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An Empirical Study on Co-Integration and Causality Among GCC Stock Markets

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Abstract: Research Question: This research attempts to explain the integration hypothesis in both short term and long term causal relationship in the Gulf Cooperation Council countries (GCC) stock markets. **Motivation:** GCC comprises some of the fastest growing economies in the world, mainly due to an increase in oil and natural gas revenues coupled with a construction and investment boom backed by reserves. Though being significant West Asian economies, studies of their stock markets have limited presence in academic literature. Hence, an attempt is made to establish interdependency among six GCC economies as not only they are culturally similar but also their energy dependency is unique geographically. The current study extends the work of Hysaj and Sevil (2021), Matar *et al.* (2021), Assraf (2003), to incorporate daily movement in the stock markets of these countries especially during the low international crude oil price environment. **Idea:** The objective is to establish cointegration and dependency among six GCC stock markets. **Data:** The data set for this study is the official daily market index levels of the Tadawul All Share (TASI) (Saudi Arabia), the Kuwait stock Exchange (Kuwait), the Bahrain Stock Exchange (Bahrain), the Muscat Stock Exchange (Oman), and the Dubai Financial Market (UAE) from 25th January 2011 to 25th January 2018 (1738 observations) collected from individual stock market's website. **Method/Tools:** Unit root test and co-integration test are applied to assess the dependency among the time series data. In order to test the existence of relationship among the GCC markets, Vector Error Correction Model (VECM), impulse response function and variance decomposition are applied. **Findings:** The results obtained establish long run linkages among all the stock markets of GCC and asymmetric short run causality among the six markets. **Contributions:** This study will help in extending the prevailing literature on integration in various ways and directions particularly from daily movement of stock market indices. This study will also enrich the sparse literature on GCC stock markets and their causal linkages.

Keywords: Co-integration, GCC stock markets, causality, VECM.
JEL Classification: C12, C32

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1. Introduction

The Middle Eastern economies have always attracted the global attention due to their accelerated development, geographical advantage, and strategic importance of biofuels. These economies being predominantly oil driven economies have been buoyant due to continuous demand for biofuel across the globe. The financial world of these countries has also maintained its pace with the rapid development. In a short time, these markets of Gulf Cooperation Countries (GCC) have rapidly progressed to match with the established global markets. These markets not only provide avenues for portfolio diversification, but also have emerged as financial hubs which provide opportunities for traders and investors. Among academicians and practitioners, there is always an urge to understand the functioning of new markets and systems. Financial market integration is an intriguing subject recently, however, a world where greater integration is attained, poses a challenge for the investors to achieve diversification in their portfolio. There is evidence in the past that market co-movements have led to contagion effect and the financial crisis of 2008 is a classic example. Nevertheless, it was financial crisis which prompted interest in investigating linkages among prominent global markets.

There have been many researches undertaken to address the phenomenon of co-integration not only theoretically but also empirically in leading global markets of the world. Cheung and Mak (1992), derived from the weekly return series of the Asian—Pacific emerging markets, the causal relationship between these markets and the two developed markets, US and Japan for the years 1977 through 1988. They found that the US market can be considered as a ‘global factor’ and is found to lead most of the Asian—Pacific emerging markets apart from three relatively closed markets: Korea, Taiwan and Thailand. The Japanese market is found to have a less influence on the Asian—Pacific emerging markets. Arshanapalli and Doukas (1993) used developments in the theory of co-integration to provide new methods of testing the linkage and dynamic interactions among stock market movements. Their results showed that the degree of international co-movements among stock price indices has increased substantially. Sheng and Tu (2000) conducted a study of co-integration and variance decomposition among national equity indices before and during the period of the Asian financial crisis. Their study demonstrated evidence in support of the existence of co-integration relationships among the national stock indices during financial crisis, however no co-integration was observed before the financial crisis. Similarly, Yousaf *et al.* (2020) confirmed long run association between the Brazil, Russia, India, China and South Africa (BRICS) stock market using asymmetric co-integration analysis. Their research indicated that the speed of adjustment for Indian and South African stock markets is higher for positive shocks, while the relationship between the stock markets pair of Russia and South Africa is linear.

Click and Plummer (2005) considered the degree to which the five stock markets in the original Association of Southeast Asian Nations countries (ASEAN-5) are correlated as a way to assess the feasibility of policy initiatives to enhance ASEAN stock market integration and the implications for portfolio investors. Their results suggest that ASEAN’s five stock markets are integrated in the economic sense, but that integration is far from complete. Wang *et al.* (2003), examines long-run relationships and short-run dynamic causal linkages among the five largest emerging African stock markets and the US market, with particular attention to the 1997–1998 global emerging market crisis. The results derived show that both long-run relationships and short-run causal linkages between these markets were substantially weakened after the crisis. Fraser and Oyefeso (2005) studied the long-run convergence between US, UK and seven European stock markets and found evidence to suggest that while real short-run diversification gains may occur, in general they tend to be short-lived.

Post financial crisis, major stock markets of the world crashed and consequently, the study of cointegration among prominent or regional markets gained attention among researchers and practitioners. Financial crisis had significant impact on the stock markets particularly with respect to regional integration and resulted in reduction of speed of convergence (Caporale *et al.*, 2019). However, varied effect of integration among various industry and geographies at sectorial level was observed. Consequently, it became important to assess the sectorial risk spillovers and their linkages to stock market as their effect would be time-varying (Wu *et al.*, 2019).

