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Black swan events and stock market behavior in Gulf countries: a comparative analysis of financial crisis (2008) and COVID-19 pandemic

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Abstract

Purpose – The current study aims to examine the impact of two black swan events on the performance of six stock markets in Gulf Cooperation Council (GCC) economies (Abu Dhabi, Bahrain, Dubai, Oman, Qatar and Saudi Arabia). The two selected black swan events are the US Mortgage and credit crisis (Global Financial Crisis of 2008) and the COVID-19 pandemic.

Design/methodology/approach – The performance of all the six stock markets are represented by their return and price volatility behavior, which has been measured by applying ARCH/GARCH model. The comparative analysis is done by employing mean difference models. The data is collected from Bloomberg on a daily frequency.

Findings – The response of two black swan events on the GCC stock markets has been heterogenous in nature. During the financial crisis, the impact was heavily felt on most of the stock markets in the GCC countries. It is revealed that the financial crisis had a negative significant impact on four of the six countries. Whereas during the COVID-19 crisis, it is revealed that there is no significant impact on four of the six selected stock markets. The positive significant impact is felt on two stock markets, namely, the Abu Dhabi stock market and the Saudi stock market.

Originality/value – The present investigation attempts to fill the gap in the literature on the intended topic because it is evident from the literature on the chosen subject that no study has been undertaken to evaluate and contrast the impact of the GFC crisis and COVID-19 on the GCC stock markets.

Keywords Black swan, Stock markets, Volatility, GARCH model

Paper type Research paper

1. Introduction

In the past two decades, worldwide securities market has seen two paramount shocks—the global crisis of 2008 caused by subprime mortgage loans and the COVID-19 pandemic in 2020. Both crises witnessed devastating losses in stock markets. Studies reveal that during the period of crises, the stock market returns manifest extreme downturns (Kim, Shamsuddin, & Lim, 2011; Pesaran, 2015). This was the case during the Great Depression in 1929, the 1987 market crash (Sentana & Wadhwani, 1992) and the subprime mortgage crisis of 2008 (Longstaff, 2010). The flaring up of the COVID-19 illness stunned worldwide and sparked

JEL Classification — D53, G01, G15

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extraordinarily devastating vulnerability in the global economy and on the landscape of the financial markets.

Thus, the surge of COVID-19 displays an outer factor to the global financial framework, thus it is pertinent to examine the connection of this worldwide occurrence to the performance of the global stock market. It is evident from days of yore that occasional occurrences take place that no one anticipated or envisioned. These are the instances that leave all off-guard to a degree that make turmoil in the global milieu and unsettled human existence. These happenings are called black swans' events [1]. The occurrence of COVID-19 is a black swan too, as this exceptional happening led to a coordinated worldwide lockdown which restricted financial activities for a few months and shocked the financial market.

The financial after-effect of the unfamiliar (COVID-19) pandemic has brought to the front the necessity to recognize the current outbreak. The hypothetical reason for contemplating the outbreak of the current pandemic-stock connections lies in the contention that stock prices, returns and volatility react to noteworthy information news and macro-financial settings. Across all the countries, the stock market came smashing down with the ascent of the COVID-19. The entire global commerce witnessed the plummet. The business milieu around the globe smashed down to a level noted to the financial crisis of 2008. Multiple papers in finance concentrating on the short-range effect of the current pandemic on the stock market returns or volatility showcase the adverse effect (Mishra, Rath, & Dash, 2020; Phan & Narayan, 2020; Zaremba, Kizys, Aharon, & Demir, 2020).

Baker *et al.* (2020) recognized three prime ingredients for COVID 19 profound effect. Firstly, the speed of data dispersal is conceivable these days compared to the past. A subsequent clarification is a seriousness of the currently widespread and its suggestions for general well-being and the worldwide economy. The third reason is that the cutting-edge economy is attributed by reliance and simplicity of significant distance travel, low correspondence costs, low transportation costs and so forth, which has encouraged the spread of infection around the world. The escalation of volatility enhances the uncertainty and acts vulnerable to the dynamic operation of the stock market. In order to lessen, it is central to gauge with precision the volatility of the stock index returns. Thus, it is pertinent to add to the extant literature on the current theme. An autoregressive conditional heteroscedasticity model (ARCH model) was brought by Engle (1982) to specify attainable correlations of the conditional variance of the prediction error. Further Bollerslev (1986) furthered it to shape a generalized autoregressive conditional heteroskedastic model (GARCH model). In accordance with, this led to the development and enlargement of a GARCH family model.

Volatility is a vital theme in finance, it reveals the attribute of the financial assets and determines the investment behavior of individual and institutional investors. Multiple papers focusing on stock returns and volatility analysis have been structured on generalized autoregressive conditional heteroskedastic (GARCH) sorts of econometric modelling. Neokosmidis (2009) through the employment of ARCH, GARCH (1,1), EGARCH (1,1) multivariate volatility models examines the four prime US stock indices, namely, Dow Jones, Nasdaq, NYSE and S&P500. The study covers the data from March 2003 to March 2009. The study reports high volatility periods at the commencement and at the close of the covered time period for all the selected stock indices. Chen (2012) through the employment of GARCH models covers New York, London and Tokyo, Hong Kong, Shanghai and Shenzen from January 1993 to March 2010. The study reveals intermittent disintegration, revealing gainful for foreign investors.

Ghorbel and Attafi (2014) using the GARCH family models encompass MENA stock market Indices from 2007 to 2012. The study manifests that the region provides the prospects to the investors to spread their portfolio and minimize their level of risk aversion. Jebran and Iqbal (2016) apply the GARCH model to the daily frequency data of the Asian economies, namely,

Pakistan, India, Sri Lanka, China, Japan and Hong Kong from the time period January 1999 to January 2014. The study manifests two-way and one-way spillover through the stipulated markets. Rao (2008) employs MGARCH and vector autoregression (VAR) models on Arabian Gulf Cooperation Council equity markets data from February 2003 to January 2006. The study manifests volatility spillover and persistence in the stipulated markets. Of late, Chaudhary, Bakhshi, and Gupta (2020) investigate the impact of COVID-19 on the return and volatility of the stock market indices of the top 10 countries based on GDP employing the GARCH model. The study manifests daily negative mean returns for the selected market indices through the first half of 2020. The Pandemic indicator is detected to be positive and significant for all the purported stock market indices.

