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Volatility Transmission across Stocks and International Markets during the COVID-19 Pandemic: Lessons from the GCC Countries

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Abstract
Globally, volatility transmission across markets has received growing attention in the recent literature. However, only a few studies have looked into this transmission in the GCC countries. No study was found to have investigated the transmission of volatility across the GCC equity markets, crude oil and gold markets during and before the COVID 19 pandemic. This paper attempts to fill this gap using daily data from 23/02/2017 to 22/03/2021. The results derived from the EGARCH model revealed that the GCC markets are integrated with varying degrees. Muscat equity market as well as the gold market are the most impacted markets by the COVID 19 pandemic, whereas Qatar equity market was the least affected. The findings also concluded that these markets are more dependent on the gold market than the oil market.

Keywords: EGARCH, volatility transmission, GCC markets, COVID 19 pandemic.

Introduction

During the last decade, the GCC countries have experienced economic and financial improvements towards creating a common market in the region. Furthermore, a significant progress has been made to reach this aim in the different GCC financial markets[1]. Although emerging markets are becoming increasingly integrated with international markets, their volatility transmission has increased (Alotaibi et al., 2015). This means that they are more likely to become vulnerable to external shocks due to the lack of diversification opportunities. Although several studies focused on examining volatility transmission across GCC countries and international markets (Alotaibi et al., 2015; Malik & Hammoudeh, 2007; Alqahtani & Chevallier, 2020), a

[1]GCC markets account for 40% and 23% of global provenoil and gas reserves respectively; sovereign wealth is estimated to be more than US$ 1 trillion in size and financial systems dominated by commercial banks (Espinoza et al., 2011)

shortage of understanding is found regarding the interaction among GCC markets during the recent COVID-19 pandemic.

The latest COVID 19 health pandemic engendered the most serious economic crisis since the World War II (Sarkodie et al., 2022). According to Al-Awadhi et al. (2020), the pandemic affected supply chains, communities and ecosystems globally. Consequently, this has led to a worldwide economic recession, affecting global and regional financial markets (Barro et al., 2020; Zhang et al., 2020; Ramelli & Wagner, 2020).

Following the before mentioned evidence, this study examines volatility transmission[2] across GCC and international markets during the COVID-19 pandemic. Daily data ranging from 23/02/2017 to 22/03/2021 is considered in this analysis including six countries namely, Saudi Arabia, Qatar, Oman, UAE, and Bahain. Saudi Arabia, Qatar, Bahrain, Oman and Kuwait which are presented by four indices namely, TASI, QE, BSE, MSM30 and MXKW respectively, whereas UAE is represented by two indices ADXGI (Abou Dhabi stock exchange) and DFMGI (Dubai stock exchange). In addition, two international markets are used in this study representing BRENT Crude Oil index and GOLD for the commodity market due to their significant interconnection with various financial markets (Elgammal et al., 2021).

The global number of confirmed COVID-19 death cases is utilized to assess the effect of the pandemic on the selected markets. Following the study by Ashraf (2020), the daily number of confirmed death cases from the Oxford martin School database[3] is adopted to proxy the COVID-19. This proxy equals to null in the pre-COVID-19 phase and started to go higher during the COVID-19 pandemic, allowing the examination of how did the growth of death cases impact the GCC and international markets. Intuitively, it permits the assessment of how volatility is transmitted across the selected markets. To ensure the validity of the findings, the Exponential EGARCH models are employed to investigate how volatility is transmitted across the examined markets (Rizvi et al., 2018; Ali et al., 2020; Basuony et al., 2021).

The remaining of this paper reviews the related literature then explains the adopted methodology. The results are discussed with policy recommendations, and finally a conclusion is drawn.

Literature Review

The Covid 19 pandemic provoked a significant level of uncertainty in relation to household spending on both goods and services which severely impacted the survival of many businesses and shattered the confidence of investors. Financial markets responded by driving down the prices of many assets causing various degrees of volatility (Uddin et al., 2021; Elgammal et al., 2021; Zhang et al., 2020).

Hammoudeh et al. (2007) were among the first to examined the interactions between the volatility of the individual GCC equity markets with the oil market using various bivariate GARCH models with weekly data from 15 February 1994 to 28 December 2004. Mexico was included in the sample as an oil-exporter with an equity market that is more developed compared to the GCC markets. Besides Mexico, the study concluded that both the US and Saudi markets are the source of a significant transmission of instability effects to the rest of the GCC markets.

