudi and Omani stock market are not susceptible to changes in volatility level of U.S. or equity market. Moreover, the results reveal that stock prices in the GCC region are regionally integrated, hence the short run effect of equity market uncertainty could be indirectly transmitted to Saudi and Omani markets via the short run causal effects on other GCC stock markets, especially the Qatari market. This study, therefore, suggests that financial policies should be put in place to curb the effects of volatility shocks in the GCC stock markets.

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1. Introduction

The finance literature has long held that there is a close link between returns and risk of investment in stock markets, where scholars have commonly defined risk as volatility and uncertainty. Intuitively speaking, risk-averse investors tend to sell off equity assets and reallocate their funds to relatively safe asset classes (such as bonds and gold) when the stock market is volatile (Hacihasanoglu *et al*., 2012; Kaul & Sapp, 2006). Consequently, it is natural that stock market investors will react negatively upon rising equity market volatility and uncertainty. On this ground, recent finance literature adopted the equity market volatility index (VIX) of the Chicago Board Options Exchange (CBOE) to gauge the level of implied stock market volatility in the U.S. The VIX index was initially introduced by Whaley (1993) with the purpose of measuring investor sentiment in the U.S. stock market. The VIX index reflects the 30-day expectations of investors on the volatility level of the U.S. stock market. The calculation of the initial version of VIX is based on S&P100 options, and the current version is based on S&P 500 options (CBOE, 2003 Whaley, 2009).

In line with this intuition, several empirical studies (Connolly et al., 2005; 2007; Rapach *et al*. 2013; Yunus, 2013; Sarwar, 2012, among others) have found a negative relationship between the VIX index and U.S. stock market returns. While the evidence of negative linkage between equity market uncertainty and stock market returns has been established, the majority of the evidence is based on the U.S. stock market. Some exceptions include Mensi *et al*. (2014), Sarwar and Khan (2017), and Abuzayed *et al*. (2018). For instance, Mensi *et al*. (2014) examined the interdependencies between the BRICS stock markets and various global factors, including S&P 500 returns, WTI crude oil price, the price of gold, the VIX index, and the U.S. economic policy uncertainty index. With the aid of quantile regressions, Mensi *et al*. (2014) revealed that the VIX is influential in the stock markets of Russia, China, and South Africa, but the effects are significant only during bear markets and not during bull markets. Similarly, Sarwar and Khan (2017) studied on how the five emerging stock markets in Latin America respond to the shocks in the implied U.S. stock market volatility. By employing a GARCH model with daily data from June 2013 to September 2014, the results provide supportive evidence that changes in VIX index demonstrated contemporaneous and delayed negative effects on stock returns and positive effects on volatility in the five emerging stock markets. Furthermore, Sarwar and Khan (2017) also found that the explanatory power of the VIX index on emerging market returns are larger during tumultuous periods. Abuzayed *et al*. (2018), on the other hand, analyzed the influence of the VIX index on 12 frontier stock markets in the MENA region. Using a bivariate VAR-GARCH model and daily data spanning from January 2001 to October 2014, the authors found that a rising VIX index does not have significant effects on the MENA region, where declines in the stock returns in all of the 12 markets were insignificant. This finding of negative but insignificant effects indicates that most of the frontier stock markets in the MENA region could be treated as a safe haven for global portfolio diversification during crisis periods.

The present state of the literature shows that the effects of equity market uncertainty on emerging stock markets are understudied. In addition, the limited evidence from emerging stock markets has demonstrated mixed and inconclusive findings. Against this backdrop, this paper aims to investigate the causal relationships between equity market uncertainty and the stock market indices of GCC countries. Specifically, this paper employs the vector autoregression

(VAR) based Granger causality test to explore the causalities among daily stock market prices of each GCC countries, the VIX index, and the U.S. Equity Uncertainty index (EQU).

The remainder of this paper is structured as follows. The subsequent Section 2 elaborates on the data employed, and Section 3 explains the VAR-based Granger causality methodology. Section 4 highlights the issues of VAR estimation. Section 5 reports and discusses the results of the Granger causality test. Section 6 concludes the study.

