Cointegration and causality between the GCC stock indices and gold indices

Sami Al Kharusi,1 Eşref Savaş Başci 2

1Economics and Finance Department, Sultan Qaboos University, Oman
2Faculty of Economics and Administrative Sciences, Hitit University, Çorum, Turkey

corresponding e-mail: ksami[at]squ(dot)edu{d}om
address: Sultan Qaboos University, Economics and Finance Department, P.o. Box 20; Al Khodh, Postal Code 123, Sultanate of Oman

Abstract: This research paper presents the empirical evidence on the relationship between the price of gold and stock price indices for the Gulf Cooperation Council (GCC) stock markets over the period beginning January 2010 and ending in December 2016 using Johansen Cointegration and VAR Based Granger Causality tests. The study is based on secondary data from GCC individual stock market. The international gold prices and six daily stock price indices; Bahrain Stock Exchange (BSE), Kuwait Stock Exchange (KSE), Qatar Stock Exchange (QSE), Saudi Stock Exchange (SSE), Muscat Securities Market (MSM), Dubai Stock Exchange (DSE) and Abu Dhabi Stock Exchange (ADSE) are used. Over the period examined, gold prices and stock price indices are co-integrated and there are multiple Granger Causality between the different GCC stock markets.

JEL Classifications: C10, E44, G15

Keywords: Gold price, stock price indices, Johansen cointegration, Granger causality, Gulf Cooperation Council


1. Introduction

The gold is considered as a strategic resource that is used by many countries as a national security and a hedging investment instrument and it has been considered as the most precious metal since ancient times (Bilal, Talib, Haq, Khan, & Naveed, 2013). The gold is considered as a conservative investment, security collateral, and risk diversifier and inflation hedger. Uncertainty of economic environment turns the attention to investing in gold as a safe haven.

Throughout history, gold maintained a unique function of both exchange and a store of value. Baur & McDermott (2010) found that gold was a strong risk management tool for major European and US stock markets during the recent global financial crisis. For GCC countries and many other both gold and oil are with no doubt considered as strategic resources for national security and various economic activities. Furthermore, there is strong evidence in the literature that equity portfolio investors uses gold to hedge the risk associated with their investment (Chkili, 2016; Ciner, Gurdgiev, & Lucey, 2013). Whenever there is a financial or economic crisis, investors tend to move out from risky assets, such as, stocks and invest in gold (Narang & Singh, 2012). The price fluctuation of gold and market volatility will impose some effects on market participants. Hence, stock market investors, producers, consumers, governments and business will face some
challenges due to the changes in gold prices. The recent statistics for the official gold holding for GCC are as follows: (1) Bahrain holds 4.7 tons, (2) Kuwait holds 79 tons, (3) Qatar holds 26.6 tons, (4) Saudi Arabia holds 322.9 tons, (5) UAE holds 7.5 tons and Oman with no holding of gold (World Gold Council, 2017). As gold have emerged as an important investment class, market participants are especially interested in the interaction across gold and the stock markets, given the increased price volatility, which affects market stabilization policies and impose more challenges to all market participants including the government.

The objective of this study is to investigate, establish and determine the causality and cointegration between GCC stock indices including Bahrain Stock Exchange (BSE), Kuwait Stock Exchange (KSE), Qatar Stock Exchange (QSE), Saudi Stock Exchange (SSE), Muscat Securities Market (MSM), Dubai Stock Exchange (DSE) and Abu Dhabi Stock Exchange (ADSE), and gold indices. Our sample period is from January 2010 to December 2016. This allows us to provide a recent view on the causality and cointegration between GCC stock indices and gold, while most of the prior studies has only accounted for the periods before and not for all GCC markets. Compared to prior studies, this study therefore provides insights from the post 2008 global financial crisis and increased market volatility due to the changes in oil price, which considered the main sources of income for all GCC countries. In fact, during this period, the price of an ounce of gold had peaked to around $1900 in September 2011 from a bottom of $1050 in December 2015. As for the GCC markets, it has experienced a major changes in market index in which most of them changed by more than 50% during the period of January 2010 to December 2016.