[2]See(Arouri et al., 2011; Guesmi & Fattoum 2014; Khalfaoui et al., 2015; Delcoure & Singh, 2018; Hammoudeh et al., 2013; Kumar et al., 2012; Sadorsky, 2012) for the theoretical understanding of volatility transmission across international markets.

[3] https://ourworldindata.org/covid-deaths?country=IND~USA~GBR~CAN~DEU~FRA

Hammoudeh et al. (2009) utilized the GARCH(1,1) and VAR(1) models to investigate the volatility spillover among the banking, industrial and service sector of Qatar, Saudi Arabia, Kuwait and UAE with daily data from December 31, 2001 to December 31, 2007. The results showed a significant inter-sector volatility more prevalent to the service sector from the industrial sector than the reverse. The oil price returns impact on all the selected countries was unexpectedly low with the highest correlation recoded for Saudi Arabia.

Using the multivariate GARCH model with daily closing prices of Brent crude oil and the GCC stock markets closing prices from May 2004 to Sept 2006, Ibrahim (2012) also found evidence of volatility transmitting from the Dubai and Saudi markets to the Kuwait stock market and similarly, from Oman to Abu Dhabi market. He concluded that only the Bahrain and Kuwait markets were reactive to outside information spillovers.

Maghyeresh et al. (2017) also studied the transmission of volatility between gold, equity and crude oil with DCC-GARCH model and data from January 2004 to May 2016 with daily frequency for the GCC region. The findings confirmed a notable positive volatility spillover from oil to equity returns for the UAE and Saudi Arabia. Gold was not found to impact the equity markets. The inverse relationship to these markets from the GCC stock markets was found to be unimportant.

Uludag and Khurshid (2019) analyzed the volatility transmission for another emerging market which is the Chinese equity market and its transmission of volatility to E7 and G7 equity markets. They employed the VAR-GARCH (1, 1) with daily data from September 1, 1995 to March 3, 2015. The results showed that despite the low openness of China, the transmission from the Chinese equity market to G7 is more significant than the transmission to E7 countries. The same was observed for the inverse transmission to the Chinese equity from the G7 and E7 countries.

More recently, Alqahtani et al. (2020) conducted a study using weekly data from the 9 July 2004 to 7 September 2018 with the DCC-GARCH model to examine the conditional correlations between the GCC countries equity market returns and the volatility in the gold market, oil market, as well as the US stock market. It was found that during crisis periods, stronger correlations existed between the volatility measures and the GCC countries stock markets. It was also concluded that Qatar and Saudi Arabia markets displayed the highest level of sensitivity to all shocks.

Ali et al. (2020) investigated the response of global financial markets volatility to the COVID-19 crisis with daily data form Jan 1, 2020, to Feb 14, 2020 for the 9 countries impacted the most by the Pandemic. Following Yu & Hassan. (2008) and Rizvi et al. (2018), they used the EGARCH model and concluded that when the number of casualties outside of China began to increase, the global financial markets experienced an escalation in volatility. Once casualties increased in the US, this aggravated the impact of the volatility of financial markets on commodities. They also concluded that the COVID-19 deaths negatively and noticeably impacted the returns of most financial securities.

Basuony et al. (2021) also used the EGARCH model with daily data to analyze the effect of the COVID-19 pandemic on the conditional volatility of stock returns for China, India, Russia, Brazil, Germany, Italy, United Kingdom, Spain and United States from January 1, 2013 to December 31, 2020. They found evidence of an unprecedented increase in volatility across all the markets.

Hussain et al. (2023) was the most recent study examining the volatility spillover of the daily global S&P oil returns index with the GCC market returns from March 2012 to May 2022. The GARCH model results showed that volatility spillovers are different cross the GCC markets with a positive significant impact of oil price volatility in Saudi Arabia and Qatar. The impact was found to be negative in Oman and negligible for the rest of the countries.

The abovementioned mixed results call for further investigations into the volatility transmission across the GCC socks and international markets particularly during the COVID 19 pandemic. This paper addresses this gap using the Exponential GARCH model.