Of late, the prolongation of the coronavirus pandemic is a main source of financial volatility, perplexing the dynamic of global financial operations covering the stock markets too. Thus, it is pertinent to investigate the impact of black swan events on the Gulf Cooperation Council (GCC) stock markets. The prime motivation of the current study lies in the fact there is the paucity of studies investigating the performance of GCC stock markets (Balcılar *et al.*, 2015). In accordance with, we identified that less attention has been paid to GGC stock markets. Additionally, there is no empirical research on the black swan events on the stock market volatility in the GCC region. Truly, this empirical examination shall sanguinely assist the market partakers and policymakers to gain insightful information and acclimatize their investment strategies and economic and financial policies in the GCC region in the subsequent stressful milieu.

The current study centers on the six stock markets in the GCC region, namely, Bahrain, Oman, Qatar, UAE (Dubai, Abu Dhabi) and Saudi Arabia [2]. These economies have kicked off the economic diversification, focusing on spawning economic output from multiple sectoral areas, such as tourism and entertainment, so as to lessen the dependence on energy resources. Further, the foreign ownership restrictions have waned through multiple sectors and brought regulatory reforms covering the financial services and equity markets, to enhance the growth, thereby permitting opportunities for foreign participation.

Malik and Hammoudeh (2007) and Khalifa, Hammoudeh, and Otranto (2014) are the leading studies investigating volatility spillovers to the GCC. In sum, studies examining intra-regional volatility focusing GCC have laconically revealed that the potent of the UAE stock market and Saudi stock market occupying the center stage in the GCC landscape (Abraham & Seyyed, 2006; Alkulaib, Najand, & Mashayekh, 2009; Hammoudeh & Aleisa, 2004). Nevertheless, distinct from the current study, most earlier studies had only measured volatility during a specific time period. The purpose of this study is to examine the impact of the black swan events covering the US financial crisis in 2008 and COVID-19 on the stock market volatility in the GCC countries (Abu Dhabi, Bahrain, Dubai, Oman, Qatar and Saudi Arabia). The study purports this through the usage of the GARCH model. The objective of this study is to compute the effects of black swan events on stock market volatility in GCC countries. The study covers the effect of the two crises (COVID-19 and the financial crisis) on the GCC stock markets.

The rest of the study is systematized as follows. Section 2 covers the literature review on the impact of the black swan events (US financial crisis and COVID-19) on the multifarious stock markets. Section 3 encompasses the data and the empirical models covered. Section 4 incorporates the results interpretation. Section 5 covers the discussion and the findings of the study. Finally, Section 6 covers the conclusion and policy implications of the study.

2. Related literature review

Literature review on the impact of the black swan events (US financial crisis and COVID-19) on the multifarious stock markets.

2.1 US financial crisis and stock market

There are a multitude of studies highlighting the effect of the US financial crisis on the various stock market at global, regional and country levels. Brunnermeier (2009) reveals that the unprincipled economic system induced failure in the housing and mortgage market that intensified to a large extent leading to turbulence in financial markets. Thus, the severe financial market mayhem in 2007 brought substantial widespread market deterioration, defaults and credit crunch. Didier, Love, and MartínezPería (2012) highlight the drivers of comovement between US stock market returns and stock market returns in 83 economies. The study figured out that economies with susceptible banking and corporate areas display more comovement with the US market. Samarakoon (2011) covers the spread of US shocks to emerging markets on account of financial crises. The study reports significant two ways, yet asymmetric interconnection in the stipulated markets. Further, the frontier markets too manifest a link to the US shocks. Hwang, Min, Kim, and Kim (2013), through the dynamic conditional correlations (DCCs) of daily frequency stock returns of 10 emerging economies and USA from 2006 to 2010, reveal evidence of multiple forms of crisis spillover. The study unearths a set of factors enhancing and lessening the conditional correlations. Multiple studies cover the effect of the US financial crisis on the BRICS emerging markets.

Aloui, Aïssa, and Nguyen (2011) reveal the magnitude of the global crisis covering the extreme financial linkage of selected emerging markets (BRIC) with the USA. The study through the copula reports a significant level of dependence existence among the purported paired markets during the rising and falling markets. Bekiros (2014), through the multivariate GARCH, reveals that BRICs have become worldwide linked after the US financial crisis. Furthermore, the nonlinear causality is identified through the volatility effects. Mensi, Hammoudeh, Nguyen, and Kang (2016) through the bivariate DCC-FIAPARCH model, the modified ICSS algorithm and the Value-at-Risk (VaR) reveals that the emerging markets, namely, BRICS (Brazil, Russia, India, China and South Africa) were substantially impacted by the global financial crisis (GFC). The study reveals the formidable manifestation of asymmetry and the important dynamic link between the USA and the selected emerging stock markets. Syriopoulos, Makram, and Boubaker (2015), through a VAR (1)-GARCH (1,1) structure, unfold time-varying correlations and volatility spillover effects of the US stock market on BRICS (Brazil, Russia, India, China and South Africa) capital markets. Zhang, Li, and Yu (2013) bring to the fore that the financial crisis has escalated the BRICS stock markets' conditional correlation series with developed stock markets. Thus, the study reports cogent proof that the financial crisis has lessened the diversification gains over the long range. Jin and An (2016), through the volatility impulse response (VIRF), reveal that the GFC led to considerable contagion effects from US to BRICS stock markets. The study reports variance in the level of impact on each selected emerging market is conditional on the country's level of unification in the global economy. In addition to the above-mentioned studies, there is a set of studies covering the impact of the crisis on the bigwig emerging market economies. Assaf (2016) reveals evidence of the variance in the returns and volatility dynamics of MENA equity markets after the financial crisis of 2008. The study reports less demonstration of long memory after the turbulence period as compared to the period before the purported period. Dufrénot, Mignon, and Péguin-Feissolle (2011), through time-varying transition probability Markov-switching model, reveal the contagion spread from the US markets to Latin American stock market volatility. Burdekin and Siklos (2012) attest to the role of crisis in influencing the persistence of equity returns in the Asia-Pacific region and reveal evidence for contagion effects. Further, the study presents long-run connection between the US market and the purported markets. Kim, Kim, and Lee (2015), through multivariate GARCH models, put forward the spillover impact of the US financial crisis on selected emerging Asian economies. The study exhibits financial contagion and unfolds the central role of foreign investment for the conditional correlation in the worldwide equity markets.

