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Research article

Assessing the safe haven properties of oil in African stock markets amid the COVID-19 pandemic: a quantile regression analysis

Emmanuel Assifuah-Nunoo*, Peterson Owusu Junior, Anokye Mohammed Adam and Ahmed Bossman

Department of Finance, School of Business, University of Cape Coast, Cape Coast, Ghana

* **Correspondence:** Email: emmanuelassifuahnunoo@gmail.com.

Abstract: Using the quantile regression approach to reveal the conditional relationships, the study re-examined the oil-stock co-movement in the context of oil-exporting countries in Africa. The data employed include daily OPEC basket price for crude oil and daily data on stock market indices for six major stock markets of oil-exporting economies in Africa—Egypt, Ghana, Morocco, Nigeria, South Africa, and Tunisia, from 02 January 2020 to 06 May 2021. We found that crude oil cannot act as safe haven instrument for stock markets in oil-exporting African countries. Notably, the oil-stock co-movement is consistent and more intense at the lower tails only. Investors are encouraged to employ oil as a diversification instrument rather than as a safe haven asset, based on market conditions. Regulators should devise strategies to strengthen the market for crude oil to lessen adverse volatilities during the COVID-19 pandemic by way of mitigating downward returns in African stock markets. The findings of the study offer more interesting economic insights to all classes of investors as well as policymakers in oil-exporting economies in Africa.

Keywords: quantile regression; oil-stock nexus; safe haven; African stock markets; diversification; COVID-19

JEL Codes: G01, G11, G15, F21, Q43, C22

1. Introduction

The global economy has, since the declaration of the deadly coronavirus disease 2019 (COVID-19) as a pandemic, suffered unprecedented challenges. Individual sectors such as food supply chains, energy, tourism, communications, among others, have all witnessed turmoil, as respectively suggested by Agyei et al. (2021), Adam (2020), Asafo-Adjei et al. (2020), Wu et al. (2021), Narayan et al. (2021), etc. Globally, financial markets have not been spared the enormous risks owing to the pandemic. Given the sensitivity of stock markets to market fluctuations (Gao et al., 2021; Siahaan & Robiyanto, 2021), it is not surprising that renowned stock markets witnessed strong volatilities in the early days of the pandemic (Bossman, 2021; Gao et al., 2021; Ji et al., 2020).

Consequential to the COVID-19 pandemic, BBC (2020) reported that the market for crude oil had historically recorded its lowest reduction in price since November 2002 (as depicted in Figure 1) and led to the outbreak of a "price war" between members of the Organisation of the Petroleum Exporting Countries (OPEC). The turbulence in financial markets amid the COVID-19 pandemic substantiates the claim by Tavor and Teitler-Regev (2019) that financial markets co-move with economic shocks resulting from events like pandemics.

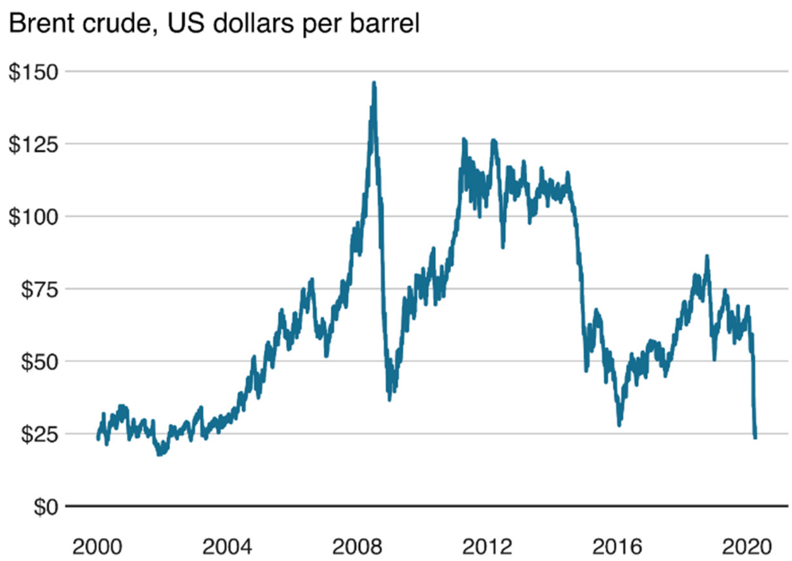

Figure 1. Trend of Crude Oil Prices. Source: BBC (2020).