Methodology

The main objective of this study is to conduct an investigation of the volatility transmission across GCC and international markets. To achieve this, The Exponential GARCH models (EGARCH (1.1)) was chosen to be utilized along with the growth of COVID-19 confirmed cases/death from more than 200 countries (Ajmi et al., 2021; Ashraf, 2020). The EGARCH model is adopted for two main reasons. Firstly, it provides more precise estimations without any parameter constraints (Rizvi et al., 2018). Secondly, following Nelson (1991), the EGARCH model is able to effectively handle the effects of asymmetry between negative and positive asset returns. The EGARCH model is defined bellow:

$$ln\sigma_{j,t}^{2} = \omega_t + \beta_j \ln\left(\sigma_{j,t-1}^{2}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^{2}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^{2}{}_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] \quad (1)$$

The conditional variance is represented by $\sigma_{j,t}^{2}$ and the ω_t element defines the conditional density function. β indicates the persistence in conditional volatility while the component γ measures the effect of leverage. When γ is less than zero, it implies that good news generates lower volatility than bad news, whereas, the inverse leverage effect occurs when γ is higher than zero. This suggests that good news are more disruptive than the negative ones. The symmetric effect of the model is captured by the GARCH effect characterized by α.

In order to measure the effect of COVID-19 on the selected markets, the growth of COVID-19 confirmed death (GD) /cases (GC) is included as an exogenous variable from equations (2) to (8). The representations of the conditional variance for returns are defined as follows:

$$Ln\sigma^{2}{}_{Gold,t} = \omega_t + \beta_j \ln\left(\sigma_{Gold,t-1}^{2}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^{2}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^{2}{}_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \delta GD + \pi GC + \theta Brent + \varphi \text{ TASI} + \tau \text{ QE} + \varphi \text{ BSE}$$
$$+ \sigma MSM30 + \partial ADXGI + \vartheta\, DFMGI \quad (2)$$

$$Ln\sigma^{2}{}_{Brent,t} = \omega_t + \beta_j \ln\left(\sigma_{Gold,t-1}^{2}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma_{t-1}^{2}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^{2}{}_{t-1}}} - \sqrt{\frac{2}{\pi}} \right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ TASI} + \tau \text{ QE} + \varphi \text{ BSE}$$
$$+ \sigma\, MSM30 + \partial ADXGI + \vartheta\, DFMGI \quad (3)$$

$$Ln\sigma^2{}_{TASI,t} = \omega_t + \beta_j \ln\left(\sigma^2_{Gold,t-1}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ Brent } + \tau \text{ QE } + \varphi \text{ BSE}$$
$$+ \sigma\, MSM30 + \partial ADXGI + \vartheta\, DFMGI \qquad (4)$$

$$Ln\sigma^2{}_{QE,t} = \omega_t + \beta_j \ln\left(\sigma^2_{Gold,t-1}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ Brent } + \tau \text{ TASI } + \varphi \text{ BSE}$$
$$+ \sigma\, MSM30 + \partial ADXGI + \vartheta\, DFMGI \qquad (5)$$

$$= \omega_t + \beta_j \ln\left(\sigma^2_{Gold,t-1}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ Brent } + \tau \text{ TASI } + \varphi\, QE + \sigma\, MSM30$$
$$+ \partial ADXGI + \vartheta\, DFMGI \qquad (6)$$

$$Ln\sigma^2{}_{MSM30,t} = \omega_t + \beta_j \ln\left(\sigma^2_{Gold,t-1}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ Brent } + \tau \text{ TASI } + \varphi\, QE$$
$$+ \sigma\, BSE + \partial ADXGI + \vartheta\, DFMGI \qquad (7)$$

$$Ln\sigma^2{}_{ADXGI,t} = \omega_t + \beta_j \ln\left(\sigma^2_{Gold,t-1}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ Brent } + \tau \text{ TASI } + \varphi\, QE$$
$$+ \sigma\, BSE + \partial MSM30 + \vartheta\, DFMGI \qquad (8)$$

$$Ln\sigma^2{}_{DFMGI,t} = \omega_t + \beta_j \ln\left(\sigma^2_{Gold,t-1}\right) + \gamma \frac{\varepsilon_{t-1}}{\sqrt{\sigma^2_{t-1}}} + \alpha \left[\frac{|\varepsilon_{t-1}|}{\sqrt{\sigma^2{}_{t-1}}} - \sqrt{\frac{2}{\pi}}\right] + \delta GD + \pi GC + \theta Gold + \varphi \text{ Brent } + \tau \text{ TASI } + \varphi\, QE$$
$$+ \sigma\, BSE + \partial MSM30 + \vartheta\, ADGXI \qquad (9)$$