Regional convergence studies emerged during post financial crisis period indicate that macro-economic shocks cause sudden movements in stock markets. However, whether such shocks in one market create a contagion effect on regional and prominent markets is an intriguing area of study. Al-Yahyaee *et al.* (2019) proved that US markets are known to spread the contagion on the regional markets of European countries. However, their study restricts causality of spread of shocks to European stock markets to fall of Lehman Brothers as major European economies had high exposures in the company. On the contrary, Lee (2019) showed that Asian economies have different trend regarding their integration in stock market index movement and the major economies shocks spilled over the other regional stock markets (Lee, 2019). This study suggests that Chinese stock market had been an outlier and was not in sync with any other major Asian financial markets. Similar findings were suggested by Wu (2020) that stock market integration in East and Southeast Asia is not as strong as it looks. However, other Asian stock economies showed long run integration over period of time (Mohti *et al.*, 2019). The Indian stock market showed co-integration with twenty-two stock indices from America and Europe over a period of forty-one months (Joshi *et al*., 2021). While in case of West African countries, weak interdependence among the stock markets was revealed on one hand and interdependence was discovered in the financial markets through the Nigerian market (Emenike, 2020). In case of emerging and developing countries implementing inflation control measures, it was discovered that the Brazilian and Czech indices are not co-integrated with other markets whereas the Columbian stock exchange has co-integration relationship with other indices (Hysaj and Sevil, 2021).

Regarding the Middle East markets, Bahloul and Amor (2021) indicated that the impact of local macroeconomic and global factors differs across the twelve countries of Middle East and North Africa (MENA). Using ordinary least squares and quantile regressions the study revealed weak integration among the stock markets of MENA countries. Matar *et al.* (2021) discovered a definite co-movement between the United States' stock market and the six GCC stock markets in the long run while displaying signs of the significant disparity between the co-movements of the stock markets throughout the scales of time during economic decline. The results derived were based on wavelet coherence method and the Dynamic Conditional Correlation GARCH (DCC-GARCH). Assaf (2003) investigated the dynamic interactions among returns from six GCC countries using vector autoregressive analysis. The research reveals substantial evidence of substantial of interdependence and feedback effects among GCC stock markets. However, this study focused on weekly averaged data and did not highlight the long run and short run causality and dependency of Muscat Securities Exchange (MSX) on other GCC markets.

Besides being economically dependent on hydrocarbons, these countries share a common geography, culture, and religious faith. Over a period, these markets have emerged as an important constituent of the world economy. GCC stock markets have been an integral part in achieving portfolio diversification and hedging for international fund managers. This resulted into extraordinary growth in flow of international funds, which lead into increased the market capitalization in these countries. The governments of this region realized the importance of unifying the gains of stock market integration and promoted cross border listing of domestic companies. They have initiated major financial reforms with an objective to regulate and liberalize financial markets across the region.

Post global crisis of 2008, these countries witnessed similar impact on their economies in the form of collapse in real estate sector, credit constraints and economic contraction (Salah, 2010). In addition to economic uncertainty, these countries witnessed political crisis triggered by Arab Spring of 2010. The fall in the crude oil prices of 2014 had downturn effect on economies of these GCC countries. These economic uncertainties spilled over its effect on their stock markets as well. All these major economic shocks were experienced from 2011 to 2018. However, these shocks had varied effects on these countries. As observed in previous literature the stock markets of GCC countries have shown substantial interdependence (Assaf, 2003), it would be interesting to study these stock markets considering the recent economic shocks.

This research also aims to extend the existing literature related to stock markets of GCC. The reader will understand dynamics of GCC stock markets for a period of seven years from 2011 to 2018. In addition, the readers will understand the interdependency and direction of movement of these stock markets. In spite of being a prominent player at the global economic stage, few research studies have attempted to observe the relationship among these stock markets. Consequently, this study intends to add to emergent literature by probing the integration hypothesis, examining, and establishing dynamic causal linkage among the stock markets of GCC.

The paper is divided in four sections. The first section includes background of the study, followed by a brief on some empirical studies conducted in the past to assess the gap in existing literature. The second section, then explains the methodology applied for the current study. Section three contains description of data, data analysis, interpretations, and key findings. The last section is the concluding section.

2. Methodology

It has been evident from past studies that the relationship among macro-economic variables is difficult to establish because economic theory is not rich enough to explain time series dynamism. This challenge limits the power of estimates and draws serious questions on the inferences derived. Hence, such difficulties lead to application of non-structured approach to model relationships among macro-economic variables and also intend to check flow of causality between variables. An attempt is made to test unit root to check whether time series data is stationary i.e. I(*1*) at first difference and is not stationery at level. After assessing the stationarity in the time series, lag order selection criterion is assessed. It is extremely important to select an appropriate lag order in any form of auto regressive models. For the current study, focus is on application of Vector Auto Regression (VAR) or Vector Error Correction Model (VECM) to analyse the dynamic impact of random shocks long run relationship between the selected variables. VECM and VAR models are designed to use non-stationary time series that are known to be co-integrated. Co-integration is a phenomenon that may be exhibited by a group of integrated time series showing existence of long run equilibrium. For analysis of six GCC markets, testing of co-integration with the help of Johansen Co-integration test is proposed. The Johansen test, named after Soren Johansen, is a procedure for testing co-integration of variables, say k which is I(*1*) time series. This test permits more than one co-integrating relationship based on the residuals from a single (estimated) co-integrating equation. There are two types of Johansen test, either with trace statistics or with eigenvalue. However, the inferences drawn from these two tests may slightly differ. For better understanding, trace statistics values will be given priority for the current analysis.