Gates (2020) tagged the COVID-19 as a "once-in-a-century" pandemic for which Ji et al. (2020) explain that the fundamental forces of the pandemic are distinct from earlier financial predicaments and such forces are more complex than has ever been observed. Following this, governments across the globe initiated several measures in the name of containing the contagious COVID-19. However, precautionary and preventive measures for containing the COVID-19 pandemic, although necessary, have also led to several temporal business shutdowns, extensive restrictions on travel and movement, chaos in financial markets, keen uncertainty, and loss of confidence (OECD, 2020). Ji et al. (2020) predict a much greater impact of the COVID-19 on the global economy and Agyei et al. (2021) also predict that the socioeconomic consequences of the pandemic on the African economy could extend into the long term. Undoubtedly, full containment of the COVID-19 pandemic is uncertain and, hence, more predicaments and related consequences are likely to befall financial markets (Ji et al., 2020). Accordingly, in line with Goodell (2020), the need for further inquiry is substantiated and, thus, cannot be overlooked.

Note that recent analysis of the oil-stock nexus in the empirical literature has emphasised the issue of the financial resource curse hypothesis (Kassouri et al., 2020), but the sample did not contain African countries. In the spirit of such a hypothesis, African countries may realise detrimental impacts of oil price volatilities on their stock markets. We examine the nature of connectedness between oil and stock returns in oil-exporting economies in Africa, drawing insights from the financial resource curse hypothesis. We contribute to the strand of literature that assesses the diversification potential of crude oil in times of crisis. Our specific contributions to the body of knowledge are as follows.

First, we focus on oil-exporting economies in Africa to ascertain the extent to which their connectedness results in diversification or safe haven potential. Assessing the safe haven properties of asset classes from time to time is essential to portfolio management. Given the susceptibility of crude oil returns to unprecedented volatilities in the COVID-19 era, international investors need a safe asset on which they could rely to mitigate unforeseen return shocks. African economies could attract foreign investors through their stock markets, but knowledge about their potential to either shield or be shielded by crude oil returns during pandemics is scanty. We tend to produce results based on oil-exporting markets in Africa.

Second, we conduct our analysis in condition-dependent market states to reveal the relationship between oil and stock returns during the bullish, bearish, and normal market conditions of the COVID-19 era. We achieve this by conducting our analysis in line with the adaptive markets hypothesis, which is yet to be employed in the context of African markets during the COVID-19 era. Lo (2004), through the adaptive markets hypothesis (AMH), suggests that varying events and structural changes result in the evolution of markets, and in line with the heterogeneous market hypothesis (HMH) propounded by Müller et al. (1997), investors are likely to respond to emerging markets and the different market dynamics in the COVID-19 pandemic, particularly in the search for optimum portfolio. This, thus, brings to light the urgency of re-examining the role of conventional safe haven instruments in the era of the COVID-19 pandemic across market conditions. The oil-stock relationship is uniquely assessed under the paradigms of the AMH ad HMH in the rea of the COVID-19 pandemic.

Methodically, we employ the quantile regression estimations to examine the role of crude oil as a safe haven for stock market returns (SMR) in oil-exporting economies in Africa. By employing the QR technique, the study would ascertain a complete representation of the interrelation between the regressor and the regressand (Nusair & Al-Khasawneh, 2018). The application of the QR would further allow variations in the coefficient estimates across the distribution of the explained variable, in this case, stock returns.

Unlike other techniques, with which the average relationship between the variables is presented, the use of QR allows drawing inference on the connection between the two assets from various quantiles, particularly drawing distinctions between market conditions, as suggested by Naifar (2016) and Nusair and Al-Khasawneh (2018). Moreover, QR is deemed robust even in the presence of issues like skewness, non-normality, outliers in the data set, and heterogeneity within the regressand (Zhu et al., 2016).