Results and Discussion

Table 1: Descriptive Statistics

	BRENT	GOLD	TASI	ADSMI	DFMGI	MSM30	MXKW	BHSEASI	QE
Mean	0.00005	0.00016	0.00009	0.00011	-0.00017	-0.00021	0.00020	0.00009	-0.00003
Min	-0.1214989	-0.03856	-0.07277	-0.06047	-0.07319	-0.03701	-0.02576	-0.04113	-0.05575
Max	0.0828521	0.056742	0.029669	0.035074	0.030679	0.009743	0.020161	0.029952	0.019405
SD	0.01197606	0.004218	0.004894	0.004942	0.005367	0.002497	0.003816	0.002759	0.004643
Kurt	25.4051151	39.40648	52.54413	37.90841	43.84308	48.8388	7.348636	65.6008	24.38907
Skew	-1.6679817	1.210744	-3.59181	-1.8742	-3.20963	-3.47589	-0.45373	-1.6588	-2.09915

Note: The descriptive statistics of return series are reported, including mean (Mean), minimum (Min), maximum (Max), standard deviation (SD), kurtosis (Kurt) and skewness (Skew).

Table 2 reports the EGARCH (1.1) results of the estimated models. They reveal that the leverage effect (γ) is negative and significant for Dubai, Saudi Arabia, Abu Dhabi, Kuwait and Qatar stock market indices and for Brent. This implies that the effect of negative innovations is more pronounced on the stock and crude oil markets than that of positive ones. Also, the leverage effect was found to be significantly positive for Muscat stock market and for Gold, indicating that positive shocks are likely to cause more volatility compared to negative shocks in these markets.

The GARCH effect α is found to be significant for all markets (except Saudi Arabia and Muscat). More precisely, the GARCH effect α is significantly positive for Abu Dhabi, Dubai, Bahrain, Qatar and Gold markets and negative for Saudi Arabia, Kuwait stock markets and crude oil market. Furthermore, it is noticed that the highest effect of volatility innovation is recorded for Bahrain (0.144084) and the gold market 0.141339 while the lowest effect is observed for Qatar stock returns (0.045338).

Table 2: Results of EGARCH (1.1) models

EGARCH(1.1)	TASI index	ADSMI index	DFMGI index	MSM 30	MXKW	BHSEASI	QE	Oil	Gold
Conditional mean equation μ	0.000230**	0.000236**	2.16E-05	-0.000212***	0.000271***	0.000183***	0.000165	0.000150	0.000135
Conditional mean equation									
ω C(2)	-0.446354***	-0.504352***	-2.103161***	-11.41143***	-0.188484***	-2.331885***	-1.014886***	-0.217904***	-3.586870***
β C (5)	0.960622***	0.960538***	0.818655***	0.086887	0.980362***	0.823354***	0.911218***	0.973121***	0.703773***
γ C(4)	-0.068572***	-0.031021**	-0.041593**	0.160893***	-0.005506	-0.009436	-0.062966***	-0.053150***	0.062000**
α C(3)	-0.016112	0.070932***	0.066342***	0.052211	-0.058291***	0.144084***	0.045338**	-0.076205***	0.141339***
Growth deaths	0.019838***	0.024925***	0.173224***	0.359568***	0.023063***	0.103484***	-0.010954	0.032761***	0.353485***
TASI	-	-21.65079***	-43.32365***	-19.28930***	-19.11412***	-22.84105***	-1.529708	-18.27375***	-25.35312***
ADSMI	7.116722*	-	30.40132***	27.63767***	-2.738226	14.28266***	16.90193***	14.50870***	11.48681**
DFMGI	-14.53991***	-1.373036	-	-36.77421***	-3.125290	-17.55294**	-25.01351***	-15.00154***	-17.20002***

MSM 30	-19.97749***	-27.26726***	-38.89929***	-	12.96619***	-71.62086***	6.055773	-18.51002***	-47.19660***
MXKW	5.761617**	-2.969760	-13.35375**	6.184959	-	-7.444258	2.322544	6.155866**	-9.984645
BHSEASI	2.994789	-8.081839*	-16.15958**	14.13401**	-6.349949*	-	-12.99856*	0.361670	57.41716***
QE	-9.645069***	6.859996*	-1.966466	-10.88883	-12.17161***	5.185530	-	0.959441	4.010170
Oil	-4.916465***	-0.754432	-3.450077**	-9.030770***	4.732623***	5.242299***	-7.685680***	-	-3.550766
Gold	11.70455***	-10.73547***	-4.321591	6.459379	4.218241**	32.70681***	15.37249***	12.88212***	-

Note: ***, ** and * represent statistical significance at 1% 5% and 10% levels, respectively

The coefficients capturing the persistence of volatility β are also significant for all markets, except for Muscat. Moreover, the volatility persistence degree in past volatility is near 1 in all considered markets in this study. This evidence indicates that the fluctuations of the conditional variance away from its long-run mean persist for a considerable period of time.