Additionally, there are multiple studies covering the effect on the European zone. In line, Horta, Mendes, and Vieira (2010) reveal the contagion of the US subprime crisis to the European stock markets of the NYSE Euronext group. The study unfolds the possibility of spread on industrial sectors was well contemplated before it was noticeable to the real economy. Karunanayake, Valadkhani, and Obrien (2010) by utilizing a multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) model reveal escalated stock return volatilities across Australia, Singapore, the UK and the USA during the GFC. The study uncovers that the US stock market cardinally drives the volatiles in other stock markets. Barunik and Vacha (2013), through the wavelet technique, reveal the linkage between Central and Eastern European (CEE) stock markets and the German DAX at different frequencies. The study reports considerably decreased contagion between the purported markets after the substantial stock market decline in 2008. Tudor (2011) reveals the linkage among the six CEE stock markets and the USA stock exchange under the realm of GFC. The study manifests the time-variant linkages among the CEE stock markets with the US market.

Further, there are selected studies covering the impact of the crisis on the developed and emerging markets jointly. Aktan and Kopurlu (2009), through VAR techniques, investigate the connection between Brazil, Russia, India, China and Argentina (BRICA) and the US market. The study reveals the US market has a considerable influence on all the stipulated markets. Further, the impulse response test reveals that all the covered markets responded to the shock. Wang, Xie, Lin, and Stanley (2017) utilizing a multiscale correlation contagion statistic exhibit cross-market linkage through the US to G7 and BRIC economies. The study detects the stock market contagion hinges on the time scale and attributes of the receiving country.

2.2 COVID-19 and stock market

There are a set of studies forcing on the impact of COVID-19 on the US financial markets and other prime markets. In line, Baek, Mohanty, and Glambosky (2020), through a Markov Switching AR model, reveal that COVID 19 has a considerable influence on US stock market volatility. The study reveals the substantial intensification of total and idiosyncratic risk through all industries. Mazur, Dang, and Vega (2020) examine the impact of COVID-19 on the US stock market performance. The study reveals that natural gas, food, healthcare and software stocks fetched high positive returns, whereas stocks in petroleum, real estate, entertainment and hospitality sectors declined greatly and the losing stocks exhibit extreme asymmetric volatility that correlates negatively with stock returns. Albulescu (2021) examines the impact of COVID-19 on the financial market volatility in the USA. David, Inácio, and Machado (2021), through error correction terms (ECT) and vector error correction model (VECM), investigate the impact of COVID-19 on global prime stock exchange indices. The study reports that the pandemic considerably impacted the stipulated market. Similarly, there are multiple studies encompassing the effect of the current pandemic on the multifarious emerging markets. Ashraf (2021), through the daily data of COVID-19 confirmed cases and stock market returns from 43 countries, detects a decrease in stock market returns in reaction to 1% rise in the escalation of the confirmed cases is persistent for economies engulfed with greater country-level uncertainty aversion. Okorie and Lin (2020) examine the fractal contagion influence of the COVID-19 pandemic on prime 32 coronavirus-affected countries. The study reports the existence of the fractal contagion effect of the COVID-19 pandemic on the selected stock markets. Moreover, the study uncovers that the fractal contagion diminishes in the higher time horizon for the returns and volatility. Salisu, Sikiru, and Vo (2020) investigate the reaction of emerging markets as a result of the uncertainty of pandemics covering COVID-19 too. The study encompasses 24 emerging markets and utilizes

panel data tools. The study reports that the developed stock markets evinced better hedging attributes addressing the pandemic than the emerging markets. Further, there are studies covering the Asian markets and G 7 markets too. Topcu and Gulal (2020) reveal the impact of the current pandemic on the regional emerging markets. The study affirms that the effect of the episode has been devastating in the Asian emerging markets, while the emerging markets have encountered the most minimized. Further, the state stimulus packages have counterbalanced the impacts of the pandemic. Ramelli and Wagner (2020) analyze stock price reactions of US firms to the COVID-19 shock and argue that companies with any Chinese exposure experienced lower adjusted returns. Akhtaruzzaman, Boubaker, and Sensoy (2021) investigate the financial contagion between China and G7 countries during the COVID-19 pandemic. The study reveals a considerable rise in the conditional correlations between the purported stock returns, mainly in the financial-related companies. In a unique covering the US financial crisis and COVID-19, Shehzad, Xiaoxing, and Kazouz (2020), through Asymmetric Power GARCH model, reveal that the repercussion of COVID-19 on the USA, Germany and Italy's stock markets is more than the consequences of GFCs. Whereas the magnitude of GFCs is more considerably felt on the Nikkei 225 index and SSEC than COVID-19. Salman and Ali (2021) reveal the short-term detrimental impact of Covid-19 on the Gulf stock markets. Additionally, this study discovered that, in comparison to the effects on the global stock markets, the GCC stock markets are less impacted. Alkhatib, Almahmood, Elayan, and Abualigah (2022) seek to examine the link between COVID-19 cases and stock market points for all Gulf States. The study reveals that the stock markets of Bahrain and Kuwait are the most affected out of six gulf countries.

Chang, McAleer, and Wang (2020) disclose that investors were vulnerable to asset losses during the GFC, which raises the likelihood of herding activity in the stock market. But, during the COVID-19 pandemic, investors were stressed and liquidated their investments in an inappropriate manner. Gunay and Can (2022) present that compared to the GFC, the COVID-19 pandemic generated a more serious and transmission risk. Choi (2021) reveals that the real estate industry and the IT industry displayed poor efficiency during the GFC, whereas the efficiency of the materials sector was bad during the COVID-19 epidemic.