For investors, both national and international, who seek to smoothen consumption and investment preference across the state of uncertainty brought about by the COVID-19 pandemic, this study offers a guide on whether or not crude oil could act as a safe haven against SMR. Nusair and Al-Khasawneh (2018) further argue that the QR technique provides a complete representation of the interrelation between the regressand and the regressor(s). This is generated through modelling of the connection between the regressor(s) and a set of specified quantiles (Mensi et al., 2014) of the regressand.

Findings from our empirical analysis explicate that the positive and significant co-movement between the oil and stock markets in the upper quantiles is inconsistent. The co-movement lacks significance in Egypt ($Q_{0.75,0.90}$), Ghana ($Q_{0.65}$) Morocco ($Q_{90,95}$), Nigeria ($Q_{0.65\text{-}0.95}$), and Tunisia ($Q_{0.65\text{-}0.95}$). This suggests that oil market shocks may not translate in stock markets at upper distributions of stock returns in Africa.

The remaining four sections of the paper include a review of relevant theories and works, the methodology, presentation of data, results' discussion, and conclusions in respect of Sections 2, 3, 4, 5, and 6.

2. Literature review

Theoretically, investor behaviour could be influenced by information flows across stock markets—and the intensity of stock market trade could be affected by this flow of information, as suggested by the efficient market hypothesis (EMH). The EMH operates on the premise that future prices of assets could be hardly predicted because all available information is utilised in arriving at current asset prices (Fama, 1970, 2021). The uncertainties associated with the pandemic could present various forms of information across stock markets, impacting the level of trade that goes on in such markets.

The oil-stock nexus is driven by the stock valuation theory on the supposition that the price of a stock is determined as the aggregate present (discounted) values of cash flows, dated into the future periods, which is contingent on macroeconomic indicators like investor confidence, aggregate demand, interest rate, inflation rate, and cost of production (Arouri et al., 2012; Badeeb & Lean, 2018; Chang et al., 2020; Kelikume & Muritala, 2019). Fluctuations in oil prices result in a reduced risk premium, which could also affect cash flows and consequently, influence the returns on stocks desired by investors. On the contrary, increasing the prices of international crude oil could increase the rate of inflation which would positively drive interest rates and consequently induce returns on stocks (Chang et al., 2020). Regarding the AMH and the HMH, propounded by Lo (2004) and Müller et al. (1997) respectively, markets could evolve from varying events and structural changes and investors are likely to respond to emerging markets and the different market dynamics in the COVID-19 pandemic, particularly in the search for optimum portfolio.

The traditional assets employed by investors in financial crises include cryptocurrencies like the bitcoin (Bouri et al., 2017; Selmi et al., 2018; Shahzad et al., 2020; Urquhart & Zhang, 2019), foreign exchange currencies (Fatum & Yamamoto, 2016; Grisse & Nitschka, 2013), gold (Baur &

Lucey, 2010; Baur & McDermott, 2010; Musialkowska et al., 2020; Selmi et al., 2018; Shahzad et al., 2020), and crude oil (Chang et al., 2020; Liu et al., 2020). The uncertain times, revealed by the present COVID-19 pandemic, have questioned the ability of these instruments (Ji et al., 2020) to stay true as reliable instruments for safe haven investments.

The absence of a theoretical model has rendered the definition of safe haven assets controversial (Ji et al., 2020). However, a prevalent observation reveals that safe haven assets are those assets that have no correlation or are inversely related to other assets or asset collections during extreme market conditions (Baur & Lucey, 2010; Bouoiyour et al., 2019; Bouri et al., 2020).

The intuition behind safe haven assets is that during market turmoil, they present opportunities for investors to create a minimum variance portfolio, where any downside market risk is moderated. From a global perspective, there exists mixed evidence of oil-stock connection and this connection has been put to test during the COVID-19 pandemic, although all results are hardly commensurate with each other. As a segment of the global financial market, as Asafo-Adjei et al. (2020) indicate, a test of the existing oil-stock interrelation is indispensable due to varying (Chang et al., 2020) economic conditions between ASMs and other markets across the globe. In practice, Arouri et al. (2012), Badeeb and Lean (2018), and Chang et al. (2020) indicate that the direct relationship between oil prices and "earnings and cash flows" within the corporate setting causes oil prices to influence stock markets, and this substantiates the essence of crude oil to the global economy (Kelikume & Muritala, 2019). Kilian (2008) and Chang et al. (2020), suggest that the oil-stock connection is unanimously positive among oil-exporting countries.