Dealing with the volatility transmission across markets, the results justify the interconnectedness of the considered markets in this study. Table 2 shows the presence of significant transmission of volatility from Saudi Arabia stock market to all considered markets in this study (except for Qatar) as the corresponding coefficients are statistically significant. This is mostly attributed to significant weight and the growing influence of the Saudi Arabian economy on the regional stock markets especially during the last years. In this regard, it is important to observe that the GCC stock markets are somewhat controlled by the Saudi Arabian stocks, as the size of this market to the total GCC market capitalization represents more than 40% (Hamoudeh et al., 2009)[4]. In addition, it is noticed that the impact of volatility transmitted from Saudi Arabia to all the GCC markets is greater than the opposite impact, which is in line with the findings by (Ibrahim, 2012)[5]. It is also worth noticing that due to the significant interdependency between these markets, there are limited opportunities for hedging through portfolio diversification (Uludag & Khurshid, 2019)[6].

It is also revealed that Muscat and Dubai stock markets are considered as a major transmitters and receivers of volatility to their regional markets. More precisely, a statistically significant bidirectional volatility spillover effects are identified from Muscat to Saudi Arabia, Abu Dhabi, Dubai and Bahrain, whereas a unidirectional effect is found between Muscat and Kuwait. In addition, the presence of significant bidirectional volatility spillover effects between Dubai market and Saudi Arabia, Muscat, Bahrain and Qatar are observed. Also, the presence of significant bidirectional volatility spillover effects is shown from Dubai to Abu Dhabi and Kuwait stock markets.

In the same context, it is revealed that Kuwait is a major volatility receiver, since they received volatility from Saudi Arabia, Muscat, Bahrain and Qatar stock markets, while it transmits volatility only to Saudi Arabia and Dubai. This evidence implies that Kuwait and the rest GCC countries are weakly integrated. The findings also indicate the presence of a weak connection between Qatar stock market and the remaining GCC stock markets. In this regard, it is shown that the presence of significant bidirectional volatility spillover effect between Qatar and Abu Dhabi stock markets, since the the lagged conditional variances of Qatar stock market index has a noticeable negative effect on the current conditional variances of Abu Dhabi stock market index with a coefficient equal to 6.859996. In addition, there is a positive significant spillover effect from Abu Dhabi stock market to Qatar stock market with a coefficient equal to 16.90193. This result indicates that the impact of Abu Dhabi stock market on Qatar stock market is the most substantial in terms of intensity. On the other hand, significant unidirectional spillovers effects are identified from Dubai and Bahrain to Qatar with coefficients equals to -25.01351 and -12.99856, respectively. It is also observed that the impact of DFMGI stock market index is higher than the impact of BHSEASI index. One of the most striking results in this research revealed that Muscat stock market recorded the highest impact on the current conditional variance of Bahrain stock market.

[4] Shock and volatility spillovers among equity sectors of the Gulf Arab stock markets
[5] Volatility Spillover Across GCC Stock Markets
[6] Volatility Spillover from the Chinese Stock Market to E7 and G7 Stock Markets

As for the commodity markets, the presence of a sizeable volatility spillover is found from the crude oil market to all GCC countries except Abu Dhabi stock market and the gold market. More precisely, bidirectional relationships are found between (Brent, Saudi Arabia), (Brent, Dubai), (Brent, Muscat) and (Brent, Kuwait), whereas unidirectional effect is identified from the crude oil market to Bahrain and Qatar stock markets indices. This indicates the presence of strong dependency between crude oil market and the most of GCC countries (Alqahtani & Chevallier, 2020)[7]. Concerning the gold market, three significant bidirectional spillover relationships are observed between (gold, Saudi Arabia), (gold, Abu Dhabi) and (gold, Bahrain), with the highest effect found on Bahrain stock market. Furthermore, the results suggested that two positive significant unidirectional relationships exist from gold to Qatar stock market and crude oil market. It was also noticed that the gold volatility spillover coefficient ranges from 4.218241 for Kuwait to 32.70681 in Bahrain.