Consider a simple example, where series $x_{1,t}, ..., x_{m,t}$ are individually I(*1*) integrated of order 1 and there exists a linear combination $y_t=\beta_1 x_{1,t}+...+\beta_m x_{m,t}+u_t$ that is I(*0*) (stationary), then phenomenon of co-integration is established, and the group of series $x_{1,t},...,x_{m,t}$ possess co-integration. If no linear combination is I(*0*), then there is no co-integration and the series taken together is not co-integrated. However, if the nonlinearity exist among the series at individual level, they are integrated at order 1, I(*1*), and hence error correction model (ECM) can be used. ECM combines the long run equilibrium with short run shocks to attain equilibrium. As more than one variable has been considered in this study, VECM is used.

VECM is a model that can be used for modelling co-integrated time series. A very simple example is a bivariate VECM with no lags for two integrated and co-integrated time series $x_{1,t}$ and $x_{2,t}$.

$$\Delta x_{1,t} = \alpha_1(x_{1,t-1} - \beta x_{2,t-1})+\varepsilon_{1,t} \tag{1}$$
$$\Delta x_{2,t} = \alpha_2(x_{1,t-1} - \beta x_{2,t-1})+\varepsilon_{2,t} \tag{2}$$

It shows that the series $x_{1,t}$ $x_{2,t}$ reacts to the most recent (as of time $_{t-1}$) disequilibrium between itself and the other series and "corrects" (given a suitable value of α_1) to reduce the disequilibrium (moves towards equilibrium). The same could be said about series $x_{2,t}$. The estimation of the equation 1.1 and 1.2 will provide residuals also referred as error correction term (ε). This will be used to check how it connects short term dynamics to long term relations.

Impulse response function and variance decomposition is applied to reassure in assessing and understanding the impact of specific market on MSX. Variance decomposition is applied to specify the quantum of information each variable contributes to the other variables in the auto-regression system of equation. It determines the extent of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables.

3. Data and Empirical Results

The data used in this study is the daily closing stock market indices of all six GCC countries. The data has been sourced from the websites of these stock markets. The sample data collected ranges from 25th January 2011 to 25th January 2018 (1738 observations). The stock markets of GCC function at different days of the week. Hence, to ensure uniformity in the analysis and to capture the long run causality, a restriction is imposed to select those days of the period, when all six markets were functional. Consequently, those observations when all six markets were not functional simultaneously have not been considered. The details of indices specific to the countries chosen are represented in the following Table 1.

Table 1: Selected countries specific stock market index

Country	Stock Market Index
Sultanate of Oman	Muscat Securities Exchange (MSX 30)
Bahrain	Bahrain All Share (BAX)
Kuwait	Premier Market-Market Cap Weighted PR (BKP)
Qatar	QE General (QSI)
Saudi Arabia	Tadawul All Share (TASI)
United Arab Emirates (UAE)	DFM General (DFMGI)

For selected stock market indices of GCC countries, daily stock market index movement is adjusted to measure the returns generated during the period of study exhibited in Figure 1. The apparent observations derived from the time series of indices reveal that the markets were highly volatile from 2011 to 2018. All the stock indices after 2011, had a fall due to the impact of financial crisis and decline in the international oil prices. However, the governments' massive support to the economies led to a surge in the overall sprit in the stock market, which led to increase in the movement of indices across all the GCC countries. The markets showed consistent growth in the initial period of 2011. End of 2013 experienced peak movement by all the six stock markets. Bahrain stock index (BAX), Kuwait stock index (BKP) and Oman stock index (MSX) exhibited high level of volatility making new peaks and bottoms during the period of study. However, this growth in stock movement was curtailed by the sudden drop in oil prices in 2014. Major developing economies like China and India manage to control oil demand significantly, resulting in oil price slump thereby triggering stock market crash as seen prominently in the vertical fall of all the six GCC indices. Muscat Securities Exchange (MSX), Kuwait stock index (BKP) and Bahrain stock index (BAX) sustained this fall in oil prices and reverted to upward stock movement. However, Saudi Arabian index (TASI), UAE index (DFMGI), and Qatar index (QSI) could not withstand the crash and failed to show any upward movement after the crash of 2014. In nutshell, all the index movements possessed stochastic trend with not much substantial drift in their overall movement. This can help to proceed with an assumption that there is a strong relationship possible among these markets.

