



Do Vaccines' Announcements Cure Stock Market Volatility? Evidence From the Gulf Cooperation Council (GCC) Markets

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ABSTRACT

COVID-19 has been impacting stock markets worldwide. Yet, a scant amount of research has been done on the stock markets of the Gulf Cooperation Council (GCC) markets. In this work, we aim to investigate whether and to what extent local and international events linked to the COVID-19 outbreak have impacted stock market volatility of the GCC countries. We model stocks' returns of these countries between January and December 2020, decomposing the errors' heteroskedasticity to account for main international and local events related to COVID-19. These events have been included as structural breaks and measured using dichotomous variables. Both local and international events were found to be associated with significant variations in volatility; however, local events seem to have impacted volatility to a lesser extent compared to international events. The announcement of the status of pandemic by the WHO had the greatest impact on volatility across the GCC markets, even greater than the impact associated to the drop in oil prices. The announcement of local approval of vaccine led to a reduction in volatility in UAE (ADX), Qatar, Saudi Arabia and Bahrain.

JEL Classification: C32, G14, G15

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INTRODUCTION

As the coronavirus (COVID-19) started spreading all over the world, equities tumbled and market volatility sky-rocketed responding to the uncertainty created by the crisis, with stock investors quickly foreseeing a severe global recession building up in the horizon. Mass-scale shut down of the economies ordered by the governments to protect their populations from the virus disrupted production, supply chains¹, labor mobility, and, more broadly, different aspects of life (Phan and Narayan, 2020) including heightened anxiety (Mann et al 2020), with low-income earners being affected the most (Shibata, 2020). The stock markets appeared to have immediately responded to the uncertain future of business and economic activities displaying severe volatility (Zhang et al 2020), with investors' panic and lockdowns playing a major role (Aggarwal et al., 2020).

Petroleum (oil), real estate, entertainment and hospitality stocks experienced a dramatic fall in March 2020 (Mazur et al., 2020). For Gulf Cooperation Countries (GCC), in addition to the spread of COVID-19, sudden oil price fluctuations also heightened risks for investors, as expected (Alqahtani et al., 2019). The rise in COVID-19 cases led to the substantial reduction of travel demand. For instance, in the UAE, where tourism represents a major component of the GDP, a reduction of 82% of scheduled departing flights was observed (Aburumman, 2020). Furthermore, the 2020 Dubai Expo, which had been seen as a key driver for growth in the UAE in 2020 (Nadkarni, 2019), had to be postponed to 2021. Besides energy, air travel and tourism, the entertainment and manufacturing sectors were also impacted significantly (KPMG, 2020).

The current severe economic downturn faced by the GCC countries², the USA, and other countries is caused by an initial negative supply shock further exacerbated by a demand shock due to rising unemployment linked to lockdowns (Boskin, 2020). Financial markets internationally, as expected, have reacted to these shocks (Harjoto et al., 2021). If we consider the recessions that occurred in the past including the great depression of the 1930s, we find that events in the financial markets played a significant role. The great depression originated from the collapse of the stock markets in major economies. Similarly, the recession of 2007-2009 started in the USA with the collapse of the mortgage-backed securities which quickly spread to other countries (Fernando et al., 2012; Akyüz, 2011), including countries in the GCC region. Earlier in 2001-2002, the dot-com bubble burst led to a recession in the USA and in many other countries worldwide (Kraay and Ventura, 2005).

Whilst we can notice similarities with other major negative economic shocks, it appears that the number of cases, governments' announcements of measures, such as lockdowns or curfew, impacted financial markets' performance and volatility. There are, in this sense, pandemic-specific shocks. In this work we will focus on assessing how the local GCC financial markets were impacted by the outbreak of the virus, as well as by the measures taken by the governments locally and internationally. Although we are focusing on the GCC countries, we also include data from the US market (S&P 500) and Bitcoin for comparative purposes. Whilst previous research has investigated impacts of COVID-19 on stock market volatility, very little research has focused on the GCC markets; furthermore, this study considers data encompassing the whole 2020, allowing to assess impacts of key announcements or policies released later in the year. We will assess innovatively the impact of vaccine's announcement on emerging stock market volatility.

The remainder of the paper is structured as follows: section 2 reviews the recent literature that link between COVID-19 and stock market volatility; section 3 discusses the data and the methodology; section 4 presents the main local and international events, section 5 presents the empirical results and, finally, section 6 provides summary and concluding comments.

LITERATURE REVIEW

On the Black Monday 9th March 2020, the global stock markets posted their steepest falls since the 2008 financial crisis. The uncertainty of the pandemic caused a significant increase in global financial market risks

¹ Even to a greater extent if compared to the 2008 financial crisis according (Yagi and Managi, 2021).

² Substantial reductions of GDP are estimated for GCC countries, with long time needed to recover. In Kuwait, the contraction of real GDP for 2020 is estimated to be close to 8%, even worse at 9% in Oman, whereas it is estimated at 7% in Saudi Arabia, 6% in Bahrain and UAE, and much less in Qatar (2%) (Bloomberg, 2020; World Bank, 2020; MFNE, 2020).

and volatility (Al-Thaqeb et al., 2020). Both the infected cases and the fatality ratio in the US and worldwide had a significant effect on the S&P 500 volatility; moreover, the persistence of the COVID-19 crisis seems to amplify both the US and global financial markets' volatility thereby representing unprecedented challenges in terms of risk management (Albulescu, 2020). The US government took actions in March such as lowering the federal funds rate in the range of 0-0.25 basis point, purchasing treasury securities and lowering costs of discount lending. In addition, non-monetary policies initiated by the governments, such as public events cancellations and information campaigns seem to have had a significant impact on the international stock market volatility (Zaremba et al., 2020).

When focusing the case of the US, it has been found that markets behaved differently according to the sector: software companies, natural gas, food, and healthcare sectors were found to perform positively, while hospitality, entertainment, crude petroleum, and real estate plummeted considerably (Mazur et al., 2020). Differences in sectors, in terms of market performance, have been also found internationally, with business equipment and automobiles industries showing a decrease in systematic risk, whereas industries such as utilities and telecom did show an increase in systematic risk (Baek et al 2020). More niche sectors, such as social entrepreneurship funds, displayed a greater level of resilience (Mirza et al., 2020)³. The gold market also showed a resilient performance (Salisu, 2021), outperforming Bitcoin (Dutta et al., 2020).