Dealing with the relationship between the selected financial markets and the COVID-19 pandemic, it is observed that the raising number of growth death cases has a positively significant effects on all the volatilities of the studied markets except Qatar. Precisely, the evidence revealed that Muscat equity market and gold market are the most affected markets by this exogenous event with coefficients that reached 35.95% and 35.34%, respectively. Nevertheless, it is found that Qatar stock market is less receptive to the raising number of COVID 19 death cases relative to the rest of the markets, with a coefficient around only 1.09%. These results confirm the findings of previous studies, which demonstrated that COVID-19 crisis, increases promptly the volatility of stock markets indices (Uddin et al., 2021[8] ; Ali et al., 2020[9]).

The volatility spillovers estimation results revealed that there is a high interdependence between the considered markets. This can be explained by the existence of financial integration among these markets, which is the result of strong economic ties through many ways namely, import-export, inflation, and capital flows among others (Pula, 2014). Furthermore, the shortage of hedging possibilities for diversification of portfolios within the GCC region is justified by this high dependency between the GCC stock markets. Intuitively, numerous reasons could explain the strong dependency between the GCC markets. Firstly, the cross-volatility spillovers are more likely to arise from banking sector, which is known to be the important industry in most GCC economies. Also, for the Saudi market, there are ambiguities regarding the exposures of some GULF banks, particularly UAE banks (Nekhili & Mohd, 2010). In addition, any fluctuations in the fundamentals of natural gas and oil as well as for their related products along with goods and services that are energy-sensitive in GCC countries, could affect promptly the equities markets of the region through different channels (Hamoudeh et al., 2009)[10]. This is not surprising, given that these countries' heavy dependence on oil and natural gas exports.

The high linkages between oil and equity markets are mostly attributed to the fact that the correlation between equities and oil in the GCC markets is related to the expectations that high crude prices will lead to large governmental revenues and therefore increased expenditure on infrastructure and development projects. This will in turn results in benefits for firms (Nkhili & Mohd, 2010)[11]. Furthermore, according to Hamoudeht et al. (2009), this volatility between the

[7] Dynamic Spillovers between Gulf Cooperation Council's Stocks, VIX, Oil and Gold Volatility Indices

[8] The effect of COVID – 19 pandemic on global stock market volatility: Can economic strength help to manage the uncertainty?

[9] Coronavirus (COVID-19) — An epidemic or pandemic for financial markets

[10] Shock and volatility spillovers among equity sectors of the Gulf Arab stock markets

[11] Volatility spillovers among the Gulf Arab emerging markets

Gulf markets may be coming from the industrial sector in Qatar market, the insurance sector in UAE market and the Kuwaiti service sector.

Surprisingly, the findings additionally indicate that the GCC equity markets are more sensitive to the gold market than the oil market, which contradicts the study by Maghyereh et al. (2017). The highest sensitivity of GCC stock markets to gold is mostly attributed to the fact that the financial situation caused by the COVID-19 crisis forces investors to seek an alternative investment to protect their portfolios against the deceasing crude oil prices. More precisely, investors seek to invest in precious metals and largely gold because it is considered as a stable haven and serves as a mean of preserving value during crises (Mensi et al., 2020)[12].

Another likely explanation for volatility spillovers can be traced to the behaviour of investors such as herding behaviour, pessimism, optimism and sentiment that can contribute to volatility transmission across these integrated markets. Also, these markets are unique compared to other emerging markets. It is known that these countries share the same culture and heritage as well as highly inter-related trades (AlMaamary et al., 2017). Hence, the likelihood of investors' sentiments being driven by the same characteristics is high.

Conclusion

In conclusion, this study confirmed the high interdependence between the considered markets. This has valuable implications for all types of investors as well as governmental policy makers. Due to how sensitive the GCC region is to changes of oil prices, policy makers need to be very careful in drafting regulatory guidelines which enable the stabilization of the economy during future crises. A particular attention has to be paid to reassuring both national and international investor that different corrective actions are to be put in place to effectively control the level of volatility spillovers among various commodities and the stock markets. Also, this research provide insight to investors and portfolio managers in their decisions on how to manage risk by forecasting the volatility transmission between different markets and adjusting their investment strategies accordingly.

[12] Spillovers and co-movements between precious metals and energy markets: Implications on portfolio management

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