Furthermore, the theory of equity valuation suggests that the price of a stock is determined as the aggregate present (discounted) values of cash flows, dated into the future periods, which is contingent on macroeconomic indicators like investor confidence, aggregate demand, interest rate, inflation rate, and cost of production (Arouri et al., 2012; Asafo-Adjei et al., 2021a; Badeeb & Lean, 2018; Boateng et al., 2021; Kelikume & Muritala, 2019). In addition, Gourène and Mendy (2018) and Kelikume and Muritala (2019) suggest that through the influence placed on inflation, corporate earnings, monetary policy measures, and other economic activities, shocks in the crude oil market could easily translate to stock markets both in advanced and emergent economies.

The past tetrad decades have seen several African economies emerging as oil-producing nations which are seen at the regional level, if not at the global stage. Notable African economies which have emerged as oil-producing states include Algeria, Angola, Chad, Cote D'Ivoire, DR Congo, Egypt, Gabon, Ghana, Libya, Nigeria, Senegal, and South Africa. Thus, relative to its use, there is a clear indication of the substantial contribution made by Africa toward oil production. Eventually, African and international investors seeking to construct portfolios may consider the addition of oil to their asset collections, contingent on their overall investment objective (Ijasan et al., 2019; Tweneboah et al., 2019). Following the theoretical channel through which the markets for stocks are affected, the essence of re-examining the oil-stock relationship cannot be overlooked in the COVID-19 pandemic.

On the empirical front, it is essential to dissociate safe haven instruments from safe assets, as suggested by Baur and McDermott (2016), Gorton et al. (2012), and Ji et al. (2020). Although hedging and diversification of portfolios are essential to investors, Baur and McDermott (2016) and Gorton, Lewellen and Metrick (2012) suggest that safe haven assets are the primary assets needed by investors during market crises. For an asset to succeed as a safe haven, it should either preserve or appreciate during market turmoil—the returns on the assets should have either a negative relationship or no interrelation with other assets or portfolios in times of market stress (Baur & Lucey, 2010).

In market stress conditions, gold has been the traditional asset employed as a safe haven instrument since it is characterised by a "store of value" or known to be "natural money", as put forward in the works of Bouri et al. (2020) and Ji et al. (2020). Chang et al. (2020) and Liu et al. (2020), however, contend that an essential driver of economic activity and GDP is crude oil, especially in oil-exporting countries. Thus, a study into the characteristics of crude oil, as an investment instrument, is essential to unveil its true relationship with stocks in times of economic downturns. Therefore, the oil-stock nexus is of concern in this study.

The extant literature provides mixed evidence of the oil-stock returns nexus both in advanced and emerging economies. When Diaz and Gracia (2017) employed the vector autoregression (VAR) model to examine the co-movement of shocks in oil price among oil and gas entities of the NYSE from 1974 to 2015, they found that the oil-stock co-movement is intense in the short term only. By the same methodology, Kang et al. (2017) reveal that oil price shocks emanating from the demand-side positively affect oil and gas corporations but a negative effect was found from the shocks associated with policy uncertainties.

Using the generalised autoregressive conditional heteroscedasticity (GARCH) technique, Antonakakis et al. (2017) evaluated the oil-stock connection under conditions of geopolitical risks and found that the oil-stock relationship is affected by geopolitical risks. Moreover, Antonakakis et al. (2017) examined the dynamic connection between shock from oil prices and market returns for stocks in both oil-importing economies and oil-exporting economies using the structural VAR model and found that the oil-stock nexus varies across time and is also dependent on structural changes and developments in the world economy. They also find variations in the relationships between oil-importing and oil-exporting countries.