As COVID-19 spread all over the world, equities fell and the markets experienced severe volatility in March 2020 (Seven and Yilmaz, 2021); in this same month, adverse effects on liquidity of debt markets peaked too in emerging markets (Gubareva, 2020). Empirical research has been documenting the effects of short-run COVID-19 outbreaks on market volatility. Zhang et al. (2020) analyzed how the coronavirus pandemic impacted stock market volatility and risk in a number of developed countries, and assessed the initial policy response in some of these countries. They suggested that whilst unconventional policies might be needed, these might add further uncertainty to an already unstable situation. They also showcased how the pandemic has had a major impact on volatility, starting with China in February and then in the US in March. Additional research has shown that COVID-19 cases and deaths seem to have impacted stock returns, trading volume, and volatility in emerging markets, whereas the number of cases alone is a key factor for developed markets. It also appears that markets tended to over-react during the first rising phase, pre-April (Harjoto et al., 2021). The most affected markets seem to be the Asian markets, followed by the South America and Middle East markets (Topcu and Gulal, 2020).

Research has investigated the impact of COVID-19 on financial markets, for instance in Malaysia (Abada and Nizar, 2022), China (Sen-Liew, 2020), and on specific sectors (Gurrib, 2021). Of particular interest for this work is previous research on emerging markets. In the literature it has been argued that emerging markets usually more prone to higher volatility due to local rather than international events (Aggarwal et al., 1999; Todea and Trodescu, 2012; Elsharief and Kabir, 2017), whereas Hammoudeh and Li (2008) found the opposite for Gulf Cooperation countries. In this study, we aim to assess whether and to what extent international and local events linked to the spread of COVID-19 have impacted the volatility of stock markets returns among GCC countries. To the best of our knowledge, no assessment of modeling the impact of both sudden volatility changes and vaccine's announcements on emerging stock markets has been so far conducted⁴.

METHODOLOGY

Data

Coronavirus confirmed cases for GCC countries are obtained from the European Centre for Disease Prevention and Control (<https://www.ecdc.europa.eu/en>). GCC equity markets data, as well as Bitcoin data, were downloaded from Investing.com (Investing.com, 2020). Crude oil price was also retrieved from Investing.com. Furthermore, we consider Google trends data⁵ (Google, 2021) with regards to the search of the

³ The gaming and eSports industry also showed a good performance during COVID-19 (López-Cabarcos et al., 2020).

⁴ Yet, there is research focusing on Gulf markets, prior to COVID, such as in Lai et al. (2019).

⁵ Google trends data is scaled on 0-100 points, with data points considered relative to the volume of searches in a given location and the time considered (Google, 2021). As in the Google Trends platform it is only possible to run a maximum of five queries at the same time, and given that in this study we consider eight countries, we repeated the searches three times, each time excluding one country, and averaging out the data points for countries considered more than once in the search.

topic ‘Coronavirus’, to visualize interest towards COVID-19 over time vis-à-vis the number of cases reported. The time period considered spans from January 2020 until December 2020. Table 1 details the indices of different countries.

Table 1 Indexes used in this study, by country

Country	Index	Observations
UAE (Dubai)	DFM	250
UAE (Abu Dhabi)	ADX	250
Bahrain	Bahrain All share	244
Oman	MSM 30	244
Kuwait	FTSE NASDAQ 15 Kuwait	207
Qatar	QE All share	248
Saudi Arabia	Tadawul All share	250
US	S&P 500	253
/	Bitcoin	364

Empirical Model

We analyze the volatility of returns by specifying an EARCH model including autoregressive components, and further decomposing heteroscedasticity as a function of specific time intervals to model volatility breaks (Harvey, 1989; Davidson and MacKinnon, 1993; Becketti, 2013). GARCH and EGARCH specifications were also tested but did not lead to gains in models’ fit.

The growth in daily prices, denoted as r_t , was derived applying the following logarithmic transformation:

$$r_t = \log(p_t/p_{t-1}) \quad (1)$$

where p_t represents the current price or price at time t , p is the price from the previous day and, Furthermore, the return at time t (r_t) is modelled as a function of a constant effect β_0 , end error term at time t , e_t :

$$r_t = \beta_0 + \beta_1 h_t + \varphi r_{t-1} + e_t \quad (2)$$

where the variance (h_t) at time t of the error term is given by:

$$h_t = \alpha_1 e_{t-1}^2 + \gamma_1 h_{t-1} + \exp(\delta_0 + \sum_i^k \delta_i X_i) \quad (3)$$

X_i represents a set of K variables to model the impact of international and local events, including the announcement of vaccine, on emerging markets’ volatility. This specification of the conditional variance follows Judge et al. (1985). The international and local events considered are discussed in section 4. They are all included as binary variables, with 5 observation days before and after the event, as well as the day of the event or the closest date available, taking value 1, 0 otherwise. We are aligned to an event-study approach of investigation previously used in the relevant literature (Buigut and Kapar, 2020). As stated earlier, after initial estimation, it was found no improvement in goodness of fit or significant impact of GARCH and GARCH in mean effects, so in the final models we have set $\beta_1 = 0$ and $\gamma_1 = 0$. The model for which we show the results, as presenting an overall better goodness of fit, follows the EARCH approach, following Nelson (1991), according to which equation (3) is modified to include the following effects:

$$\ln(h_t) = \gamma_1 h_{t-1} + \exp(\delta_0 + \sum_i^k \delta_i X_i) + \alpha_{11,1} z_{t-1} + \gamma_{11,1} (|z_{t-1}| - \sqrt{2/\pi}) \quad (4)$$

where $z_t = (e_t/\sqrt{h_t})$ ⁶. Even in this case we set we have set $\beta_1 = 0$ and $\gamma_1 = 0$ following initial estimations indicating no improvement in log-likelihood or lack of significance of parameters. Model estimation was performed with the software STATA; the code is available upon request.

⁶ More effects can be included associated with z_{t-2} , z_{t-3} , etc. as appropriate. We tested model specification for each country focusing on goodness of fit and significance of coefficients.

COVID-19: CASES, INTERNATIONAL AND LOCAL EVENTS INCLUDING VACCINE ANNOUNCEMENTS

COVID-19 Cases

WHO declared the presence of a global emergency on January 31st. More than a month later, on March 11th (beginning of week 7, 2020), the status of pandemic was officially announced (Mirza et al., 2020). At that time, the epicenter of the virus had moved from China to Europe, with Italy having recorded 132 cumulative cases in week 8 of 2020, then soaring to 1689 in week 9 and 7375 in week 10. When cases were starting to rise exponentially in Italy, the number of cases in the GCC was still low, with the highest number of cumulative cases by week 8 registered by the UAE, albeit with just 13 cases. In Figure 1 we present the weekly average of cases registered for the whole 2020 across Italy, US, UAE, Saudi Arabia, Kuwait, Qatar, Bahrain, and Oman. For comparative purposes, we scaled the number of cases taking into account the populations' size. Relevant data is shown in Table 2. In this table we also present key information in terms of cumulative cases and deaths by the countries considered. It is also worth noting that these are the cases officially reported based on the testing conducted: they should be seen as an estimate due to potentially unreported or undetected cases.