The rest of the paper is organized as follows: Section 2, discuss the previous studies in the field and reviews the related literature. Section 3, explains the data and methodology including the econometrics model. Section 4 makes the analysis and the implications, and finally section 5 concludes.

2. Literature review

Many of the past literature had concentrated on studying the relationship between GCC stock markets and foreign exchange markets. GCC stock markets are not only influenced by the changes in foreign exchange markets but also the changes in gold, oil and other commodities.

Different timeframe and econometrics techniques have been used to model the linkages between gold and stock market indices. There is no clear rejection or confirmation for the relationships between gold and stock markets movements. Smith (2002) discovered a short-run correlation between gold price and stock price indices but small and negative for Japan and European markets. Dirk & Baur (2010) concluded that most developed countries during the financial crisis used gold as safe haven. Horng & Huang (2013) investigated the relationship of both Malaysian Stock Market and Thailand Stock Market with gold market. They applied the bivariate asymmetric integrated generalized autoregressive conditional heteroscedasticity (IGARCH) model and found that gold market affects both risk and return of Malaysian Stock Market and Thailand Stock Market. In GCC stock markets, Al Janabi, Hatemi, & Irandoust (2010) found that these markets are informationally efficient with both gold and oil price indexes. They used daily price stock indexes for the period 2006 to 2008. In Turkey, Buyuksalvarci (2010) concluded that gold price had no significant effects on the Istanbul Stock Exchange-100 index return.
Mishra, Das, & Mishra (2010) proved that stock market returns Granger-causes the gold prices and gold prices Granger-causes stock market returns. The finding are consistent with previous theory that consider the gold as “safe haven”.

Mulyadi & Anwar (2012) concluded that there is inverse relationship between the gold and the performance of the stock markets. Generally, gold is considered as a safer asset relative to stocks. Kumar (2014) examined the relationship between the gold prices and Indian sectoral indices and concluded that there is no evidence of a volatility spillover running from gold prices. Sreekanth & Veni (2014) study revealed the existence of long-run cointegration between gold prices and stock index (S&P CNXNIFTY) of the Indian National Stock Exchange. They have used different econometric tools including Dickey-Fuller (ADF) test, Granger causality test (GCT), Vector Error Correction Model, Wald's coefficient diagnosis, residual analysis and Johansen cointegration test for the period 2005 to 2013. Similar negative relationship between gold and stock prices found by Shahzadi & Chohan (2012) using the KSE-100 index, the index of Pakistan’s Karachi Stock Exchange in Pakistan. They used ADF test, GCT and Johansen cointegration test for five years data from December 2005 to December 2010.

Choudhry, Hassan, & Shabi (2015) examined the co-movements between stock market returns and gold returns during the recent global financial crisis for the S&P500 in United States and FTSE100 in United Kingdom. They found that gold may not perform well as “safe haven” during the financial crisis but it can be used as a hedge against stock market returns and volatility. Tuyysuz (2013), Emmrich & Mcgroarty (2013), Miyazaki & Hamori (2013), and Chen & Lin (2014) provided empirical evidence that gold used as a “safe haven” during the financial crisis.

Considerable amount of research is done to investigate the relationship between gold and stock prices but literature gives mixed views about this relationship. The reasons for these differences in results could be due to the time series modeling techniques and time period of study used in the studies. To address the literature gap, this study employs to determine long and short time cointegration and causality between GCC stock indices including Bahrain Stock Exchange, Kuwait Stock Exchange, Qatar Stock Exchange, Saudi Stock Exchange, Muscat Securities Market, Dubai Stock Exchange and Abu Dhabi Stock Exchange to study the relationship with the gold prices during a recent timeframe after the 2008 global financial crisis. This will help institutional investors and private portfolio managers to make informed investment decisions and diversification of portfolios.