Extant studies on the position of crude oil as a safe haven have yielded mixed findings even in the COVID-19 era, for reasons such as but not limited to the heterogeneity of the sample, differing net position of economies (whether oil-importing or oil-exporting), and methodology (Chang et al., 2020). When Mensi et al. (2021) investigated the safe haven and hedge properties of crude oil in the Asian economy, the safe haven role of Brent oil was found to be weak for precious metals in a portfolio—it best served as a hedge for precious metals within the Asian economy.

In the United States economy, Bouoiyour et al. (2019) assessed the safe haven characteristics of oil relative to Bitcoin and precious metals in the context of political uncertainty. Using the empirical mode decomposition technique, the authors found that in times of political risks, the oil serves as a strong safe haven instrument but is time-dependent. Moreover, Liu et al. (2020) assessed the characteristics of crude oil as either a hedge, diversifier or a safe haven instrument for traditional currencies, employing the "asymmetric-DCC model", supplemented with quantile regression (QR) and the cross-quantilogram framework. Their findings suggested an absence or a negative relationship between crude oil and traditional currencies in times of crisis.

Among the Gulf Cooperation Council (GCC) economies, Nusair and Al-Khasawneh (2018) employed the QR analysis to evaluate the oil-stock relationship and found that generally, the two markets co-move together both in normal market conditions and in market stress, suggesting that crude oil may poorly perform as a safe haven when combined with stocks in the same portfolio in a market crash.

A review of existing works indicates that several methods have been used to study the oil-stock nexus in normal markets and some cases, are compared to periods of financial crises. a handful of works have been conducted under the quantile regression framework and in Africa, no study is yet recorded on the oil-stock nexus in the periods of the COVID-19 pandemic. Therefore, this study re-examines the oil-stock co-movement in Africa under the QR framework.

We note that investor responses to market dynamics differ across market conditions (Hashmi et al., 2021; Ijasan et al., 2021; Kassouri & Altıntaş, 2020, 2021). Furthermore, Kassouri, Altıntaş and Bilgili (2020) noted that oil-exporting countries tend to suffer from price volatilities in the oil market. Hence, in addition to expecting that stock market returns are caused by crude oil shocks, for any given stock market of an oil-exporting country from Africa, we expect that the relationship between its returns and crude oil returns are distinct across market states and this is expected to cause a change to the safe haven property of crude oil. Impliedly, following the lessons drawn from the literature, we hypothesise as follows:

H1: a change in crude oil returns causes a change in stock returns.

H2: the comovement between oil and stock returns is statistically distinct across quantiles.

3. Methods

An application of the quantile regression (QR) analysis is made in this paper to re-examine the safe haven properties of crude oil in ASMs during the COVID-19 pandemic. Pioneered by Koenker and Bassett (1978), QR offers an extension to the traditional ordinary least squares (OLS) regression. Relative to the OLS, QR allows for a wide-ranging analysis of data, as suggested by Mensi et al. (2014) and Nusair and Al-Khasawneh (2018). Specifically, with the traditional OLS, only a summary of the mean relationship (among a set of regressors and the regressand) is generated from the contingent average of the regressand. Mosteller and Tukey (1977) indicate that the results from a standard OLS are only a fractional view of the connection between the regressand and the regressor(s). Nusair and Al-Khasawneh (2018) further argue that the QR technique provides a complete representation of the interrelation between the regressand and the regressor(s). This is generated through modelling of the connection between the regressor(s) and a set of specified quantiles of the regressand. Relative to OLS, which provides results on the contingent mean of the explained variable, QR helps to describe the overall contingent distribution in relation to the explained variable. Furthermore, the application of the traditional OLS, by focusing on a conditional average, may tend to yield coefficients that are either underestimated or overestimated, and in certain instances, may fail to reveal relevant relationships between the set of explanatory variables and the explained variable (Binder & Coad, 2011). Supplementary to generating a comprehensive representation of the connection between the set of independent variables and the dependent variable, Zhu et al. (2016) suggest that the QR technique is largely robust to non-normal blunders, the existence of outliers in the data set, heterogeneity within the regressand, and skewness.