It can be noticed that COVID-19 has impacted GCC countries differently. In relative terms, Qatar was the country most heavily hit in terms of cases. It however registered the lowest absolute number of reported deaths in the GCC, whereas the highest number was reported by Oman, which in contrast showed a relatively lower number of cases. In Oman we find the highest value of the mortality rate (1.16%), whereas much lower is the analogous statistic for Qatar (0.17%), UAE (0.33%), Bahrain (0.38%), Kuwait (0.62%); remarkably, all GCC countries display mortality rates due to COVID-19 lower than US (1.74%) and Italy (3.51%). This is, however, information that at the beginning of the pandemic was highly uncertain, with great variation observed between countries (Liang et al., 2020). It is also worth noticing that at the start of the pandemic, the number of tests conducted to detect cases in the GCC, and in other parts of the world, was relatively low, whereas it later caught up to be amongst the highest in the world as far as the UAE and Bahrain are considered (OWD, 2021).

The increase in international COVID-19 cases, coupled with the uncertainty in terms of mortality rates, prompted all GCC countries to undertake substantial health-related measures. At first, these measures were focused around preventing or limiting the spreading of the virus from other countries, by means of significant travel restrictions and quarantine measures. Travel restrictions started, around February 2020, with a focus on countries more affected by the virus at the beginning of 2020, such as Italy and China, and were later extended to a great deal of countries (Amankwah-Amoah, 2020; Devi, 2020). This had major impacts, in the short term, for the airline sector, prompting government support (Abate et al., 2020).

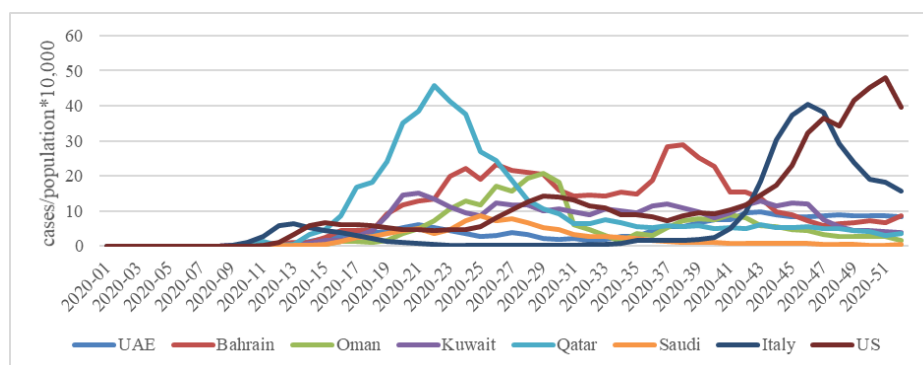


Figure 1 Covid-19 cases across Italy, US, and GCC countries

Table 2 Covid-19 cumulative cases and deaths by country

Country	Cum. Cases 8th week	Cum. Cases 16th week	Cum. Cases 52th week	Cum. Deaths 52th week	Population
US	35	759,687	19,151,651	333,326	331,002,647
Italy	132	178,972	2,047,696	71,925	60,359,546
UAE	13	6,943	201,836	657	9,890,400
KUWAIT	3	1,915	149,653	931	4,270,563
QATAR	0	5,448	143,062	244	2,881,060
OMAN	0	1,266	128,472	1,495	5,106,622
BAHRAIN	1	1,873	91,733	351	1,701,583

Source: European Centre for Disease Prevention and Control (ECDPC 2021)

As the virus continued to spread internally, since March 2020 GCC countries started to implement curfews (partial and total in some instances such as in Kuwait), to limit residents’ time outside of their house and the chances of interacting with other people. At the same time, educational establishments were closed, and education activities moved to a distance-learning mode. Additionally, non-essential government agencies were closed, and operations moved to digital as much as possible. Also, religious practices outside of home were discouraged or prohibited. Curfews, in limited areas or country-wide, were mandated across the GCC countries: Qatar (20 March), Kuwait (March 22), Saudi Arabia (March 23), Bahrain (March 24), UAE (March 26), Oman (April 10). Non-essential services, such as the entertainment and leisure, started to be heavily hit from this time (HWF, 2020).

COVID-19 Cases and Google Searches

Unsurprisingly, in March people googled more and more about the virus. Among all Gulf countries, Google searches of the term ‘Coronavirus’ peaked in mid-March 2020 (Figure 2), ahead of the spread of the virus in the Gulf (Figure 1). Searches in Qatar had also a second peak on week 21, at the same time the number of Covid-19 cases spiked in the country. For the US as well, the peak of searches was registered in March. Instead, when considering the case of Italy, the volume of searches peaked during the second wave of coronavirus cases in the country towards the latter half of the year⁷. As shown in Figure 3, when considering the whole 2020, there is a substantial positive correlation between the cases and the google trend index values for Italy (0.66) and the US (0.43). Amongst the GCC countries, it can be observed a positive correlation when considering Qatar (0.34), and to a much lower extent as far as Saudi Arabia and the UAE are concerned (0.09). In the first part of the year, however, correlation was much stronger across all countries considered, with the exception of Saudi Arabia. This appears to point towards a strong interest in the GCC at the beginning of the pandemic, which substantially decreased in the remainder of the year and decoupled from the number of cases.

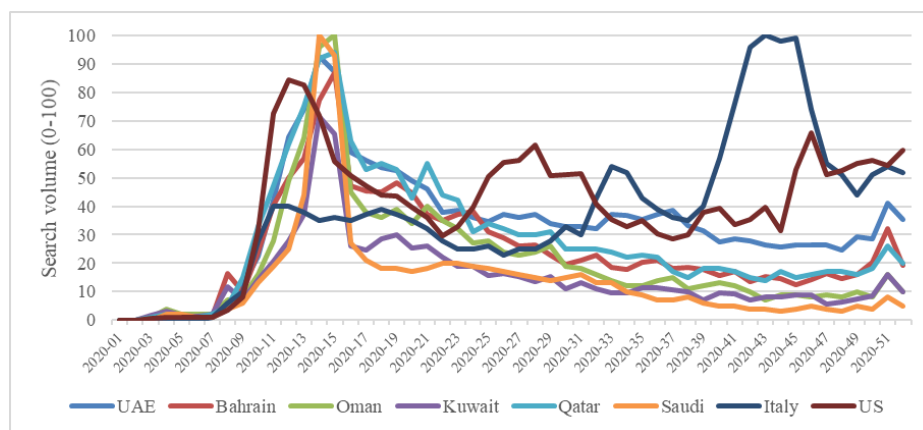


Figure 2 Google searches of ‘Coronavirus’ (Google trends index)

⁷ Costola et al. (2020) had previously shown how Google Trends Index searches were particularly connected with stock markets in Italy. Smales (2021) suggests that Google Trends Index searches seems to be a proxy of investors’ attention especially for the retail sector.