Through the literature review on the current theme, it is revealed that no study has been conducted to investigate and compare the impact of two crises (GFC and COVID-19) on the GCC stock markets, thus the current study endeavors to lessen the paucity on the purported theme. The examination of GCC stock markets during the two crises, therefore, may offer policymakers who supervise these venues with insights they can use to implement necessary policies and actions.

3. Empirical analysis

3.1 Research methodology

The basic objective of the study is to examine the impact of shocks on the volatility of the stock market in GCC countries, the empirical analysis is carried out through the GARCH model followed by various statistical techniques such as Descriptive Statistics, the Unit Root Test and the ARCH effect test. Two black swan events have been selected in the study, namely, GFC 2008 and COVID-19, hence, the whole analysis is divided into two parts according to the content of the subject matter.

The first part is related to the financial crisis and stock market volatility in the GCC countries, while the second part is related to the COVID-19 and stock market volatility in six GCC stock market indices, namely (Abu Dhabi, Bahrain, Dubai, Oman, Qatar and Saudi Arabia) are selected [2]. The market return has been calculated from the concern indices and volatility is measured from the return series with the help of the GARCH Model.

To examine the impact of black swan events on volatility, two dummy variables as exogenous volatility regressors have been generated for the two selected events. DUM1 for the event of the Financial Crisis 2008 as a dummy variable, while DUM2 for the event of COVID-19. The model has been extended by including two dummy variables separately. The dummy variable (DUMFC) for the financial crisis assumes a value of 0 for the pre-crisis period (before March, 2008) and 1 for the (after March 1, 2008). While, the dummy variable (DUMCO) for the COVID-19 period assumes a value of 0 for the pre-coronavirus period (before March, 2020) and 1 for the current coronavirus period (after March, 2020).

3.2 Data collection

The study dataset encompasses the daily closing prices from six GCC stock markets (Abu Dhabi, Bahrain, Dubai, Oman, Qatar and Saudi Arabia) [2]. All the variables were in US $ Dollars. All the data were collected from Bloomberg. Each purported index covers the performance of all the companies listed on the stock exchanges. The time period taken for the first part of the analysis is from October 1, 2007, to September 2008. Likewise, pre-financial crisis (October 1, 2007, to March 31, 2008) and during the financial crisis (April 1, 2008, to September 30, 2008). The time period taken for the second part of the analysis is from October 1, 2019, to September 2020. The selection of this period was done to incorporate both the pre-COVID period (October 1, 2019, to March 31, 2020) and the COVID period (April 1, 2020, to September 30, 2020). The considered period for this study will give a superior comprehension of stock markets' behavior.

3.3 Brief description about the variables

(1) SMRBHFC – indicates stock market returns of Bahrain for the financial crisis period, calculated from the Bahrain Bourse All Share Index, which is coded by the BHSEASI Index.

(2) SMRBHCV – indicates the stock market returns of Bahrain for COVID-19 period, calculated from the Bahrain Bourse All Share Index, which is coded by the BHSEASI Index.

(3) SMROMFC – indicates stock market returns of Oman for the financial crisis period, calculated from the Muscat Securities MSM 30 which is coded by MSM30Index.

(4) SMROMCV – indicates stock market returns of Oman for the COVID-19 period, calculated from the Muscat Securities MSM 30 which is coded by MSM30Index.

(5) SMRADFC – indicates stock market returns of Abu Dhabi (UAE), for the financial crisis period, calculated from the Abu Dhabi Securities Market, which is coded by the ADSMI Index.

(6) SMRADCV – indicates stock market returns of Abu Dhabi (UAE), for the COVID-19 period, calculated from the Abu Dhabi Securities Market, which is coded by ADSMI Index.

(7) SMRDBFC – indicates the stock market returns of Dubai (UAE) for the financial crisis period, calculated from the Dubai Financial Market DFMGI Index.

(8) SMRDBCV – indicates stock market returns of Dubai (UAE) for the COVID-19 period, calculated from the Dubai Financial Market DFMGI Index.

(9) SMRQTFC – indicates the stock market returns of Qatar for the financial crisis period, calculated from the Qatar Exchange Index which is coded by the DSM index.

(10) SMRQTCV – indicates the stock market returns of Qatar for COVID-19 period, calculated from the Qatar Exchange Index which is coded by the DSM index.

(11) SMRSUFC – indicates the stock market returns of Saudi Arabia for the financial crisis period, calculated from the Tadawul All Share Index which is coded by the SASEIDX Index.

(12) SMRSUCV – indicates the stock market returns of Saudi Arabia for the COVID-19 period, calculated from Tadawul All Share Index which is coded by the SASEIDX Index.

(13) DUMFC – the dummy variable for the financial crisis, a black swan event.

(14) DUMCO – the dummy variable for the COVID-19, a black swan event.

3.4 Order of the tests

The first problem with the time series is that it should be stationary. The ADF (unit root) test has been applied to check the stationarity of each time series. Another condition for the regression analysis is that the error term should not be autocorrelated. To confirm the autocorrelation, Ljung–Box Q statistics has been used. It is used for the test of residuals autocorrelation. If the residuals autocorrelation is significant, the AR model would not be using all available information.

The Ljung–Box test can be defined as follows:

H0. The data are random or no autocorrelation

Ha. The data are not random.

The test statistic is:

$$Q_{LB} = \left(n(n+2) \sum_{j=1}^{h} \frac{p^2(i)}{n-j} \right.$$

where n is the sample size, $r(j)$ is the autocorrelation at lag j, and h is the number of lags being tested.

Critical Region: The hypothesis of randomness is rejected if,

$$Q\_(LB) \; > \; \text{chi} - \text{square distribution} \left(x_1^2 - x, h \right))$$

where x^2 is the percent point function of the chi-square distribution.

The significance of the Ljung–Box test is decided by the p value in the analysis. When the p value is significant, it rejects the null hypothesis of no autocorrelation. To remove the autocorrelation problem, the models are re-estimated with the ARMA error. The coefficient of the AR (1) is the exact level of autocorrelation. The significance level is decided by p value.