The study specifies a conventional OLS regression to benchmark the results of the QR. The traditional OLS could be specified as

$$StkR_t = \alpha_0 + \alpha_1 OilR_1 + \varepsilon_t \tag{1}$$

where ε_t represents the noise term; $StkR_t$ and $OilR_t$ are respectively the returns on stocks and returns on the oil price of OPEC, and are based on the log-returns of daily stock price (share indexes) expressed as

$$StkR_t = lnP_t - lnP_{t-1} \tag{2}$$

$$OilR_t = lnP_t - lnP_{t-1} \tag{3}$$

where $StkR_t$ and $OilR_t$ define the continuously compounded stock returns and price returns of OPEC oil, P_t represents the stock price (share index) or price of OPEC oil in the current period, t, and P_{t-1} represents the stock price (share index) or price of OPEC oil in the previous period, *(t–1)*.

The traditional OLS model in Equation (1) can best render a response to only one query in this study, that is, whether or not oil price shocks are essential for SMR (Nusair & Al-Khasawneh, 2018) but the OLS model may fail to respond to a very essential query like whether or not shocks on the oil market would affect SMR differently for "markets with low returns" than for "markets with high returns". Nusair and Al-Khasawneh (2018), therefore, advanced that QR is employed in providing answers to this important query and would reveal, where there exists, any differences in the effect of oil price shocks on SMR in different market conditions (bearish, normal, or bullish). See also, Owusu Junior et al. (2020a), Owusu Junior et al. (2020b), Owusu Junior and Tweneboah (2020), etc.

With QR, a model of the conditional τ^{th} quantile of the explained variable is generated for specified values of $\tau \in (0,1)$. Therefore, the contingent QR model for $StkR_t$ given $OilR_t$ could be expressed as

$$Q_{StkR_t}(\tau/OilR) = \alpha^{\tau} + OilR_t'\beta^{\tau} \tag{4}$$

where the conditional τ^{th} quantile of the regressand $StkR_t$, the SMR, is defined by $Q_{StkR}(\tau/OilR)$, the intercept is presented as α^{τ}, and allowed to be subject to τ. A vector of the τ^{th} related coefficients are defined as β^{τ}, and $OilR'$ defines a vector of regressors, which in this study, is restricted to returns on OPEC oil prices. Following Koenker and Bassett (1978), the τ^{th} quantile coefficients of the conditional distribution is expressed as

$$\min_{\beta\in\mathbb{R}^k}\Big[\sum_{t:StkR_t\geq\alpha^{\tau}+OilR_t'\beta^{\tau}}\tau|StkR_t - \alpha^{\tau} - OilR_t'\beta^{\tau}| + \sum_{t:StkR_t<\alpha^{\tau}+OilR_t'\beta^{\tau}}(1-\tau)|StkR_t - \alpha^{\tau} - OilR_t'\beta^{\tau}|\Big] \tag{5}$$

The minimisation problem of Koenker and Bassett (1978) in Equation (5) could be expressed as the minimised weighted deviations from the contingent quantile

$$\min_{\beta \in \mathbb{R}^K} \sum_t \rho_\tau (StkR_t - \alpha^\tau - OilR_t' \beta^\tau) \tag{6}$$

where the weighting factor, termed a check function, is represented by ρ_τ and holds for the set $\tau \in (0,1)$ as

$$\rho_\tau(\xi_t) = \begin{cases} \tau \xi_t, & \text{if } \xi_t \geq 0 \\ (\tau - 1)\xi_t, & \text{if } \xi_t < 0 \end{cases} \tag{7}$$

where $\xi_t = StkR_t - \alpha^\tau - OilR_t' \beta^\tau$. Hence, the QR is a weighted regression in which varying weights are attributed to data points or observations contingent on whether the observations are either below or above the line-of-best-fit, as suggested by Binder and Coad (2011) and stressed by Nusair and Al-Khasawneh (2018). The aggregate residuals are minimised by the QR model within which positive residuals are weighted with τ and negative residuals are weighted with $(1 - \tau)$.