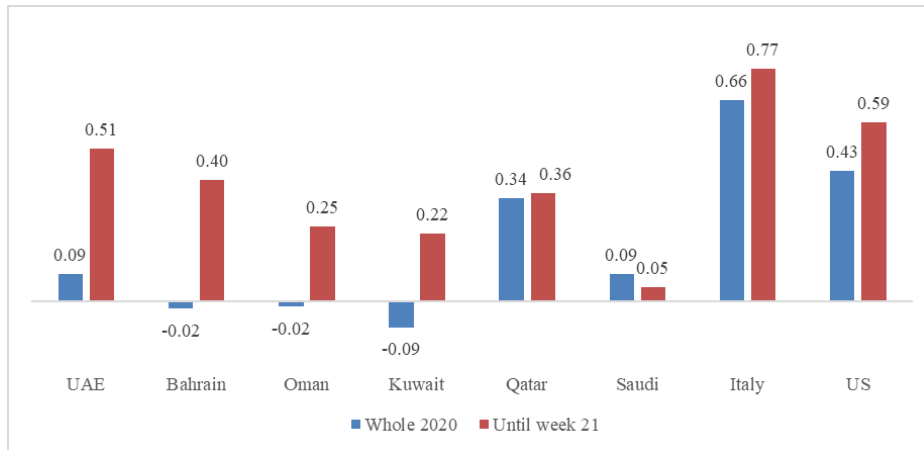


Figure 3 Correlation between cases and Google trend data

Major Events

Major economic stimuli were approved in the GCC countries shortly after the pandemic hit the region. For instance, Saudi Arabia announced on March 14th a stimulus of 50 billion Ryals to support the private sector; Bahrain, on the 17th of March, declared a stimulus of over 11 billion USD; and the UAE approved a 16 Billion AED package to support business continuity on March 22nd.

Around June, also to support business continuity, most GCC countries begun reducing/removing curfews: Bahrain (May 23rd), Kuwait (1st June), Qatar (15th June), Saudi (21st June), UAE (June 24th), Oman (July 3rd). Earlier in March, prices of Crude oil started precipitating (Figure 4) due to a price cut influenced by Saudi Arabia (Bloomberg, 2020b). This is a major event, representing a second negative shock for GCC economies (World Bank, 2020), especially more concerning as happening after the start of the COVID-19 crisis (Sakurai and Kurosaki, 2020; Salisu et al., 2020). In terms of oil production per capita, among GCC countries Kuwait topped the ranking in 2019, followed by Qatar, UAE, Saudi Arabia, Oman and Bahrain (EIA, 2018; OWD, 2019).

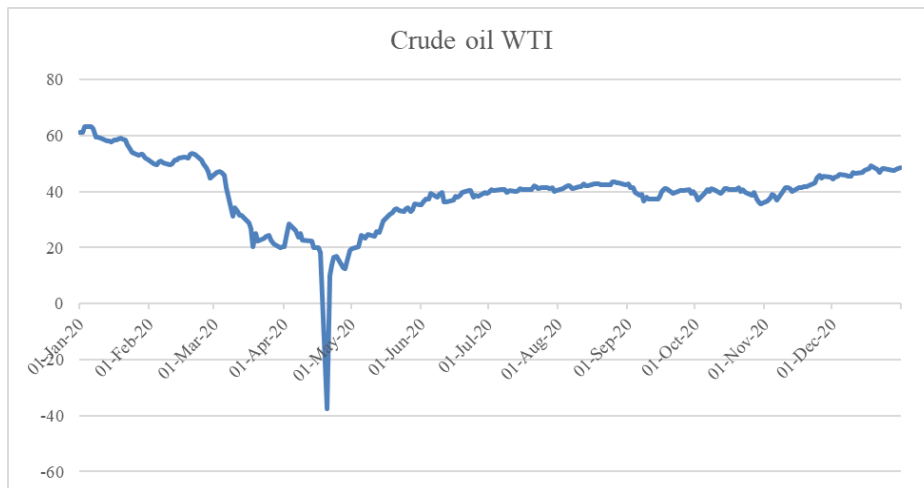


Figure 4 Price of crude oil WTI

News of promising results from vaccine trials started to be released in November 2020, with first approvals for the use of vaccines reached in December. A first good news was made public on November 9th with regards to the Pfizer-Biontech vaccine (Pfizer, 2020) claiming 90% efficacy; then, on November 23rd, a similar press release was given by AstraZeneca (AstraZeneca, 2020), claiming a 70% efficacy. Later, on December 9th, it was announced that the Chinese vaccine producer Sinopharm had reached an 86% level of efficacy (FT, 2020). The Pfizer vaccine was then approved for use in Bahrain (December 4th), Saudi (December 10th), Kuwait (December 13th), Oman (December 15th), Qatar (21st December), UAE (December 22nd). The UAE had approved earlier in December (December 9th) the use of the vaccine Sinopharm which had been tested in the UAE as well. It appears interesting to assess whether the simple announcement of

discovery of a vaccine is enough for the market to positively react, as logistics, procurement and distribution challenges might greatly slow down the vaccination campaigns (Mills and Salisbury, 2020). The main events considered, local and international, are displayed in Table 3 below. We do not consider the economic stimuli announced in March as closely overlapping with the declaration of the status of pandemic.

Table 3 List of main international and local events

Country	WHO declares emergency	WHO declares pandemic	First local COVID-19 case	First local COVID-19 death	Announcement of restrictions	Lifting of restrictions	Oil price drop peak	First news of successful vaccine trial	Local approval of vaccine
UAE	/	/	Jan 29th	Mar 20 th	Mar 26 th	June 24th	/	/	Dec 9th
Bahrain	/	/	Feb 21st	Mar 16 th	Mar 24 th	May 23 rd	/	/	Dec 4th
Oman	/	/	Feb 24th	Apr 1 st	Apr 10 th	Jul 3 rd	/	/	Dec 15th
Kuwait	/	/	Feb 24th	Apr 4 th	Mar 22 nd	Jun 1 st	/	/	Dec 13th
Qatar	/	/	Feb 27th	Mar 28 th	Mar 20 th	Jun 15th	/	/	Dec 21st
Saudi Arabia	/	/	Mar 2 nd	Mar 24 th	Mar 23 rd	Jun 21 st	/	/	Dec 10th
International	Jan 31 st	Mar 11 th	/	/	/	/	Apr 20 th	Nov 9 th	/

Dates compiled referring to Mirza et al. (2020), HFW (2020), Bloomberg (2020c), The National (2020), Oman Daily Observer (2020a, 2020b), BNA (2020), The Guardian (2020), Reuters (2020), Meed (2020), Khaleej Times (2020), Gulf News (2020).