To detect the problem of heteroskedasticity, Breusch–Pagan test/ARCH test has been applied with the null hypothesis (H0) that the errors are homoscedastic. In the condition of rejection of null hypothesis (p value is "0" or near "0"), White's heteroskedasticity consistent variance matrix has been applied to calculate the HC t-values and p values.

3.5 The generalized auto regressive conditional heteroskedasticity (GARCH) model

Engle (1982) was the first one to propose a model to explain time-changing variances and called it the Auto-Regressive Conditional Heteroskedasticity (ARCH) model. The main points behind an ARCH model are:

Mean corrected returns from an asset (that is an error term in the model) is serially uncorrelated but dependent.

Such dependence may be captured by a simple quadratic function of lagged error tems (ut) that is ARCH model. But a long lag structure could not be captured by the ARCH model. This problem was solved by Bollerslev (1986) by introducing GARCH process which allowed the conditional variance to be a function of prior period's squared errors as well as its past conditional variance. The GARCH process solves the problem naturally by allowing for long lags to be modeled. In the ARCH(q) process, the conditional variance is specified as a function of past sample variances only, whereas the GARCH (p, q) process allows lagged conditional variances to enter as well. The advantage of a GARCH model is that it captures the tendency in financial data for volatility clustering. It, therefore, enables us to make the connection between information and volatility explicit, since any change in the rate of information arrival to the market will change the volatility in the market (Singh and Karimullah, 2016).

A model with errors that follows a GARCH (1, 1) process is represented as follows:

$$Y_t = a + b_1 X_t + U_t \tag{1}$$

$$h_t = a + b_1 (U_{t-1})^2 + b_2 h_{t-1} \tag{2}$$

where h_t = conditional variance (sigma square)

Equation (1) is the conditional mean equation and (2) is the conditional variance equation.

$$U_t = \text{Error term}$$

The GARCH (1,1) framework has been extensively found to be most parsimonious representation of conditional variance that best fits many financial time series (Bollerslev, 1986; Bologna & Cavallo, 2002) and thus, the same has been adopted to model stock return volatility. The goal of such models is to provide a volatility measure – like a standard deviation – that can be used in financial decisions concerning risk analysis, portfolio selection and derivative pricing. The estimated GARCH model with Dummy Variables in this study will be,

For the first part of the analysis:

The Conditional Mean Equation

$$y_t = \mu + \lambda_1 \text{DUMFC}_t + e_t$$

Conditional Variance Equation

$$h_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}^2 + \delta_1 \text{DUMFC}_t$$

For the second part of the analysis:

The Conditional Mean Equation

$$y_t = \mu + \lambda_1 \text{DUMCO}_t + e_t$$

Conditional Variance Equation

$$h_t^2 = \omega + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}^2 + \delta_1 \text{DUMCO}_t$$

Therefore, in the conditional mean equation, a negative and statistically significant coefficient for the shocks period (financial crisis and COVID-19) would indicate a correlation between the shocks period and a reduction in the mean returns of the markets, while a positive and statistically significant coefficient would indicate a correlation between shocks period and an increase in the mean returns of the market. In the conditional variance equation, a negative and statistically significant coefficient for shocks period would indicate

a correlation between shocks period and a reduction in the volatility of the markets, while a positive and statistically significant coefficient for shocks period would indicate a correlation between coronavirus and an increase in the volatility of the market.

4. Results interpretation

4.1 The first part of the analysis: financial crisis and stock market volatility

Table 1 of descriptive statistics shows that the return data series do not follow a normal distribution. The mean and median as measures of central tendency and standard deviation, skewness and kurtosis measure variability.

Table 2 shows that all the return data series are Stationary (concluded according to the *p* values).

Table 3 shows that all the data series are serially correlated, hence the series have been re-estimated with AR method and then tested for autocorrelation.

Table 4 shows that after AR modification all data series are not autocorrelated.

Table 5 shows that the series consists of heteroscedasticity and detecting a significant ARCH effect (concluded according to the *p* values).

4.2 Result of GARCH model

Now all the conditions are in the favor of the GARCH model, as the return data series is stationary, no auto-correlated and heteroscedastic, hence we can apply the GARCH model.

Items/Variables	SMRSUFC	SMROMFC	SMRBHFC	SMRDBFC	SMRADFC	SMRQTFC
nobs	178.000000	178.000000	178.000000	178.000000	178.000000	178.00
NAs	0.0000000	0.00000000	0.000000	0.000000	0.000000	0.0000
Minimum	−9.873170	−7.686321	−2.553804	−15.176328	−6.286447	−12.503
Maximum	7.314166	7.141609	2.148790	10.470429	7.904133	6.5891
1. Quartile	−0.598848	−0.498641	−0.347099	−1.023210	−0.674552	−0.645
3. Quartile	0.970511	0.887675	0.415714	0.991769	0.865883	0.9959
Mean	0.071794	0.185618	0.033404	0.091153	0.116247	0.1266
Median	0.126777	0.320147	0.000934	0.051270	0.038471	0.040
Sum	12.779324	33.040056	5.945824	16.225148	20.691991	22.54
SE mean	0.144742	0.125559	0.047699	0.166699	0.111647	0.133
LCL Mean	−0.213847	−0.062167	−0.060729	−0.237820	−0.104083	−0.137
VCL mean	0.357435	0.433403	0.127536	0.420125	0.336578	0.390
Variance	3.729122	2.806171	0.404990	4.946346	2.218775	3.184
Standard Dev	1.931094	1.675163	0.636388	2.224038	1.489555	−1.784
Skewness	−0.819809	−0.332882	0.154001	−0.827002	0.522798	−1.6202
Kurtosis	5.256415	5.261987	2.410500	14.447029	7.188336	13.754

Source(s): Author's calculation

Table 1. Descriptive statistics (Financial crisis dataset)

Variables	*t*-Statistic	Prob.*
SMRADFC	−8.906894	0.0000
SMRBHFC	−15.33500	0.0000
SMRDBFC	−10.98849	0.0000
SMROMFC	−11.81065	0.0000
SMRQTFC	−13.02491	0.0000
SMRSUFC	−10.19045	0.0000