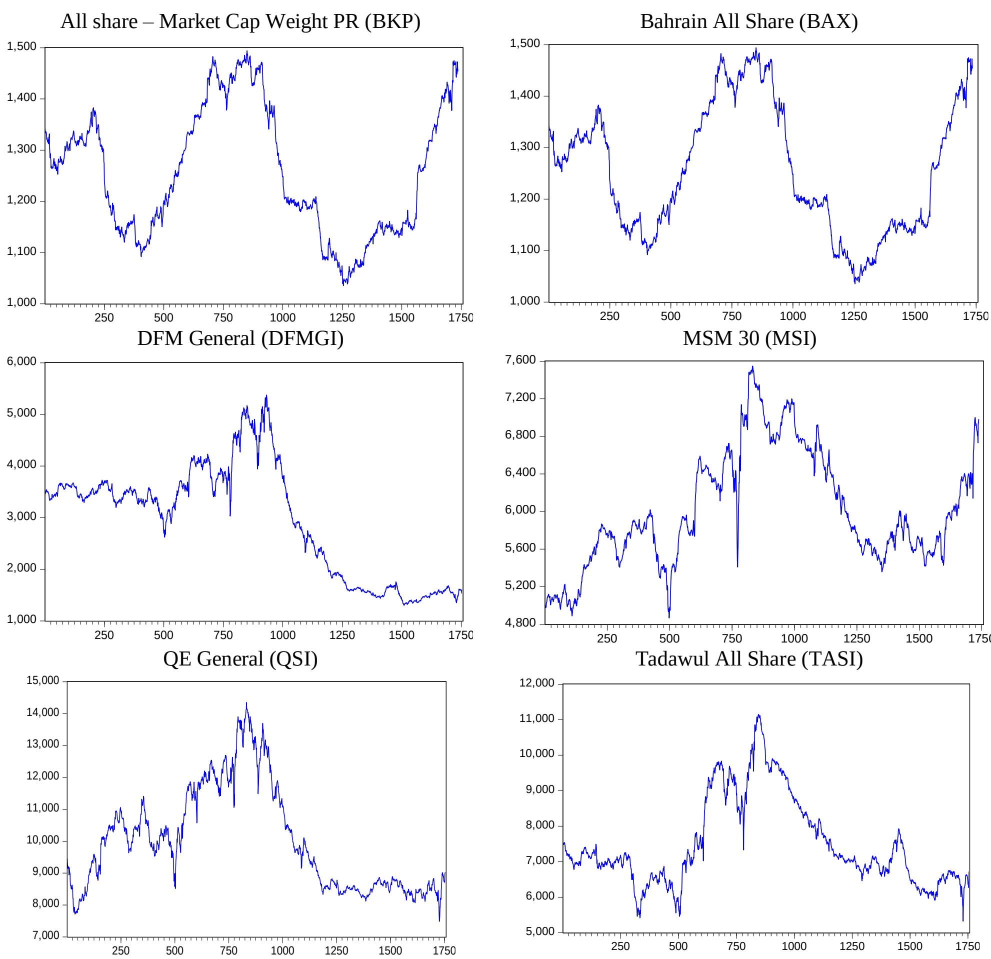

Figure 1: Daily stock index movement of GCC markets

Table 2 depicts descriptive statistics of selected stock returns. An effort is made to explain the dynamics of time series of daily stock returns individually for all the markets. The returns from the stock markets have been calculated using the log transformation process $Y_t = lnY_t/lnY_{t-1,}$ where Y_t is the index at time t and Y_{t-1} is the index at time $t-1$.

Table 2: Descriptive statistics of GCC stock markets index returns

	MSX	DFMGI	BKP	QSI	BAX	TASI
Mean	2.13%	-3.29%	0.57%	0.21%	0.57%	-0.01%
Variance	0.4347	2.07158	0.21544	0.97348	0.21739	1.2672
Skewness	1.1456	0.23044	0.29802	0.60048	0.21887	0.96393
Kurtosis	17.062	7.9754	4.7341	10.2	5.1335	11.029

The summary statistics reveal that during the period, DFMGI and TASI generated negative returns. However, MSX, BKP, QSI and BAX generated positive returns. It is evident from the data represented in Table 2 that MSX with a positive return of 2.13% has outperformed its peers while DFMGI with average negative daily returns is the underperformer in the group. Moreover, DFMGI has the maximum volatility expressed as highest variance as compared to other GCC stock markets. The skewness for all the six markets has been positive. The kurtosis (K) value is positive and greater than zero (K>0) which indicates the distribution of time series of daily index returns is characterized by high peak and flat tails compared to normal distribution. Such distribution is termed as Leptokurtic.

Table 3: Testing of unit root

	ADF Test		PP Test	
	At Level		At Level	
	Constant	Constant & Trend	Constant	Constant & Trend
MSX	-1.814	-1.842	-1.692	-1.693
DFMGI	0.664	0.960	0.666	0.964
BKP	-2.038	-2.277	-2.068	-2.279
TASI	-1.522	-1.537	-1.646	-1.590
BAX	-0.905	-0.740	-1.024	-0.861
QSI	-1.560	-1.918	-1.588	-1.995
	First difference		First difference	
	Constant	Constant & Trend	Constant	Constant & Trend
MSX	-20.46***	-20.46***	-30.28***	-30.27***
DFMGI	-36.75***	-36.76***	-36.74***	-36.74***
BKP	-48.64***	-48.65***	-47.76***	-47.81***
TASI	-39.54***	-39.55***	-39.48***	-39.50***
BAX	-33.18***	-33.18***	-51.82***	-51.86***
QSI	-41.43***	-41.42***	-41.58***	-41.57***

Notes: *** Significance at the 1% level. ** Significance at the 5% level. * Significance at the 10% level. H_0: Null Hypothesis: Series has a unit root. Number of lags based on AIC criteria are two as daily data is taken for the study. ADF: Augmented Dickey Fuller Test, PP: Phillips-Perron Test. Figures show the test statistics and figures in parenthesis indicate MacKinnon (1996) one-sided p-values. Unit root test is conducted with Constant and Constant & Trend test equation. Bartlett kernel estimation method with Newey-West Bandwidth.