We expect the WHO announcements of emergency and pandemic to be associated with greater volatility of stock return; we have a similar expectation with regards to the drop of oil price. With regards to local events, we expect the first cases, deaths, and announcements of restrictions to lead to an increased volatility. However, we expect a decrease in volatility associated with the lifting of restrictions. Finally, we expect a reduced volatility around the announcements of successful vaccine trials as well as local approvals of vaccine. It is important to notice that confounding effects cannot be excluded as a great number of events are at play throughout the year.

RESULTS

Descriptive Statistics and Correlation Analysis of Returns

Average returns across all markets considered dropped substantially in February, and even more in March (Table 4). Dubai and Kuwait stock markets registered the lowest drop in return in March, followed by Abu Dhabi. Average return was again positive in April for all markets considered with the exception of Bahrain. Worth noticing, Bitcoin returns were also negative in March. When averaging returns across GCC countries (Figure 5), it can be noticed that average return dropped to a greater level as opposed to US (-0.01 vs -0.006 in March).

Table 4 Average return by month

Month	ADX (Abu Dhabi)	DFM (Dubai)	Kuwait	Oman	Saudi	Qatar	Bahrain	US	Bitcoin
Jan	0.001	0.000	0.002	0.001	-0.001	0.000	0.001	0.000	0.009
Feb	-0.003	-0.004	-0.004	0.001	-0.004	-0.004	0.000	-0.005	-0.003
Mar	-0.012	-0.017	-0.016	-0.008	-0.007	-0.005	-0.009	-0.006	-0.009
Apr	0.006	0.006	0.003	0.001	0.004	0.003	-0.001	0.006	0.010
May	-0.001	-0.002	0.002	0.000	0.001	0.001	-0.002	0.002	0.003
Jun	0.002	0.003	0.002	0.000	0.000	0.001	0.000	0.001	-0.001
Jul	0.000	0.000	-0.001	0.001	0.002	0.002	0.000	0.002	0.007
Aug	0.002	0.005	0.005	0.003	0.003	0.002	0.004	0.003	0.001
Sept	0.000	0.001	0.001	-0.002	0.002	0.001	0.002	-0.002	-0.003
Oct	0.002	-0.002	0.000	-0.001	-0.002	-0.001	0.000	-0.001	0.008
Nov	0.003	0.005	0.000	0.001	0.005	0.002	0.002	0.005	0.012
Dec	0.001	0.001	0.001	0.000	0.000	0.001	0.000	0.002	0.012

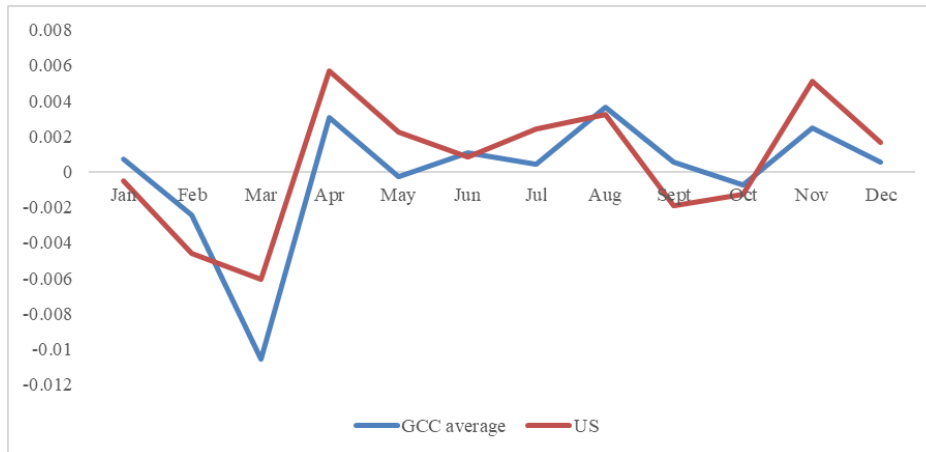


Figure 5 Average return values by month, GCC average

When considering standard deviation of returns (Table 5), which allows us to start inspecting volatility in these markets, we see that for all markets considered it peaked in March. Among GCC countries, Kuwait and Abu Dhabi markets presented the largest increase, whereas the lowest rise in standard deviation was found in Oman. The standard deviation of the return of Bitcoin also peaked in March, presenting the highest average value as opposed to the other markets considered. Standard deviation values returned to pre-March levels since May in Qatar, then in June in Oman, Saudi and for Bitcoin, whereas only in July in Abu Dhabi, Dubai and US. When inspecting the average standard deviation across all GCC countries vis-à-vis the US standard deviation (Figure 6), it can be seen that GCC’s average standard deviation of returns increased to a lower extent (0.059 vs 0.036).

Table 5 Average standard deviation of return by month

Month	ADX (Abu Dhabi)	DFM (Dubai)	Kuwait	Oman	Saudi	Qatar	Bahrain	US	Bitcoin
Jan	0.007	0.011	0.009	0.005	0.010	0.007	0.007	0.007	0.030
Feb	0.006	0.006	0.008	0.005	0.009	0.007	0.002	0.016	0.027
Mar	0.048	0.042	0.062	0.015	0.036	0.031	0.020	0.059	0.107
Apr	0.026	0.025	0.022	0.009	0.015	0.016	0.006	0.026	0.037
May	0.013	0.014	0.019	0.008	0.023	0.007	0.007	0.014	0.036
Jun	0.010	0.015	0.012	0.003	0.006	0.008	0.003	0.019	0.026
Jul	0.006	0.006	0.014	0.005	0.006	0.006	0.006	0.008	0.022
Aug	0.006	0.009	0.008	0.006	0.005	0.005	0.005	0.005	0.024
Sept	0.004	0.008	0.009	0.003	0.006	0.007	0.007	0.016	0.030
Oct	0.005	0.007	0.013	0.003	0.013	0.006	0.005	0.013	0.019
Nov	0.006	0.010	0.012	0.004	0.007	0.008	0.004	0.010	0.037
Dec	0.006	0.013	0.008	0.004	0.007	0.006	0.005	0.005	0.034