Source(s): Author's calculation

Table 2. Result of test for stationarity (Unit root test)

Table 6 shows that there is a significant impact of the financial crisis pandemic on Bahrain stock market volatility (p value shows significance). The negative sign of the dummy coefficient shows that the financial crisis has decreased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

Table 7 shows that there is a significant impact of the financial crisis pandemic on UAE stock market volatility (p value shows significance). The positive sign of the dummy coefficient shows that the financial crisis has increased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
D_ SMRBHFC	0.200287	0.033404	5.995835	0.0000
D_ SMRDBFC	0.200287	0.033404	5.995835	0.0000
D_ SMROMFC	0.278892	0.032833	8.494127	0.0000
D_ SMRQTFC	0.238196	0.032766	7.269542	0.0000
D_ SMRSUFC	0.343411	0.034421	9.976877	0.0000

Source(s): Author's calculation

Table 3. Result of autocorrelation financial crisis dataset

Variables	Coefficient	Std. Error	*t*-Statistic	Prob.
D_ SMRBHFC	−0.039220	0.008630	−4.544762	0.0000
D_ SMRDBFC	0.029956	0.004369	6.857098	0.0000
D_ SMROMFC	−0.008090	0.020198	−0.400549	0.0091
D_ SMRQTFC	0.087482	0.017248	5.072058	0.0000
D_ SMRSUFC	0.425021	0.037117	11.45079	0.0000

Source(s): Author's calculation

Table 4. Result of removal of autocorrelation of autocorrelation (by AR modification)

	Coefficient	Std. Error	*t*-Statistic	Prob.
Variable - SMRQTFC				
C	0.636743	0.210504	3.024857	0.0029
ARCH (−1)	0.49769	0.06577	7.567018	0.0000
Variable -SMRBHFC				
C	0.331557	0.070270	4.718353	0.0000
ARCH (−1)	0.175178	0.074451	2.352914	0.0197
Variable –SMRSUFC				
C	1.004363	0.337604	2.974973	0.0033
ARCH (−1)	0.570667	0.062242	9.168556	0.0000
Variable – SMRADFC				
C	1.827160	0.511586	3.571562	0.0005
ARCH (−1)	0.099297	0.075436	1.316308	0.1898
Variable – SMROMFC				
C	0.970498	0.250468	3.874748	0.0002
ARCH (−1)	0.393506	0.073149	5.379484	0.0000
Variable – SMRDBFC				
C	0.997223	0.327819	3.041991	0.0027
ARCH (−1)	0.381068	0.070108	5.435449	0.0000

Source(s): Author's calculation

Table 5. Result of test for heteroscedasticity (ARCH Effect)

Table 8 shows that there is a significant impact of the financial crisis pandemic on Oman stock market volatility (p value shows significance). The negative sign of the dummy coefficient shows that the financial crisis has decreased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

Table 9 shows that there is a significant impact of the financial crisis pandemic on Qatar stock market volatility (p value shows insignificance). The negative sign of the Dummy coefficient shows that the financial crisis has decreased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

Table 6.
Impact of financial crisis on Bahrain stock market volatility

Dependent variable: SMRBHFC Variables	Coefficient	Std. Error	z-Statistic	Prob.
C	−0.165014	0.123799	−1.332922	0.1826
D_SMRBHFC	0.512135	0.021845	23.44433	0.0000
DUMFC	−0.207684	0.054901	−3.782855	0.0002
ARCH (−1)	0.578548	0.261482	2.212576	0.0269
GARCH (−1)	−0.150733	0.045674	−3.300192	0.0010

Source(s): Author's calculation

Table 7.
Impact of financial crisis on Dubai stock market volatility

Dependent variable: SMRDBFC Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	−1.095744	0.276800	−3.958616	0.0001
D_SMRDBFC	0.557381	0.021410	26.03430	0.0000
DM	0.626693	0.238378	2.628992	0.0086
ARCH (−1)	1.209206	0.349585	3.458973	0.0005
GARCH (−1)	0.416240	0.067913	6.128997	0.0000

Source(s): Author's calculation

Table 8.
Impact of financial crisis on Oman stock market volatility

Dependent variable: SMROMFC Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.057785	0.037867	1.526005	0.1270
D_SMROMFC	0.534895	0.028802	18.57123	0.0000
ARCH (−1)	0.040896	0.069796	0.585943	0.5579
GARCH (−1)	0.756386	0.082109	9.211974	0.0000
DM	−0.830888	0.148683	−5.588319	0.0000

Source(s): Author's calculation

Table 9.
Impact of financial crisis on Qatar stock market volatility

Dependent variable: QATERPX_LAST Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	0.517624	0.107701	4.806119	0.0000
D_SMRQTFC	0.513137	0.018261	28.09986	0.0000
ARCH (−1)	1.736016	0.472333	3.675403	0.0002
GARCH (−1)	−0.089680	0.041223	−2.175473	0.0296
DM	−0.374553	0.069877	−5.360208	0.0000

Source(s): Author's calculation

Table 10 shows that there is a significant impact of the Financial Crisis pandemic on Saudi Stock Market Volatility (p value shows significance). The negative sign of the Dummy coefficient shows that the financial crisis has decreased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

4.3 COVID-19 and stock market volatility

Table 11 of descriptive statistics shows that the return data series does not follow a normal distribution. The mean and median as measures of central tendency and standard deviation, skewness and kurtosis measure variability.

Table 12 shows that all the return data series are Stationary (concluded according to the p value).