In examining the influence of shocks in crude oil prices on SMR with QR estimations, the study models the quantile relationships to conform to the traditional OLS model defined in Equation (1) as

$$Q_{StkR_t}(\tau / OilR) = \alpha_0^\tau + \alpha_1^\tau OilR_t \tag{8}$$

Using the QR model in Equation (8), the study investigates the plausible oil-stock connection in 19 quantiles defined as $(\tau = 0.05, 0.10, 0.15, \ldots 0.95)$. Although the study period is strictly the pandemic era, different regimes could be defined to reflect changes in the market which could be a result of investor behaviour as they respond to news in the markets concerning the COVID-19 pandemic. The study defines three market conditions in the pandemic, contingent on the news available to the market as: $(\tau = 0.05, 0.1, 0.15, 0.20, 0.25, 0.30)$ for lower quantiles, $(\tau = 0.35, 0.40, 0.45, 0.50, 0.55, 0.60)$ for intermediate quantiles, and $(\tau = 0.65, 0.70, 0.75, 0.80, 0.85, 0.90, 0.95)$ for upper quantiles.

4. Data and preliminary analysis

4.1. Data

The data set used in the processing and analysing results consists of daily OPEC basket price for crude oil and daily data on stock market indices for six major stock markets of oil-exporting economies in Africa—Egypt, Ghana, Morocco, Nigeria, South Africa, and Tunisia from 02 January 2020 to 06 May 202—yielding 240 observations. The chosen period covers when the COVID-19 pandemic was suspected to be spreading across many countries and triggered initial shocks in the prices of crude oil. Given that the first case of COVID-19 was reported in China on 31 December 2019, stock and commodities markets are suspected to respond to the news, at least a day after the incidence, owing to the EMH – the chosen period is, thus, considered ideal for the study. The daily OPEC basket crude oil price was obtained from OPEC Database (https://www.opec.org/opec_web/en/data_graphs/40.htm) and the daily stock indices were obtained from EquityRT. The study analysed the data using the returns of daily crude oil prices and stock indices computed with the formula in Equations (2) and (3).

4.2. Descriptive statistics

An overview of the pattern of movements in oil and stock prices and returns in the study period is essential and hence, the study explored the statistical distribution of the returns series to commence the analysis of the data. The graphical distribution of OPEC crude oil basket prices and stock market indices for the six ASMs is represented in Figure 2.

A peep at the plots shows that all crude oil prices, as well as all stock market indices, trended downwards, particularly in the period between February and May 2020 with a few exceptions. Crude oil prices gained an upward trend after May 2020 with few volatilities. In respect of stock indices, the Egyptian market index was seen to be fairly volatile after the sharp decline between February and March 2020. The Ghanaian share index continued to trend downwards between March 2020 and December 2020, after which it picked an upward trend. Morocco, Nigeria, South Africa, and Tunisia, after the sharp decline in the stock index between February and May 2020, realised upward trends interspersed with few volatilities.

Generally, ASMs could be seen to exhibit similar characteristics during the COVID-19 pandemic. The study, therefore, presents the pairwise correlations between the stock indices. The pairwise correlation matrix is summarised in Table 1.

Table 1. Correlation matrix of crude oil and stock market indices.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Crude Oil	1.000						
(2) Egypt	0.577***	1.000					
(3) Ghana	0.300***	0.335***	1.000				
(4) Morocco	0.934***	0.596***	0.281***	1.000			
(5) Nigeria	0.834***	0.407***	0.292***	0.911***	1.000		
(6) South Africa	0.925***	0.390***	0.210***	0.916***	0.913***	1.000	
(7) Tunisia	0.828***	0.471***	0.059	0.875***	0.698***	0.815***	1.000

Note: ***, **, and * are in respect of *$p < 0.01$, $p < 0.05$, and $p < 0.1$.*

The correlation matrix indicated that stock indices in Morocco, Nigeria, South Africa, and Tunisia, are highly correlated with oil prices whereas the indices for markets in Egypt and Ghana showed moderate and low correlations respectively with crude oil prices. A moderate to high correlation was spotted among ASMs—this presents no collinearity problem since the analysis was made for distinct markets. Furthermore, the returns series somewhat indicate stationary and this property of the series was confirmed statistically, using two approaches, the augmented Dickey-Fuller (ADF) test of Dickey and Fuller (1981) and the Phillips-Perron (PP) test of Phillips and Perron (1988) for which the series proved stationary at first difference. The results of the two tests are presented in Table 2.