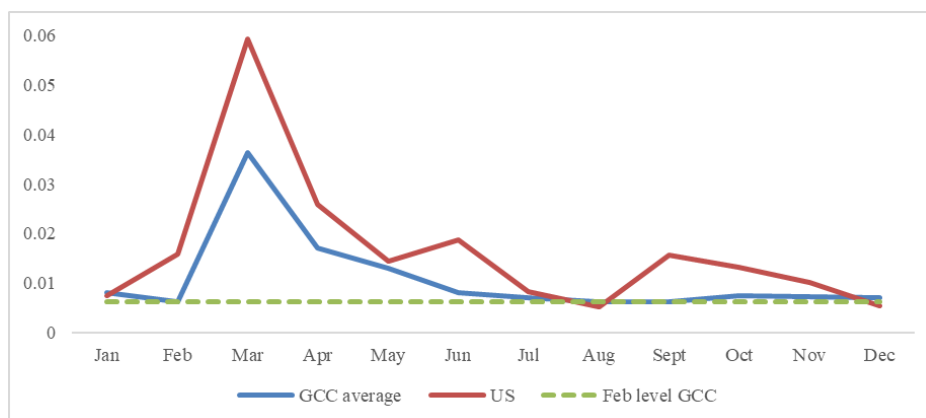


Figure 6 Standard deviation values by month, GCC average vs US

When assessing the correlation between the average returns (Table 6), we find the highest positive correlation between Abu Dhabi and Dubai, Abu Dhabi/Dubai and Kuwait, Qatar and Saudi. The average returns of the US markets are strongly correlated with Saudi and Qatar, much less with Bahrain, Oman, and Kuwait. We also found a positive, albeit lower on average, correlation with the average returns of Bitcoin,

especially with Abu Dhabi and US, much less with Bahrain and Kuwait. The correlation pattern between the standard deviations of returns (Table 7) seems stronger and involving more countries. Abu Dhabi and Dubai data are strongly correlated with Kuwait, Oman, Qatar, US and Bitcoin. Kuwait presents a strong correlation with the standard deviation values of all the markets considered, whereas Oman and Saudi display the lowest correlation values.

Table 6 Correlations between average return values

ADX									
0.972	DFM								
0.910	0.923	Kuwait							
0.852	0.873	0.890	Oman						
0.832	0.885	0.779	0.716	Saudi Arabia					
0.850	0.882	0.802	0.702	0.950	Qatar				
0.782	0.837	0.870	0.874	0.684	0.642	Bahrain			
0.808	0.824	0.701	0.701	0.903	0.938	0.506	US		
0.721	0.655	0.565	0.602	0.569	0.645	0.452	0.726	Bitcoin	

Table 7 Correlations between standard deviations of return values

ADX									
0.980	DFM								
0.963	0.932	Kuwait							
0.936	0.896	0.905	Oman						
0.879	0.841	0.911	0.887	Saudi Arabia					
0.985	0.967	0.963	0.898	0.849	Qatar				
0.859	0.839	0.925	0.861	0.840	0.874	Bahrain			
0.950	0.918	0.949	0.825	0.847	0.966	0.836	US		
0.915	0.918	0.949	0.870	0.851	0.947	0.919	0.908	Bitcoin	

Next, we present the stock returns and volatility along with the number of new COVID-19 cases, by country (Figures 7-12⁸). It can be seen that, across the countries considered, volatility peaks and at the same time average return reaches the lowest value around mid-March, whereas further increases in the number of new cases do not appear to be associated with substantial variations in average returns or volatility.

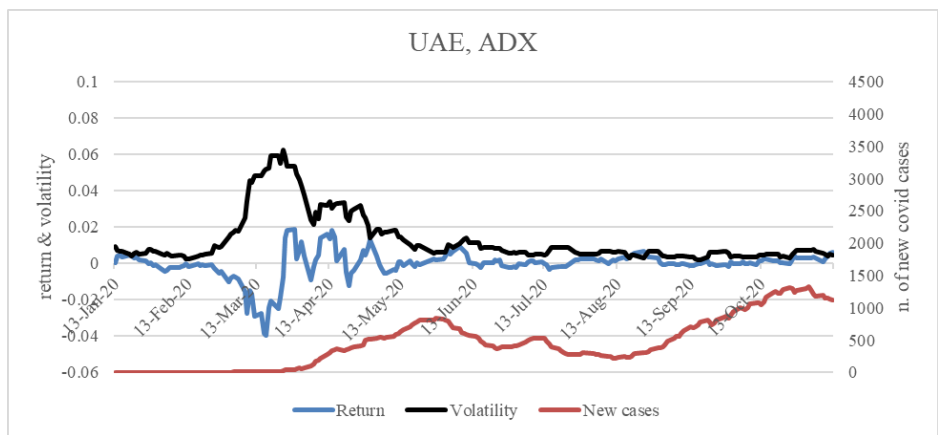


Figure 7 Stock return, volatility and new covid cases (UAE, ADX)

⁸ Stock return, volatility and number of new cases are reported applying a weekly moving average.

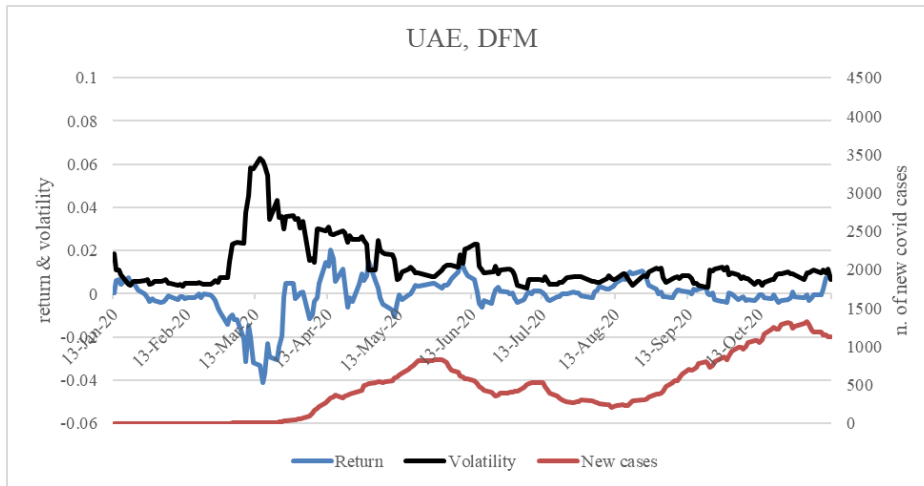


Figure 8 Stock return, volatility and new covid cases (UAE, DFM)

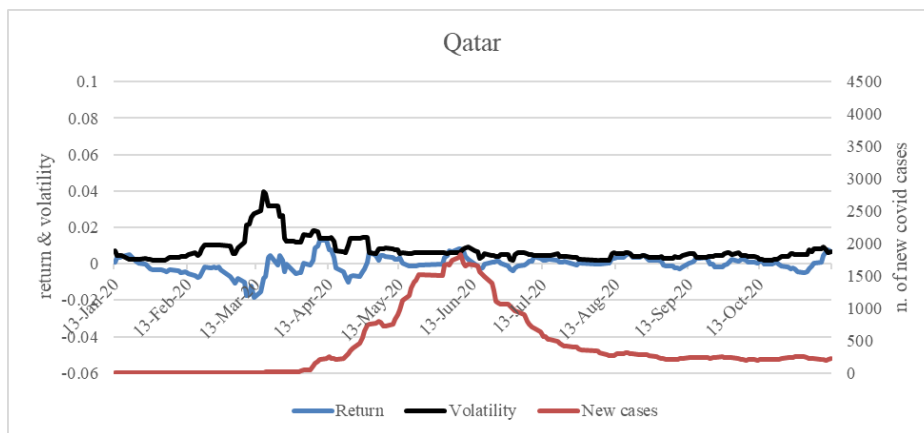


Figure 9 Stock return, volatility and new covid cases (Qatar)