3. Data and methodology

In this study we used the international gold prices and six daily stock price indices as follow; Bahrain Stock Exchange (BSE), Kuwait Stock Exchange (KSE), Qatar Stock Exchange (QSE), Saudi Stock Exchange (SSE), Muscat Securities Market (MSM), Dubai Stock Exchange (DSE) and Abu Dhabi Stock Exchange (ADSE) from 2010 to 2016. These series’ data consist of daily closing prices from January 1, 2010 to December 31, 2016. There are 2557 observations within each series.

Cointegration can be calculated with different methods in the literature. In this study, we have selected Johansen Test to calculate cointegration. The Johansen test and its estimation strategy depend on maximum likelihood. The test can be used to estimate all cointegration when there are more than two variables. Furthermore, the test helps to
estimate all cointegration vectors with numerous variables that may include at least two cointegration vectors (Acikalin & Basci, 2016).

When studying the time series data, it is necessary to ensure that all data are stationary to avoid econometric problems. We used Augmented Dickey-Fuller (ADF) test to determine all series whether stationary or non-stationary using Equation 1, which is given below.

\[ \Delta y_t = \varphi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + u_{it} \]  

(1)

According to Equation (1), null hypothesis means non-stationary or it exist a unit root with \( \varphi = 0 \). Contrarily, alternative hypothesis does not include a unit root and it is stationary with \( \varphi < 0 \).

When all series are stationary, then we can use using Johansen’s Methodology to test the cointegration. The Johansen Cointegration Test starting a point with Vector Autoregression (VAR) equation. In the VAR equation, it includes \( p \) order and it can be shown in Equation (2).

\[ y_t = \mu + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t \]  

(2)

Where \( y_t \) is an nx1 vector of variables which are integrated of one order, and it is denoted I(1). If vectors are more than 1, then Equation (2) can be re-written as Equation (3) below,

\[ \Delta y_t = \mu + \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta y_{t-i} + \varepsilon_t \]  

(3)

Where,

\[ \Pi = \sum_{i=1}^{p} A_i - I \quad \text{and} \quad \Gamma_i = - \sum_{j=i+1}^{p} A_j \]

In Equation (3) \( \Pi \) means coefficient matrix and if reduced rank lower than \( n \) then it has matrices like \( n \times r \). This matrices has \( \alpha \) and \( \beta \) within rank in \( r \) and if all variables are stationary, then \( r \) is the number of cointegration relations. Thus, \( A \) is the parameter in the Vector Error Correction Model act as an adjustment parameter. And \( \beta \) is a cointegration vector of each column of the model (Johansen, 1995).
There are two tests related to Johansen Cointegration Test that are used in canonical correlations. Significance of the correlation is used in $\Pi$ matrix for reduced rank (Hjalmarsson & Osterholm, 2007).

\[
J_{trace} = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_i)
\]

(4)

\[
J_{max} = -T \ln(1 - \hat{\lambda}_{r+1})
\]

In Equation (4), $T$ means sample size and $\hat{\lambda}$ largest canonical correlation of $i$. The null hypothesis of $r$ cointegration vectors can be tested by the trace test that tests against the $n$ cointegration vectors, which is the alternative hypothesis.

The causality is a concept related to prediction. In literature, Granger Causality is the most known statistical concept of causality. With the Granger Causality, if there are two variables and first variable's past values then it should include information, which helps predict the second variable. However if future information include past values of second variables, then we can conclude that there are Granger Causality between both variables (Granger, 2001). Granger Causality can be written as bivariate linear autoregressive model with two variables using Equation (5) below,

\[
Y_1(t) = \sum_{1}^{p} A_{11} jY_1(t-j) + \sum_{1}^{p} A_{12} jY_2(t-j) + \epsilon_1(t)
\]

(5)

\[
Y_2(t) = \sum_{1}^{p} A_{21} jY_1(t-j) + \sum_{1}^{p} A_{22} jY_2(t-j) + \epsilon_2(t)
\]

Where, $p$ means model order, $A$ represents coefficient of the model and $\epsilon$ represents residuals, which is the prediction errors for all series in the model. If variance of $\epsilon_1$ in first equation in the Equation (5) contains the $Y_2$ reduced version, then it can be concluded that $Y_2$ Granger Cause of $Y_1$. However, if the coefficients in the model accordingly and significantly different from zero, it can be concluded that $Y_2$ is Granger Cause of $Y_1$.