2. The Data

In line with the objective, this paper includes nine variables in the subsequent causality analysis. The list of variable includes the U.S. Equity Uncertainty index (EQU), the VIX index, the stock market indices of the six GCC countries, and OPEC oil price. This paper includes the Organization of the Petroleum Exporting Countries oil price (OPEC) as a control variable given the importance of the price of crude oil to oil producing and exporting countries such as the GCC. This paper uses daily data spanning from January 5, 2009 to August 16, 2018. The EQU index is sourced from Baker *et al*. (2018), the VIX index is obtained from the CBOE, and the GCC stock market indices and OPEC oil price were sourced from Bloomberg terminal. All variables of stock market indices are expressed as natural logarithms, while the EQU, VIX, and oil price data are reported in levels. In addition, considering that the Granger causality analysis requires stationary data and that the financial variables employed are likely to be nonstationary at level, this study takes the first difference of the logged stock market indices and oil price prior to the VAR estimation and Granger causality analysis[1]. Table 1 describes other details of the data collected.

Table 1. Source and Description of Variables

Variable	**Description**	**Source**
EQU	U.S. Equity Uncertainty index	Baker *et al*. (2018)
VIX	CBOE Implied Stock Market Volatility index	CBOE
BHR	Bahrain Bourse All-Share Index	Bloomberg Terminal
KUW	KSE Index	
OMR	Muscat Stock Exchange Index	
QTR	QE General Index	
SAR	Tadawul All-Share Index	
UAE	Abu Dhabi General Index	
OPEC	Oil price	

[1] A preliminary unit root analysis performed on the variables reveals that all variables are I(1) except the EQU and the VIX. Hence both the EQU and the VIX are reported in levels for the VAR estimation. The results of the augmented Dickey-Fuller unit root test are available upon request.

3. Methodology

In order to examine the causal relationships between GCC stock markets returns and the uncertainty indices, this paper utilizes the Granger causality test (Granger, 1969) in a VAR setting. The VAR technique (Sims, 1980) is widely adopted in the literature given its merits. First, the VAR model is exceptionally capable in handling the identification issue of complex interrelationships within a vector of endogenous variables. Second, the standard VAR model does not require economic a priori theory behind the relationships of the variables as all variables can be treated endogenously in the system. Consider the following VAR model in its reduced form:

$$X_t = C_1 X_{t-1} + \cdots + C_p X_{t-p} + u_t \tag{1}$$

where X_t is a 9×1 vector of endogenous variables, $C_1, \ldots, C_p$ are 9×9 coefficient matrices, p is the optimal lag length, and u_t is a white noise disturbance term. The right-hand-side of system (1) contains the lags of the endogenous variables X_t, which are the predetermined exogenous variables that can explain the value of X at time *t*.

By incorporating the endogenous variables of this study into the VAR mode, System (1) can be expanded as follow:

$$\begin{bmatrix} EQU_t \\ VIX_t \\ \Delta BHR_t \\ \Delta KUW_t \\ \Delta OMN_t \\ \Delta QTR_t \\ \Delta SAR_t \\ \Delta UAE_t \\ \Delta OPEC_t \end{bmatrix} = \sum_{i=1}^{p} \mathrm{C}_i \begin{bmatrix} EQU_{t-i} \\ VIX_{t-i} \\ \Delta BHR_{t-i} \\ \Delta KUW_{t-i} \\ \Delta OMN_{t-i} \\ \Delta QTR_{t-i} \\ \Delta SAR_{t-i} \\ \Delta UAE_{t-i} \\ \Delta OPEC_{t-i} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \\ u_{5t} \\ u_{6t} \\ u_{7t} \\ u_{8t} \\ u_{9t} \end{bmatrix} \tag{2}$$

where C_i is the representation of the 9×9 coefficient matrices. Given the VAR setting in (2), this paper conducts the VAR Granger causality test to assess the null of non-causality between each pair of the endogenous variables. For instance, the Granger causality test running from the VIX to the BHR can be examined by testing whether the coefficients of lagged VIX terms in the BHR equation are jointly insignificant. Rejection of the null hypothesis indicates that VIX Granger causes BHR, indicating that the lags of VIX can improve the prediction of future values of stock market index in Bahrain. For each pair of the endogenous variables, say Y and Z, Granger (1969) demonstrated that there exists four possible outcomes: (i) Y Granger causes Z, (ii) Z Granger causes Y, (3) there is a bi-directional causality between Y and Z, and (iv) Y do not Granger cause Z and vice versa.