Before testing the existence of linkages among the six GCC stock markets, there is a need to examine the stationarity property in the time series. Table 3 presents the results of unit root test through application of Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. ADF tests is applied to examine the null hypothesis that a unit root is present in a time series sample (Fuller, 1976) and PP test is applied to observe problem of structural breaks in time series, by adopting a non-parametric adjustment (Phillips and Perron, 1988). Both the test analysis reveal that all six markets index data are non-stationary at level and has unit root in the series. Hence, at level, null hypothesis cannot be rejected as the test statistics are not statistically significant. However, at first difference, the series reject the null hypothesis and hence, conclude that series are stationary. Consequently, from the analysis of unit root test, it can be inferred that all the stock market indices series are integrated in order 1 alternatively, I(*1*).

3.1 Co-integration Analysis

After assessing the stationary property of the data series, co-integration testing using the Johansen Co-integration Test is conducted. However, prior to conduct of the co-integration test, there is a need to select appropriate lags. Hence, appropriate lag order selection criteria test is applied and the results are displayed in Table 4 which indicate four lag criteria. Among the four criteria used, the two Schwarz information criterion (SC) and Hannan-Quinn information criterion (HQ) give consistent lags of two. Therefore, for current Model 2 lags orders have been selected.

Table 4: Lag order selection

Lag	LogL	LR	AIC	SC	HQ
0	-75414.97	NA	87.34334	87.36229	87.35035
1	-50344.77	49937.18	58.35179	58.48443	58.40085
2	-50167.83	351.1992	58.18858	58.43491*	58.27970*
3	-50122.62	89.42773	58.17791	58.53794	58.31109
4	-50057.94	127.5024	58.14469	58.61841	58.31992
5	-50013.19	87.89126	58.13455	58.72197	58.35185
6	-49956.38	111.1871	58.11045	58.81156	58.36980
7	-49913.19	84.22019	58.10213*	58.91694	58.40354
8	-49885.43	53.94577*	58.11167	59.04017	58.45513

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

Johansen Co-integration Test will help in finding the speed and direction of moving causality among the six GCC markets in long run and short run. The test considers null and alternative hypothesis and the results of Johansen Co-integration Test using maximum likelihood estimation is represented in Table 5.

Table 5: Johansen co-integration test MLE

Null Hypothesis	Trace Statistics	5% Critical value	Max-Eigen Statistics	5% Critical Value
None*	130.228	95.75	60.306	40.07
At most 1*	69.92	69.81	41.79	33.87
At most 2	28.12	47.85	15.54	27.58
At most 3	12.58	29.79	8.27	21.13
At most 4	4.30	15.49	3.85	14.26
At most 5	0.449	3.841	0.449	3.841

Notes: * denotes rejection of the hypothesis at the 0.05 level.

The results derived from the test of co-integration rejects the first two null hypotheses and shows existence of at least two co-integrating equations among the six GCC stock markets. The results from the trace statistics and Max-Eigen value gives similar results for the test. This validates the finding that there exist some linkages between these stock markets in long run. As more than one co-integrating equations from the analysis is generated, VECM can be applied. VECM will analyze the dynamic impact of random shocks long run relationship between the stock markets and help in generating the co-integrating equations. These equations will provide the understanding in deriving the speed to co-integration among all the six markets. Moreover, this model will also establish long run and short run flow of causality existing in time series. The model of VECM will be applied to assess the impact of five GCC stock markets on MSX. Consequently, MSX is assumed as dependent variable and other variables derived from the VECM model are assumed as independent variables. The results obtained from this test will reveal the vulnerability of MSX with regard to random shocks in other GCC markets in long run and short run. The VECM equation is derived and represented as follows:

$$\begin{aligned} D(MSX) = {} & C(1)*(MSX(-1) - 6.233*BAX(-1) + 1.4396*DFMGI(-1) \\ & + 0.8652*TASI(-1) - 1.4098*QSI(-1) + 5184.5692) + C(2)*(BKP(-1) \\ & - 2.5063*BAX(-1) + 0.4839*DFMGI(-1) + 0.5019*TASI(-1) \\ & - 0.5343*QSI(-1) + 2072.4149) + C(3)*D(MSX(-1)) \\ & + C(4)*D(MSX(-2)) + C(5)*D(BKP(-1)) + C(6)*D(BKP(-2)) \\ & + C(7)*D(BAX(-1)) + C(8)*D(BAX(-2)) + C(9)*D(DFMGI(-1)) \\ & + C(10)*D(DFMGI(-2)) + C(11)*D(TASI(-1)) + C(12)*D(TASI(-2)) \\ & + C(13)*D(QSI(-1)) + C(14)*D(QSI(-2)) + C(15) \end{aligned} \quad (3)$$

The above equation is run using OLS process and derive the values of coefficients are shown in the following Table 6.