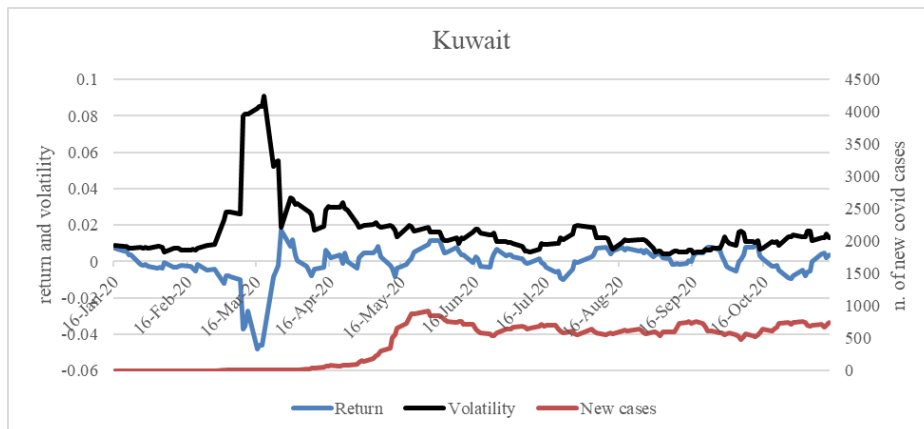


Figure 10 Stock return, volatility and new covid cases (Kuwait)

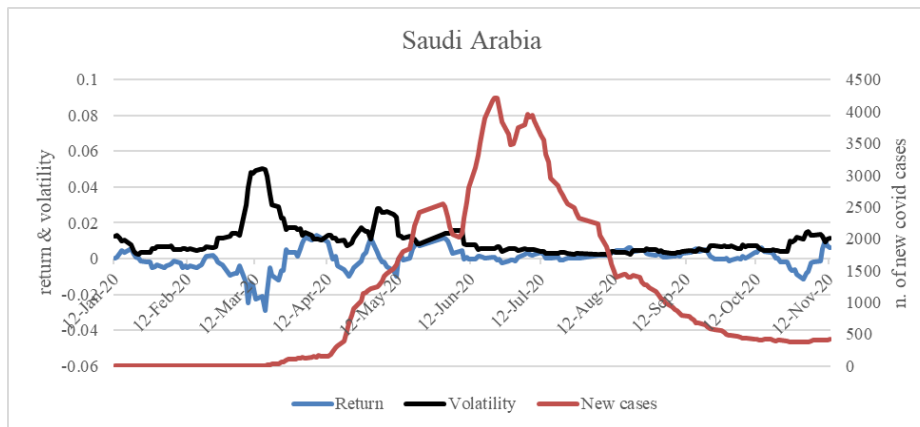


Figure 11 Stock return, volatility and new covid cases (Saudi Arabia)

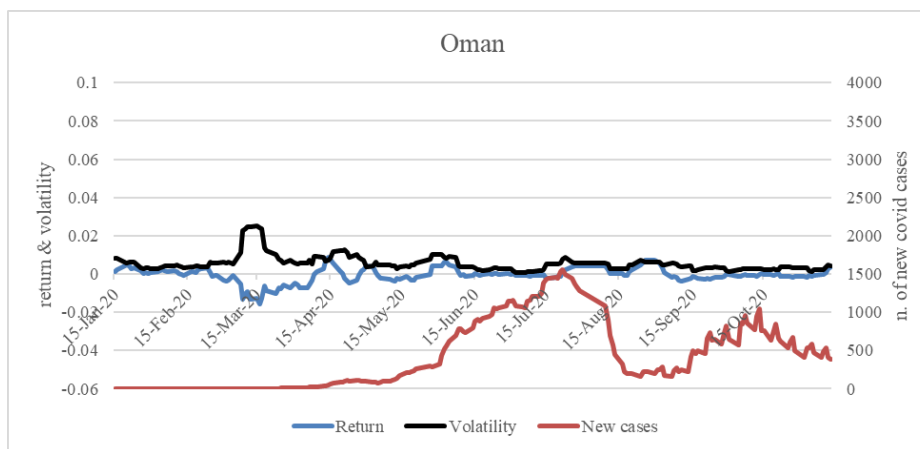


Figure 12 Stock return, volatility and new covid cases (Oman)

Econometric Results

Econometric results with heteroscedasticity decomposition, taking into account the events listed in Table 3, are presented in Table 8. Across all the GCC markets, estimation results suggest that volatility significantly increased around the announcement of the WHO that the circulation of the virus had reached the status of a pandemic. This happened in mid-March, when the epicenter was in Italy, and GCC countries were not experiencing yet a substantial number of cases. The link between volatility and WHO pandemic's announcement can be visualized in the Figures 7-12. Instead, there appears to have been no significant impact on increased volatility arising from the announcement of the status of emergency which had been made earlier in January. Around that date, volatility in the Abu Dhabi, Kuwait and Bahrain markets dropped. Considering another major international event, namely the drop of oil price that plummeted in mid-April, we observe a significant effect on volatility, with volatility increasing in Abu Dhabi and Qatar (in line with Oman and Bahrain being the smallest oil producers in the GCC).

The first cases of COVID-19 locally raised the volatility of the following markets: Abu Dhabi, Qatar, Kuwait, Saudi Arabia; a reduction of volatility was observed in Bahrain. The first local deaths seem to be associated with greater volatility in Oman and Qatar, whilst no corresponding impact was found in the remaining markets. The announcement of restrictions significantly raised the volatility in the stock markets of Abu Dhabi and Bahrain. The positive news of successful vaccine trials released in November appears to have had no significant impacts on any of the GCC markets apart from Bahrain, where it was observed a reduction in volatility. Instead, the news of local approval of a vaccine significantly lowered volatility in Abu Dhabi, Qatar and Saudi Arabia. It is important to notice that during the latter half of the year, volatility was already trending at much lower levels as opposed to March.