Dependent variable: SMRSUFC

Variables	Coefficient	Std. Error	z-Statistic	Prob.
C	1.140744	0.147270	7.745928	0.0000
D_SMRSUFC	0.541075	0.023678	22.85101	0.0000
ARCH (−1)	−0.161755	0.049105	−3.294084	0.0010
GARCH (−1)	0.210959	0.074082	2.847619	0.0044
DM	−1.056677	0.297029	−3.557490	0.0004

Source(s): Author's calculation

Table 10. Impact of financial crisis on Saudi stock market volatility

Items/Variables	SMRDBCV	SMRQTCV	SMROMCV	SMRBHCV	SMRSUCV	SMRADCV
Nobs	247.00	247.00	2.47	247.00	247.00	247.000
Minimum	457.94	2211.88	8.78	3266.29	1586.28	904.805
Maximum	779.517	2924.632	1.090	4426.26	2292.88	1427.90
1. Quartile	561.22	2499.70	9.15	3459.41	1935.72	1163.86
3. Quartile	742.64	2804.49	1.043	4049.17	2165.71	1378.77
Mean	634.87	2626.27	9.746	3815.211	2031.46	1246.68
Median	611.214	2664.02	9.425	3806.39	2069.92	1229.27
Sum	156813.43	648688.72	2.4075	942357.31	501771.93	307932.09
SE Mean	6.211	11.89	4.19	22.81	10.846	7.891
LCL Mean	622.63	2602.84	9.664	3770.271	2010.10	1231.144
UCL Mean	647.10	2649.69	9.82	3860.15	2052.82	1262.232
Variance	9528.98	34943.39	4.33	128583.99	29058.16	15383.24
Stdev	97.616	186.93	6.58	358.58	170.46	124.029
Skewness	0.070	−0.39	2.732	0.214301	−0.60	−0.263
Kurtosis	−1.472	−0.974	−1.58	−1.30	−0.542	−0.87

Source(s): Author's calculation

Table 11. Descriptive statistics (COVID-19 data set)

Variables	t-Statistic	Prob.*
SMRADCV	−4.300147	0.0006
SMRBH CV	−4.824059	0.0001
SMROM CV	−4.289190	0.0006
SMRQTCV	−8.377071	0.0000
SMRSU CV	−5.055786	0.0000
SMRDB CV	−3.286018	0.0167

Source(s): Author's calculation

Table 12. Test for stationarity (Augmented Dickey-Fuller test) COVID data set

Table 13 shows that there exists no autocorrelation for all the time series. (concluded according to the p value).

Table 14 shows that the series consists of heteroscedasticity as the null hypothesis of homoscedasticity is rejected. (concluded according to the p value).

4.4 GARCH model results

Now all the conditions are in the favor of the GARCH model, as the return data series is stationary, no auto-correlated and heteroscedastic, hence we can apply the GARCH model.

Table 15 shows that there is a significant impact of the COVID-19 pandemic on Abu Dhabi Stock Market Volatility (p value shows significance). The positive sign of the Dummy coefficient shows that the COVID-19 has increased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

Table 16 shows that there is no significant impact of the COVID-19 pandemic on Bahrain Stock Market Volatility (p value shows insignificance). However, the GARCH coefficient is significant which indicates volatility clustering in the market.

Table 17 shows that there is no significant impact of the COVID-19 pandemic on Oman Stock Market Volatility (p value shows insignificance). However, the GARCH coefficient is significant which indicates volatility clustering in the market.

Table 13. Result of autocorrelation (Breusch-Godfrey serial correlation LM test) test (See, separate file)

Variables	Coefficient	Std. Error	*t*-Statistic	Prob.
SMRBHCV	−0.006227	0.007236	−0.860646	0.3903
SMROMCV	0.003545	0.003625	0.977766	0.3292
SMRQTCV	−0.018579	0.017621	−1.054340	0.2928
SMRSUCV	0.013193	0.014834	0.889384	0.3747
SMRDBCV	0.017386	0.018475	0.941074	0.3476

Source(s): Author's calculation

Table 14. Result of test for heteroscedasticity (ARCH effect)

Variable	Coefficient	Std. Error	*t*-Statistic	Prob.
C	−7454.745	1752.568	−4.253612	0.0000
SMRBHCV	1.201128	0.293894	4.086940	0.0001
SMRADCV	−2.413692	1.303059	−1.852327	0.0452
SMROMCV	0.667015	0.226177	2.949087	0.0035
SMRQTCV	5.409243	0.805089	6.718814	0.0000
SMRSUCV	−3.423613	0.587744	−5.825011	0.0000
SMRDBCV	−12.03872	2.449346	−4.915077	0.0000

Source(s): Author's calculation

Table 15. Impact of COVID 19 on Abu Dhabi stock market volatility

Dependent variable: SMRADCV Variables	Coefficient	Std. Error	*t*-Statistic	Prob.
SMRADCV (−1)	−0.105868	0.069930	−1.513913	0.1300
ARCH (−1)	0.373249	0.074633	5.001125	0.0000
GARCH (−1)	0.630099	0.047162	13.36019	0.0000
DUMCO 01	0.000860	0.000837	1.027256	0.0043
C	0.000485	0.000193	2.513332	0.0120

Source(s): Author's calculation

Table 18 shows that there is no significant impact of the COVID-19 pandemic on Qatar Stock Market Volatility (p value shows insignificance). However, the GARCH coefficient is significant which indicates volatility clustering in the market.

Table 19 shows that there is a significant impact of the COVID-19 pandemic on Saudi Stock Market Volatility (p value shows insignificance). The positive sign of the Dummy coefficient shows that COVID-19 has increased the volatility in the market. The GARCH coefficient is significant which indicates volatility clustering in the market.

Dependent variable: SMRBHCV

Variables	Coefficient	Std. Error	*t*-Statistic	Prob.
SMRBHCV (−1)	0.184207	0.098997	1.860722	0.0628
ARCH (−1)	0.271010	0.081288	3.333939	0.0009
GARCH (−1)	0.638311	0.082527	7.734544	0.0000
DUMCO 01	0.000333	0.000765	0.434884	0.6636
C	6.16E−06	1.73E−06	3.561914	0.0004

Source(s): Author's calculation

Table 16. Impact of COVID-19 on Bahrain stock market volatility

Dependent variable: SMROMCV

Variables	Coefficient	Std. Error	*z*-Statistic	Prob.
SMROMCV (−1)	0.345686	0.109382	3.160346	0.0016
ARCH (−1)	0.299889	0.104060	2.881887	0.0040
GARCH (−1)	0.650423	0.107837	6.031560	0.0000
DUMCO 01	0.000389	0.000898	0.432874	0.6651
C	5.73E−06	2.20E−06	2.602948	0.0092