Table 6: Vector error correction causality test

	Coefficient	Std. Error	t-Statistic	Prob.
C(1) MSX(-1) - 6.233*BAX(-1) + 1.4396*DFMGI(-1) + 0.8652*TASI(-1) - 1.4098*QSI(-1) + 5184.5692	-0.01595	0.003724	-4.28404	0.0000***
C(2) BKP(-1) - 2.5063*BAX(-1) + 0.4839*DFMGI(-1) + 0.5019*TASI(-1) - 0.5343*QSI(-1) + 2072.4149	0.034993	0.009128	3.833587	0.0001***
C(3) (MSX(-1))	0.25664	0.024323	10.55148	0.0000***
C(4) (MSX(-2))	0.052498	0.024593	2.134665	0.0329
C(5) (BKP(-1))	0.013838	0.09695	0.14273	0.8865
C(6) (BKP(-2))	-0.01192	0.095363	-0.125	0.9005
C(7) (BAX(-1))	0.153512	0.158486	0.968617	0.3329
C(8) (BAX(-2))	-0.27683	0.161103	-1.71832	0.0859
C(9) (DFMGI(-1))	0.005166	0.018906	0.273242	0.7847
C(10) (DFMGI(-2))	-0.02043	0.019244	-1.06142	0.2886
C(11) (TASI(-1))	0.011872	0.011609	1.02267	0.3066
C(12) (TASI(-2))	0.008483	0.011364	0.746446	0.4555
C(13) (QSI(-1))	0.007372	0.009187	0.802424	0.4224
C(14) (QSI(-2))	-0.00442	0.009208	-0.47995	0.6313
C(15) Constant	0.8239	0.926222	0.889528	0.3738

Notes: *** indicates statically significance at 1% level.

The coefficient *C(1)* is the coefficient of co-integrating model which is also referred as error correction term (ECT). It represents the speed with which the variables will adjust to equilibrium in long run. From the linear regression, lagged residuals represent the deviation from the long-run relationship in the previous period. The results derived from the analysis exhibit that the value of coefficient *C(1)* is -0.01595 and the p value is less than 5% (0.0000) which indicate that speed coefficient is statistically significant at 1 per cent. The coefficient *C(1)* is inferred as the proportion of disequilibrium that disperses by the next period. In the above analysis, *C(1)* is negative which indicates that if MSX is below its long run equilibrium with the other GCC markets, the negative value of ECT will cancel out and become positive readjusting itself back to equilibrium. On the contrary, if MSX is above its long run equilibrium, the negative coefficient of ECT will pull it back down to the equilibrium. Hence, it suggests in long run the markets will eventually move towards equilibrium and causality will flow from TASI, DFMGI, BAX, QSI and BKP indices to MSX. Nevertheless, it is equally important to assess the short run relationship. To test the short run causality, Wald test is applied. Wald test will assess the statistical significance of remaining coefficients by generating the *p* values. These *p* values will give the direction of short run causality movement from the independent variables to dependent variable with following null hypothesis for Wald test.

Table 7: Wald Test

	Null Hypothesis	Test Statistics
Long Run Causality (C(1))	C(1) = 0	15. 478 ***
Oman (MSX)	C(3)=0	11.846***
Dubai (DFMGI)	C(9)=C(10)=0	2.166
Kuwait (BKP)	C(5)=C(6)=0	3.974
Bahrain (BAX)	C(7)=C(8)=0	1.405
Qatar (QSI)	C(13)=C(14)=0	1.6945
Saudi Arabia (TASI)	C(11)=C(12)=0	4.039

Notes: Test Statistics indicate Chi-square value with 2 df. *** indicates statically significance at 1% level.

The results obtained from the Wald test indicate short run causality and long run causality among the six markets. Here as per the null hypothesis, on the basis of the obtained co-integrating equations, it is assumed that selected markets had trivial impact on MSX. However, the results obtained from Wald test suggest the value of Chi-Square test statistics of 15.478 is statistically significant for co-integrating equation coefficient [*C(1)*]. Hence, two major results can be drawn through Wald test. First, the long run causality runs from all other markets to MSX. In other words, in long run all the six GCC markets move towards equilibrium. However, the same cannot be said in the case of short run. The study has tested selected markets' influence on MSX and found none of the other markets have significant impact on the movement of MSX in short run. In short run, only the lagged coefficient of MSX had statistically significant impact on the MSX index, while it cannot be proved that other stock markets had any significant impact on short run movement of MSX. As such the null hypothesis with respect to short run causality cannot be rejected.

In order to further supplement the findings, impulse response function and variance decomposition is applied. Impulse response function works excellent when reaction of any dynamic system is to be assessed to some external change. The results obtained from impulse response function are displayed in the Figure 2.