4. Results and implications

We have started to analyze all series log version with Unit Root test. According to the results of ADF test statistics, we need to generate all series with first difference to having stationary series.
Figure 1 shows that all series in the model with daily closing price and Table 1 shows their descriptive statistics before log version.

**Figure 1. Daily closing data of all series**

![Graph showing daily closing data of all series](image)

**Table 1. Descriptive statistics**

<table>
<thead>
<tr>
<th></th>
<th>BahRAIN</th>
<th>KUWAIT</th>
<th>OMAN</th>
<th>QATAR</th>
<th>SAUDI ARABIA</th>
<th>UAE_ADX</th>
<th>UAE_DFM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>1278.318</td>
<td>6490.286</td>
<td>6203.646</td>
<td>9742.219</td>
<td>7402.912</td>
<td>3585.843</td>
<td>2667.365</td>
</tr>
<tr>
<td>Median</td>
<td>1254.130</td>
<td>6364.600</td>
<td>6201.160</td>
<td>9275.560</td>
<td>6922.960</td>
<td>3630.370</td>
<td>2382.810</td>
</tr>
<tr>
<td>Maximum</td>
<td>1605.980</td>
<td>8430.730</td>
<td>7547.650</td>
<td>14350.50</td>
<td>11149.36</td>
<td>5253.410</td>
<td>5374.110</td>
</tr>
<tr>
<td>Minimum</td>
<td>1035.300</td>
<td>4936.510</td>
<td>4867.000</td>
<td>6502.930</td>
<td>5323.270</td>
<td>2293.090</td>
<td>1301.240</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>145.5795</td>
<td>802.7583</td>
<td>552.4852</td>
<td>1837.019</td>
<td>1312.713</td>
<td>953.5949</td>
<td>1151.349</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.157839</td>
<td>0.289803</td>
<td>0.244415</td>
<td>0.515199</td>
<td>0.964351</td>
<td>0.133788</td>
<td>0.477532</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.598340</td>
<td>2.039601</td>
<td>2.122258</td>
<td>2.348611</td>
<td>2.874351</td>
<td>1.335882</td>
<td>1.874896</td>
</tr>
</tbody>
</table>

| Jarque-Bera | 219.9342 | 134.0623 | 107.5417 | 158.3237 | 398.0053 | 302.6725 | 232.0483 |
| Probability | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |
| Sum         | 3268659. | 16595662 | 15862723 | 24910854 | 18929247 | 9169001. | 6820453. |
| Sum Sq. Dev.| 54170320 | 1.65E+09 | 7.80E+08 | 8.63E+09 | 4.40E+09 | 2.32E+09 | 3.39E+09 |
| Observations| 2557     | 2557     | 2557     | 2557     | 2557     | 2557     | 2557     |

Figure 2 shows the log series of each variable in the model including the seven GCC stock markets and gold prices.
According to Table 2, Johansen Cointegration Test result shows that there is a 1-cointegration equation in the model between series. It means that at least one cointegration relationship in long period.

In Table 3, there are so many Granger Causality relations between variables. According the Granger Causality Test results, only statistically significant result has been showed in Table 3. Relationships and way of causality can be understand from probability and Chi-Sq. test statistics from the Table. Granger Causality can be either in one direction or in both directions. Figure 3 shows the VAR Granger Causality results for the stock markets. There five relationship with two direction effects: (1) Abu Dhabi Stock Exchange with Saudi Stock Exchange, (2) Abu Dhabi Stock Exchange with Dubai Stock Exchange, (3) Kuwait Stock Exchange with Muscat Securities Market, (4) Qatar Stock Exchange with Saudi Stock Exchange and (5) Qatar Stock Exchange with Muscat Securities Market. Furthermore, there are another nine relationship with one direction effect between the seven stock markets.