Source(s): Author's calculation

Table 17. Impact of COVID-19 on Oman stock market volatility

Dependent variable: SMRQTCV

Variables	Coefficient	Std. Error	*z*-Statistic	Prob.
SMRQTCV (−1)	0.037689	0.086238	0.437035	0.6621
ARCH (−1)	0.211652	0.045631	4.638363	0.0000
GARCH (−1)	0.749784	0.048368	15.50158	0.0000
DUMCO 01	0.001737	0.001126	1.542549	0.1229
C	5.32E−06	1.85E−06	2.878625	0.0040

Source(s): Author's calculation

Table 18. Impact of COVID-19 on Qatar stock market volatility

Dependent variable: SMRSUCV

Variables	Coefficient	Std. Error	*z*-Statistic	Prob.
SMRSUCV (−1)	0.102698	0.090474	1.135100	0.2563
ARCH (−1)	0.427316	0.058374	7.320321	0.0000
GARCH (−1)	0.627504	0.044829	13.99785	0.0000
DUMCO 01	0.002914	0.001241	2.349078	0.0188
C	7.77E−06	4.01E−06	1.939292	0.0525

Source(s): Author's calculation

Table 19. Impact of COVID-19 on Saudi stock market volatility

Table 20 shows that there is no significant impact of the COVID-19 pandemic on UAE Stock Market Volatility (p value shows insignificance). However, the GARCH coefficient is significant which indicates volatility clustering in the market.

The overall finding suggests that there is volatility clustering in all the stock markets for both crisis periods but differ in terms of the impact of the two black swan events. The volatility of all the stock markets is significantly affected by the global financial crises. While there are only two stock markets, namely, Qatar and Saudi, having a significant impact of COVID-19 on their volatility.

5. Discussion and the findings

The study examines the impact of two black swan events (financial crisis of 2008 and the COVID-19 pandemic) on the performance of six stock markets in GCC economies (Abu Dhabi, Bahrain, Dubai, Oman, Qatar and Saudi Arabia). It is worth noting that the response to two black swan events on the GCC stock markets have been different in nature.

During the financial crisis of 2007–2008, the impact was heavily felt on most of the stock markets in the GCC countries. It is revealed the financial crisis had a negative significant impact on four of the six countries manifested. In an isolated occurrence, there was a positive significant effect of the crisis on Dubai stock market. Whereas during the COVID-19 crisis, it is revealed that there is no significant impact of the current pandemic on four of the six stock markets selected under the study. The positive significant impact is felt on two stock markets, namely, Abu Dhabi stock market and the Saudi stock market.

Investigating the impact of both crises on each stock market exclusively, it is perplexing to note that each stock market responded differently to each crisis. Thus, it can be laconically summarized that the two black swan events led to heterogeneity of response of the GCC stock markets.

This type of result reflects an important point that in the financial crisis, information technology spread the news about market failures hence created a fear and uncertainty among the investors which affected the volatility, while at the time COVID-19 due to ICT, the investors were able to maintain the transaction and settlement of the securities, hence less affected by the COVID pandemic. Thus, while pursuing for green pasture in the GCC region, it is pertinent to note that there is the existence of heterogeneity traits in the volatility behavior of the individual GCC stock market. Though all the GCC markets are dependent, primary on the natural resource, but they are distinct in their economic settings.

Practical Implications: This study provides great learning about the psychological thinking of investors towards risk. In the time of GFC, the investors were feared market uncertainty so they were not investing their money, while during the period of COVID-19, the investors were not feeling risk like financial crisis. On the other hand, the stock market gave better options to the investors to invest at the time of the pandemic period when the opportunity for investment was shrinking in the other sectors of the economy. The second implication is that the current pandemic gave the realization to the countries that making

Table 20. Impact of COVID-19 on UAE stock market volatility

Dependent variable: SMRDB CV				
Variables	Coefficient	Std. Error	z-Statistic	Prob.
SMRDBCV (−1)	0.144757	0.081337	1.779717	0.0751
ARCH (−1)	0.288145	0.081617	3.530458	0.0004
GARCH (−1)	0.686744	0.056017	12.25965	0.0000
DUMCO 01	0.000295	0.001409	0.209379	0.8342
C	1.12E−05	3.75E−06	2.982472	0.0029

Source(s): Author's calculation

investment in the area of information and communication technology is the need of the hour, because of ICT expansion the markets were able to function even in the time of such panic stage in a pandemic. Further, implication of the study is that a similar study can be conducted in other countries as well as other sectors (oil and gas, service sector, foreign trade, so on) of the economies, particularly in the Gulf region, which would provide a better understanding of the impact of these two crises having distinct features. The study leads to further research based on a primary survey having the opinion of the investors about their perspectives on investment during the period of COVID-19. Hence, the findings suggest volatility clustering, another study can be conducted to analyze the stage of asymmetric information using an extension of the GARCH model among the economies. We have found the same nature of the impact of the financial crisis, so the finding suggests to examine stock market integration among the GCC economies.

6. Conclusion and policy suggestions

The current study explores the impact of two black swan events on the performance of six stock markets in GCC economies based on the daily data from Bloomberg. The study employed the ARCH/GARCH model. It is evident through the study that the response to two black swan events on the GCC stock markets has been different in nature. Thus, there is the pertinent implication for the market participants and policy makers. From an investment and portfolio designing point of view, the investors have to keep the variant response of GCC stock markets in consideration. Global investors have to consider the significant heterogeneity attributes of the region. Though the GCC economies have multiple factors in common, there are distinct settings on account of their level of dependency on natural resources and the pace of economic reforms. The prime reason for this variegation is due to the pace of structural reforms, policy action toward economic stability and their dependence on the oil earning. The current pandemic gave the realization to the countries that making investments in the area of financial technology is the need of the hour. There is an emergent sanguinity among the financial market institutions to escalate their ICT outlays. In line, the GCC economies have to prepare with a high level of connectivity infrastructure in order to minimize the negative economic impact of COVID-19.

Notes

1. Taleb (2007).
2. On account of restructuring and related issues in Kuwait stock market, Kuwait stock market is not part of the study.

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