3.1 VAR Estimation

This paper selects the optimal lag order (p) of the VAR model based on the Hannan Quinn Criteria (HQC). The Hannan Quinn criteria is preferred in this study over the alternatives such as the AIC and SIC as the HQ criteria takes into account the log likelihood and the sum of squares residual of the VAR model. The HQ criterion suggests a lag order of 2 (See Table A1 in appendix).

Moreover, the estimated VAR model should satisfy the stability condition of the system, which can be evaluated based on the inverted AR root table. Table A2 in the appendix shows that the absolute value of all the modules were less than one, which means all the characteristic roots lie within the unit circle. Hence, the VAR system is stationary and satisfies the VAR stability condition.

3.2 Granger Causality

Table 2 below reveals the chi-square statistics resulting from the VAR Granger causality tests.

Table 2. Results of VAR Granger Causality

Excluded: Dependent:	EQU	VIX	ΔBHR	ΔKUW	ΔOMN	ΔQTR	ΔSAR	ΔUAE	ΔOPEC
EQU	-	42.58^{***}	1.259	4.832^{*}	5.901^{*}	2.785	0.041	1.627	1.177
VIX	2.602	-	9.274^{***}	0.094	1.417	3.049	0.466	0.042	3.212
ΔBHR	0.165	20.86^{***}	-	2.693	0.417	3.147	2.967	1.642	1.461
ΔKUW	5.620^{*}	6.187^{**}	1.046	-	0.426	8.466^{**}	5.465^{**}	2.540	0.635
ΔOMN	1.225	4.061	0.838	2.797	-	2.702	16.20^{***}	1.171	1.460
ΔQTR	0.464	9.520^{***}	0.547	0.590	0.126	-	27.89^{***}	6.284^{**}	2.432
ΔSAR	0.328	0.310	8.975^{**}	2.237	5.608^{*}	5.176^{*}	-	8.433^{**}	2.504
ΔUAE	5.300^{*}	2.901	1.278	2.313	1.818	6.314^{**}	2.100	-	0.948
ΔOPEC	1.550	4.526	1.983	0.900	17.22^{***}	5.728^{*}	1.447	0.524	-

Note: The bolded variables are the dependent variables in each VAR row equation. All variables are natural logged except EQU, VIX, and OPEC. Δ is difference operator. All figures above represent chi-square estimates with d.f. = 2.
***, **, and * indicates rejection of null hypothesis of no causality at 1%, 5%, and 10% level, respectively.

First, consider the causal effect of the EQU and the VIX on the GCC stock market prices. The results indicate that the EQU Granger causes the stock prices in Kuwait and UAE at the 10% significance level. On the other hand, the VIX index seems to exert stronger Granger causality forces on the stock markets in Bahrain, Kuwait, and Qatar, where the results are significant at the 5% level in the case of Kuwait and at the 1% level in the Bahraini and Qatari stock markets. In addition, there is no significant evidence of Granger causality running from the EQU or the VIX to the daily stock prices in Saudi Arabia and Oman. These results reveal an important finding that the GCC stock markets behave heterogeneously to the volatility and uncertainty from the U.S. market. Specifically, Bahraini and Qatari markets prices are most susceptible to equity market uncertainty among the six GCC countries, while the stock market prices of Kuwait and the UAE are weakly sensitive to the volatility and uncertainty from the U.S. In contrast, stock market indices in Saudi Arabia and Oman are not susceptible to changes in volatility and uncertainty levels of the U.S. markets.

Table 3. Direction of Granger Causality

Bi-directional			Uni-directional		
EQU	↔	ΔKUW	ΔBHR	→	ΔSAR
ΔQTR	↔	ΔUAE	EQU	→	ΔUAE
ΔSAR	↔	ΔOMN	ΔOMN	→	ΔOPEC
ΔSAR	↔	ΔQTR	ΔQTR	→	ΔKUW
VIX	↔	ΔBHR	ΔQTR	→	OPEC
			ΔSAR	→	ΔKUW
			ΔUAE	→	ΔSAR
			VIX	→	EQU
			VIX	→	ΔKUW
			VIX	→	ΔQTR

Turning to the directional pattern of the Granger causalities, this paper found 5 bi-directional causalities and 10 uni-directional causalities running among the 9 endogenous variables. Table 3 summarizes the pattern and the direction of these Granger causalities. The feedback effects between the stock prices of GCC stock markets coincide with the general belief that the GCC equity markets are regionally integrated.