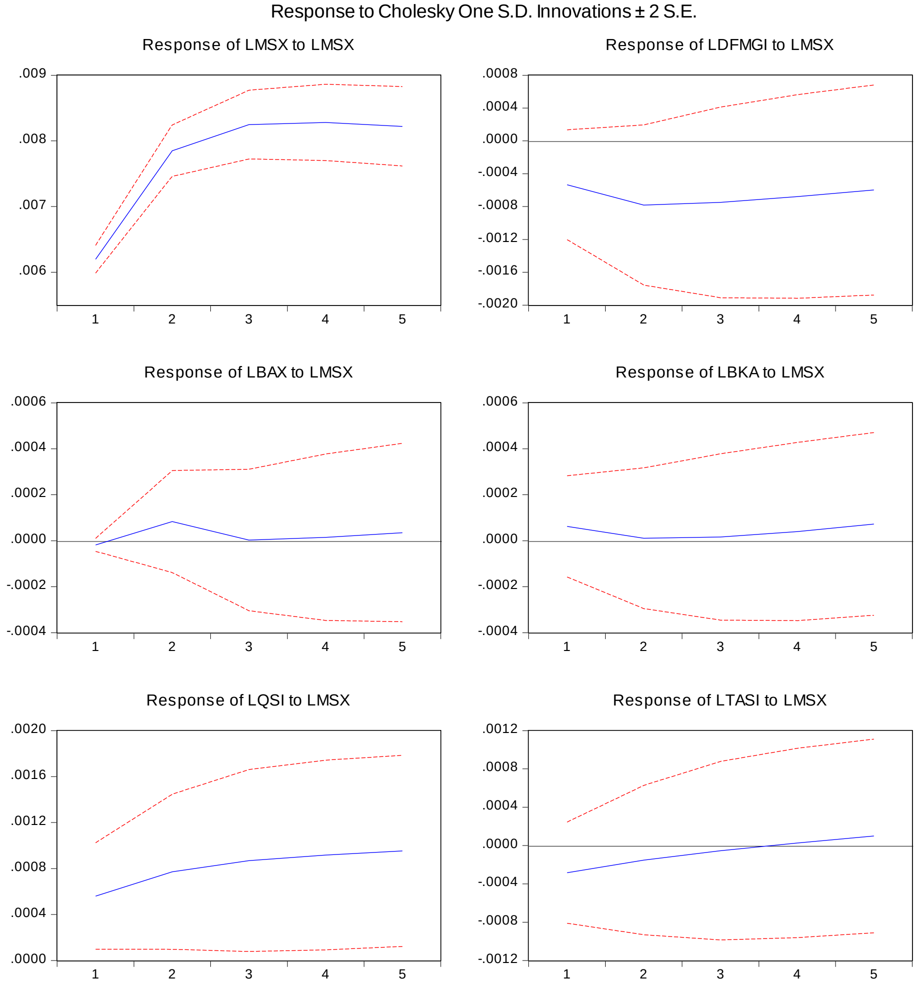

Figure 2: Impulse response function

The above figure results exhibit the impulse response function of MSX with itself and other GCC markets. Red line in the figure shows the accuracy with 95% confidence interval and blue line shows the impulse response function. A one standard deviation shock on LMSX initially increases LMSX in period one. This positive response sharply increases and continues in period two. Between period two and three, it keeps increasing till it hits period four where it gets steady and remains in the constant trajectory. With regard to other markets, one standard deviation shock of LDFMGI in period one reduces LMSX. Moreover, the shock creates negative impact on LMSX. After period two, it keeps increasing upwards towards the positive path. With regard to LBAX, one standard deviation shock of LBAX on LMSX results in increase in LMSX in period one. However, between period two and three, it results in decrease till it reaches period four, where the effect of one standard deviation shock results in slight increase in LMSX. With regard to LBKA, one standard deviation shock of LBKA results in decrease in LMSX in period one. However, from period two, it results in slight increase in LMSX for the subsequent periods. LQSI in period one with one standard deviation shock increases the LMSX. The increase is continued till period three and thereafter it is constant with slight increase in period four and five. LTASI has different response than its peers. One standard deviation shock in LTASI results in increase in LMSX and thereafter it is observed that this increase in consistently observed in the subsequent periods. The overall observation from impulse response function, reveals that the impact of other GCC markets on MSX is asymmetric in short run. This finding is further strengthened by use of variance decomposition for movement of MSX as show in Table 8.

Table 8: Variance decomposition of LMSX

Period	S.E.	LMSX	LBAX	LBKA	LDFMGI	LQSI	LTASI
1	0.006197	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.010018	99.65610	0.000118	0.022603	0.088338	0.206203	0.026636
3	0.013001	99.42230	0.000253	0.021429	0.145019	0.370431	0.040566
4	0.015439	99.27194	0.000280	0.024887	0.180872	0.484319	0.037703
5	0.017515	99.17581	0.000261	0.027073	0.203168	0.563635	0.030054
6	0.019333	99.10733	0.000226	0.026131	0.217859	0.622756	0.025701
7	0.020961	99.04962	0.000192	0.023717	0.227996	0.669625	0.028854
8	0.022440	98.99321	0.000171	0.020972	0.235296	0.708731	0.041621
9	0.023800	98.93277	0.000166	0.018651	0.240719	0.742611	0.065081
10	0.025061	98.86521	0.000181	0.017203	0.244840	0.772765	0.099798

Analysis of variance decomposition reveals in short run 100% focus variance in LMSX is explained by itself in the first period. Others variables do not have strong influence in this period. From second period onwards, it is observed that apart from MSX itself, QSI has some impact on the MSX. Over time, this influence of QSI on MSX increases. It is also evident that DFMGI is the next market which has some impact on MSX from the second period onwards. The impact of other markets viz BAX, BKA and TASI is relatively less on the MSX both in short run.

4. Conclusion

This study investigates the time-varying, long and short run relationship among stock market returns of six GCC countries (Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates). To investigate the movement of stock markets and measure their interdependency, Johansen Co-integration test was applied. Evidence from co-integration test traces the illustration of possible dynamic linkages among the GCC stock markets. The results show that six GCC stock markets had maximum two co-integrating vectors or analogously five independent common stochastic trends within this variables system. The calculated recursive coefficient of the error correction term is negative and statistically significant during the period, suggest in long run the stock markets move towards equilibrium. The causality movement among all the GCC stock markets in long run converge and flow in a unified direction. However, similar conclusion cannot be drawn in short run causality flow as shown by impulse response function and variance decomposition, MSX has considerable impact on itself especially in short-run. MSX has exhibited significant impact which resulted the market to change. However, other markets had limited response in short run and were asymmetric in nature. The analysis showed that short run causality flow is unidirectional from the lagged MSX value towards MSX. However, with respect to lagged value of other GCC markets, short run causality flow is not observed to be statistically significant towards MSX. In long run, overall empirical findings present that regional financial integration among the six GCC stock markets has increased however, it is still limited. In future, higher level of integration is expected between these regional stock markets which will provide greater diversification and broaden investor base.