**TABLE 2. JOHANSEN COINTEGRATION RANK TEST (TRACE)**

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Trace statistic</th>
<th>0.05 Critical value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None *</td>
<td>0.015545</td>
<td>129.2455</td>
<td>125.6154</td>
<td>0.0295</td>
</tr>
</tbody>
</table>

Note: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values
### TABLE 3. VAR GRANGER CAUSALITY TEST RESULTS

<table>
<thead>
<tr>
<th>DEPENDENT VARIABLES</th>
<th>EXCLUDED VARIABLES</th>
<th>CHI-SQ</th>
<th>PROB.</th>
<th>RESULT OF CAUSALITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dubai Stock Exchange (DSE)</td>
<td>Abu Dhabi Stock Exchange (ADSE)</td>
<td>17.22152</td>
<td>0.0018</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Saudi Stock Exchange (SSE)</td>
<td>18.69425</td>
<td>0.0009</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Muscat Securities Market (MSM)</td>
<td>9.303134</td>
<td>0.0540</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td>Abu Dhabi Stock Exchange (ADSE)</td>
<td>Dubai Stock Exchange (DSE)</td>
<td>11.79596</td>
<td>0.0189</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Saudi Stock Exchange (SSE)</td>
<td>13.62397</td>
<td>0.0086</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Qatar Stock Exchange (QSE)</td>
<td>7.835716</td>
<td>0.0978</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td>Saudi Stock Exchange (SSE)</td>
<td>Abu Dhabi Stock Exchange (ADSE)</td>
<td>15.21007</td>
<td>0.0043</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Qatar Stock Exchange (QSE)</td>
<td>8.768569</td>
<td>0.0672</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td>Qatar Stock Exchange (QSE)</td>
<td>Saudi Stock Exchange (SSE)</td>
<td>36.27102</td>
<td>0.0000</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Muscat Securities Market (MSM)</td>
<td>19.60416</td>
<td>0.0006</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td>Muscat Securities Market (MSM)</td>
<td>Saudi Stock Exchange (SSE)</td>
<td>64.92152</td>
<td>0.0000</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Qatar Stock Exchange (QSE)</td>
<td>11.62942</td>
<td>0.0203</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Kuwait Stock Exchange (KSE)</td>
<td>8.660808</td>
<td>0.0702</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td>Kuwait Stock Exchange (KSE)</td>
<td>Saudi Stock Exchange (SSE)</td>
<td>21.62660</td>
<td>0.0002</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Qatar Stock Exchange (QSE)</td>
<td>13.39750</td>
<td>0.0095</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Muscat Securities Market (MSM)</td>
<td>10.53437</td>
<td>0.0323</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td></td>
<td>Bahrain Stock Exchange (BSE)</td>
<td>18.86820</td>
<td>0.0008</td>
<td>GRANGER CAUSE</td>
</tr>
<tr>
<td>Bahrain Stock Exchange (BSE)</td>
<td>Qatar Stock Exchange (QSE)</td>
<td>11.86250</td>
<td>0.0184</td>
<td>GRANGER CAUSE</td>
</tr>
</tbody>
</table>

### FIGURE 3. VAR GRANGER CAUSALITY RESULT DIAGRAM

![VAR Granger Causality Result Diagram](attachment:image.png)
5. Conclusion

The literature provides abundant evidence on the importance of gold for hedging and safe haven purposes that is used by governments, institutions and individuals. In this study, we used Johansen Cointegration and VAR based Granger Causality to examine the causality and cointegration between GCC stock indices and gold indices from January 2010 to December 2016. The main finding highlights that there is a strong Granger Causality between the gold indices and GCC stock indices according the statistically significant level. Furthermore, there five relationships with two direction effects another nine relationships with one direction effect between the seven stock markets. This means that changes in one market is followed by later changes in another market during the period of study. Hence, we can conclude that stock market performance in all seven GCC markets provides useful information in predicting the changes in other markets within GCC. Our results is particularly useful for policy makers who have been using gold as indicator and hedging instrument for portfolio investment in stock markets. This is important as a risk management tool for institutional investors and multinational corporations. Further research should focus on whether the relationship with oil and stock indices will be move in a different direction of gold or not.

References