Table 8 Econometric model results (EARCH specifications with heterogeneity decomposition)

Market	Dubai (DFM)		Abu Dhabi (ADX)		Qatar (All share)	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
β_0	-0.0002	0.0008	0.0008	0.0005	0.0005	0.0005
φ	0.052	0.091	-0.062	0.090	0.065	0.092
δ_1 (WHO emergency)	-2.01	1.50	-4.3***	1.509	-0.103	0.735
δ_2 (WHO pandemic)	2.56***	0.731	3.17***	0.647	3.41***	0.381
δ_3 (1 st case)	0.409	1.505	3.74***	1.48	0.782**	0.381
δ_4 (1 st death)	0.685	1.30	1.166	1.43	2.91***	0.873
δ_5 (Restrictions)	0.713	1.25	2.15**	1.15	-1.073	0.882
δ_6 (Restrictions lifting)	-1.146*	0.601	-0.849	0.641	-0.583	1.00
δ_7 (Oil price drop)	1.12	0.972	2.03**	0.586	1.42***	0.532
δ_8 (Vaccine news)	-0.342	0.906	-0.203	0.574	0.269	0.417
δ_9 (Vaccine approval)	-0.320	0.415	-0.887*	0.500	-1.56***	0.342
δ_0	-8.69***	0.083	-9.39***	0.085	-9.80***	0.105
$\alpha_{11,1}$	-0.0319	0.172	0.097	0.125	0.105	0.126
$\alpha_{11,2}$	-0.109	0.159	0.090	0.083	/	/
$\alpha_{11,3}$	/	/	/	/	/	/
$\gamma_{11,1}$	0.241	0.234	0.199	0.204	0.145	0.138
$\gamma_{11,2}$	0.751***	0.258	0.758***	0.130	/	/
$\gamma_{11,3}$	/	/	/	/	/	/
Log likelihood	733.2627		795.69		833.95	

Note: ***1%, ** 5%, * 10% significance. S.e.: standard error.

Table 8 Cont.

Market	Kuwait (NASDAQ 15)		Saudi (Tadawul)		Oman (MSM 30)		Bahrain (All share)	
	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.	Coeff.	s.e.
β_0	0.0013	0.0009	0.0007	0.0007	0.0001	0.0003	0.0004	0.0003
φ	0.017	0.102	0.041	0.110	0.200***	0.071	0.090	0.103
δ_1 (WHO emergency)	-0.87***	0.331	-0.662	1.03	-0.507	0.908	-1.23***	0.401
δ_2 (WHO pandemic)	3.17***	0.260	1.86**	0.797	3.60***	0.372	1.93***	0.542
δ_3 (1 st case)	0.904**	0.234	1.36*	0.700	0.653	0.529	-2.08***	0.370
δ_4 (1 st death)	0.837	0.578	0.130	0.638	1.16**	0.493	0.539	0.668
δ_5 (Restrictions)	0.767	0.505	0.445	0.870	0.508	0.780	1.29**	0.564
δ_6 (Restrictions lifting)	0.060	0.417	-1.18*	0.610	-2.17***	0.544	-0.747	0.738
δ_7 (Oil price drop)	0.859	0.607	0.695	0.539	1.29	0.854	-0.342	0.613
δ_8 (Vaccine news)	0.28	0.548	0.074	0.465	-0.359	0.358	-1.11**	0.472
δ_9 (Vaccine approval)	-0.657	0.488	-1.57***	0.468	0.230	0.323	-0.662	0.477
δ_0	-8.77***	0.114	-8.89***	0.048	-10.8***	0.085	-10.05***	0.061
$\alpha_{11,1}$	0.228	0.151	-0.31***	0.161	0.438***	0.132	-0.170	0.152
$\alpha_{11,2}$	0.013	0.194	0.119	0.192	/	/	/	/
$\alpha_{11,3}$	0.333	0.266	/	/	/	/	/	/
$\gamma_{11,1}$	-0.158	0.198	0.607***	0.161	0.082	0.201	0.387**	0.196
$\gamma_{11,2}$	-0.449	0.303	0.543**	0.267	/	/	/	/
$\gamma_{11,3}$	0.596	0.393	/	/	/	/	/	/
Log likelihood	590.22		773.08		950.28		898.27	

Note: ***1%, ** 5%, * 10% significance. S.e.: standard error.

CONCLUSIONS

This work has assessed the impact of international and local events on stock markets of GCC countries, considering the whole 2020. We have also assessed correlation patterns between average returns and standard deviations of returns. Results indicate that the average volatility of GCC stock markets was lower than the volatility of the US stock market. Furthermore, the findings indicate that volatility returned to their pre-crisis levels by July across the GCC and US markets, with Qatar experiencing a reduced volatility already in May, and Oman in June. Instead, the average return dropped to a greater extent in the GCC as opposed to the US; at the same time, the volatility increased to a greater extent in the US market. A strong positive correlation among the standard deviation of returns was found between the GCC markets, and between the GCC markets and US, with greatest values between Qatar and UAE, Qatar and Kuwait, and Qatar and US.

International and local events linked to the COVID-19 pandemic have significantly affected the volatility of GCC markets. The announcement of the pandemic had the strongest impact on volatility across all the GCC markets. The fall in oil prices had also a major impact on volatility, but only in Abu Dhabi and Qatar. Among the international events considered, only the news of successful vaccine trials had no impact on volatility, except for the case of Bahrain. Local events impacted volatility but to a lesser degree compared to international events. The first cases of COVID-19 had no impact in the Dubai and Oman markets, whilst had a

mild effect on the Kuwait and Qatar markets, and a stronger effect only for the Saudi Arabia and Abu Dhabi market. First deaths of COVID-19 affected volatility only in Qatar and Oman. Similarly, imposing local restrictions affected volatility only in the Abu Dhabi and Bahrain markets. The lifting of restrictions seems linked with a lowered volatility in Dubai, Saudi Arabia and Oman. Finally, we have found no impact associated with news of successful vaccine trials across all emerging markets considered apart from Bahrain; however, the local approval of COVID-19 vaccines is associated with a reduction in volatility in the Abu Dhabi, Qatar and Saudi Arabia markets.

All in all, it appears that the announcement of the status of pandemic in March had the strongest impact on volatility followed by the oil price shock. This confirms the importance of international events for emerging markets, as previously put forward by Hammoudeh and Li (2008). Before the virus spread significantly in the GCC, stock markets reacted substantially. This is a strong indication towards preparing policies, both fiscal and monetary (unless the country is following a fixed exchange rate regime such as the UAE), ahead of virus diffusion in the country when expectations of international spread is forming. A great deal of fear and uncertainty seems to build up at the beginning of the pandemic (Lyócsa and Molnár, 2020), which is when timely actions from the policy makers are needed the most. Draft plans of emergency policy measures for such situations should be kept updated by the governments, which need to manage communication with utmost care. As Zhang et al. (2020) cautioned, particular attention needs to be put in place to avoid generating further uncertainty whilst setting policies that might need to be unconventional. Furthermore, working towards more cohesive societies within countries seems to be important, as trust towards governments and fellow citizens can help reduce uncertainty (Engelhardt et al., 2021). Coordination and cooperation between GCC countries is also recommended in light of the similar reactions the markets have shown throughout 2020. In terms of avenues for future research, further studies could investigate potential effects linked with different types of vaccines and distribution factors.

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