This study contributes in providing useful information to financial managers to understand the dynamics of the stock market in GCC region and help in making better investment choices for portfolio management. The results provide managers and the investors' significant clues to invest their funds in any GCC stock market to generate efficient returns. Additionally, the stock market linkages allow the finance managers to understand the movement which help to raise capital by offering financial securities in appropriate stock market. The long run convergence of these stock markets indicate the possibility of launching unified financial instruments which will not only attract foreign direct investments but also provide alternative investment options. These instruments, will be indeed a step further in the regional GCC integration. The major government initiatives towards capital formation and investments will be enhanced and contribute to overall sustainable development of the region. As the study reveals weak form of short run causality, the policy makers need to be less concerned with the economic or non-economic shocks in GCC countries in short run. Though these countries have uniformity in terms of culture, location, economic dependence and religion, short term shocks will not deter the stock markets returns as they will move towards equilibrium in long run.

References

Al-Yahyaee, K. H., Mensi, W., Al-Jarrah, I. M. W., & Tiwari, A. K. (2019). Testing for the Granger-causality between returns in the US and GIPSI stock markets. *Physica A: Statistical Mechanics and its Applications*, *531*, 120950.

Arshanapalli, B., & Doukas, J. (1993). International stock market linkages: Evidence from the pre-and post-October 1987 period. *Journal of Banking & Finance*, *17*(1), 193-208.

Ashraf, F. (2003). US-Iraq War: India's Middle East Policy. *Strategic Studies*, *23*(2), 151-169.

Assaf, A. (2003). Transmission of stock price movements: the case of GCC stock markets. *Review of Middle East Economics and Finance*, *1*(2), 171-189.

Bahloul, S., & Amor, N. B. (2021). A quantile regression approach to evaluate the relative impact of global and local factors on the MENA stock markets. *International Journal of Emerging Markets*, 1746-8809.

Caporale, G. M., You, K., & Chen, L. (2019). Global and regional stock market integration in Asia: A panel convergence approach. *International Review of Financial Analysis*, *65*, 101381.

Cheung, Y. L., & Mak, S. C. (1992). The international transmission of stock market fluctuation between the developed markets and the Asian—Pacific markets. *Applied Financial Economics*, *2*(1), 43-47.

Click, R. W., & Plummer, M. G. (2005). Stock market integration in ASEAN after the Asian financial crisis. *Journal of Asian Economics*, *16*(1), 5-28.

Emenike, K. O. (2020). Dynamic Interdependence Between Crude Oil Prices And Foreign Exchange Market In Nigeria. *Studies in Economics and Econometrics*, *44*(3), 1-20.

Fraser, P., & Oyefeso, O. (2005). US, UK and European stock market integration. *Journal of Business Finance & Accounting*, *32*(1-2), 161-181.

Fuller, W. A. (2009). *Introduction to statistical time series*. John Wiley & Sons.

Hysaj, A., & Sevil, G. (2021). Stock market cointegration and diversification opportunities under inflation targeting regime. *European Journal of Economic and Financial Research*, *4*(4), 51-64.

Joshi, N. A., Mehta, D., Patel, B., & Patel, N. (2021). Causality and cointegration among stock market indices: A study of developed markets with sensex. *International Journal of Accounting & Finance Review*, *7*(1), 31-52.

Lee, B. J. (2019). Asian financial market integration and the role of Chinese financial market. *International Review of Economics & Finance*, *59*, 490-499.

MacKinnon, G. H. (1996). *Essays on internally generated firm changes* (Doctoral dissertation, University of Alberta).

Matar, A., Al-Rdaydeh, M., Ghazalat, A., & Eneizan, B. (2021). Co-movement between GCC stock markets and the US stock markets: A wavelet coherence analysis. *Cogent Business & Management*, *8*(1), 1948658.

Mohti, W., Dionísio, A., Vieira, I., & Ferreira, P. (2019). Regional and global integration of Asian stock markets. *Research in International Business and Finance*, *50*, 357-368.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Salah, I. (2010). Effect of the financial crisis on the Middle East. *Global Business Law Review*, *1*, 99-108.

Sheng, H. C., & Tu, A. H. (2000). A study of cointegration and variance decomposition among national equity indices before and during the period of the Asian financial crisis. *Journal of Multinational Financial Management*, *10*(3-4), 345-365.

Wang, Z., Yang, J., & Bessler, D. A. (2003). Financial crisis and African stock market integration. *Applied Economics Letters*, *10*(9), 527-533.

Wu, F. (2020). Stock market integration in East and Southeast Asia: The role of global factors. *International Review of Financial Analysis*, *67*, 101416.

Wu, F., Zhang, D., & Zhang, Z. (2019). Connectedness and risk spillovers in China’s stock market: A sectoral analysis. *Economic Systems*, *43*(3-4), 100718.

Yousaf, I., Ali, S., & Wong, W. K. (2020). Return and volatility transmission between world-leading and Latin American stock markets: Portfolio implications. *Journal of Risk and Financial Management*, *13*(7), 148.