4. Conclusion

This paper aims to investigate Granger causality relationships between the U.S. equity market uncertainty index (EQU), the implied equity market volatility index (VIX), oil prices, and the stock market index of each GCC country. By using daily data from January 2009 to August 2018, the VAR-based Granger causality test reveals some important findings. First, the EQU and VIX only Granger cause certain, but not all, stock market shifts in the Gulf region. In particular, Bahraini and Qatari stock markets are most susceptible to the EQU and VIX as compared to other GCC countries, whereas the Saudi and Omani stock markets are not susceptible to changes in volatility and uncertainty level of U.S. market. As the results also show that the stock prices in the GCC region are regionally integrated, the short run effect of equity market uncertainty could be indirectly transmitted to Saudi and Omani markets via the short run causal effects on other GCC stock markets, especially the Qatari market.

Therefore, this study recommends equity market participants such as investors and financial regulators observe the changes in the U.S. market uncertainty and volatility. In addition, Saudi and Omani markets can be positioned as a safe haven for international portfolio diversification when there is change in the existing uncertainty level or volatility in the U.S. stock market.

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Appendix

Table A1. Lag Length Selection Criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	14006.83	NA	1.30e-19	-17.94593	-17.91505	-17.93445
1	14932.06	1838.616	4.40e-20	-19.02829	-18.71949*	-18.91348
2	15138.22	407.2880	3.75e-20	-19.18874	-18.60203	-18.97060*
3	15270.02	258.8773	3.51e-20*	-19.25388*	-18.38925	-18.93240
4	15326.64	110.5520	3.63e-20	-19.22262	-18.08008	-18.79782
5	15408.68	159.2326	3.62e-20	-19.22395	-17.80349	-18.69581
6	15469.80	117.9399	3.72e-20	-19.19847	-17.50009	-18.56700
7	15511.25	79.49268	3.91e-20	-19.14776	-17.17147	-18.41296
8	15577.66	126.6108	3.98e-20	-19.12905	-16.87485	-18.29093
9	15635.55	109.6846	4.11e-20	-19.09942	-16.56730	-18.15797
10	15693.71	109.5315	4.23e-20	-19.07014	-16.26010	-18.02535
11	15760.80	125.5920	4.31e-20	-19.05231	-15.96437	-17.90420
12	15824.34	118.1985	4.41e-20	-19.02993	-15.66406	-17.77848
13	15884.66	111.5051	4.53e-20	-19.00341	-15.35963	-17.64863
14	15955.35	129.8765	4.59e-20	-18.99019	-15.06850	-17.53209
15	16022.50	122.5927	4.68e-20	-18.97244	-14.77283	-17.41100
16	16081.47	106.9832	4.81e-20	-18.94420	-14.46667	-17.27943
17	16136.69	99.52732	4.98e-20	-18.91114	-14.15570	-17.14304
18	16196.00	106.2255	5.13e-20	-18.88333	-13.84998	-17.01190
19	16259.01	112.1339*	5.25e-20	-18.86027	-13.54900	-16.88552
20	16309.50	89.25338	5.47e-20	-18.82115	-13.23197	-16.74306

* indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion

Table A2. AR Roots

Root	**Modulus**
0.898495	0.898495
-0.481709	0.481709
0.441010	0.441010
0.310180 + 0.133570i	0.337717
0.310180 - 0.133570i	0.337717
0.048105 - 0.282443i	0.286510
0.048105 + 0.282443i	0.286510
-0.234852 - 0.119875i	0.263677
-0.234852 + 0.119875i	0.263677
0.171110 - 0.150743i	0.228039
0.171110 + 0.150743i	0.228039
0.073081 - 0.215677i	0.227722
0.073081 + 0.215677i	0.227722
-0.137687 + 0.173333i	0.221364
-0.137687 - 0.173333i	0.221364
0.009389 + 0.197958i	0.198181
0.009389 - 0.197958i	0.198181