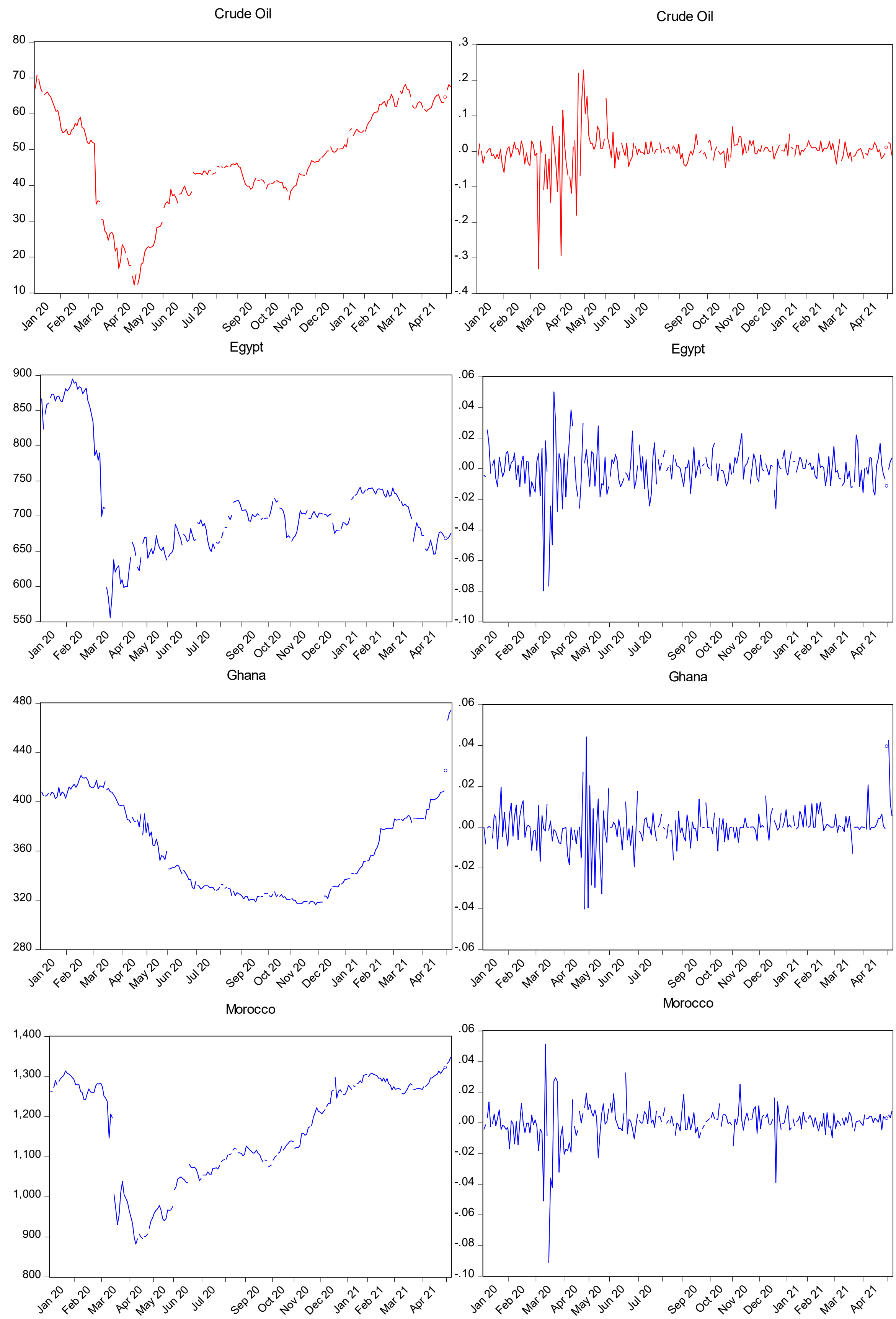

Figure 2. Graphical Representation of Daily Raw Series (Left) and Return Series (Right).

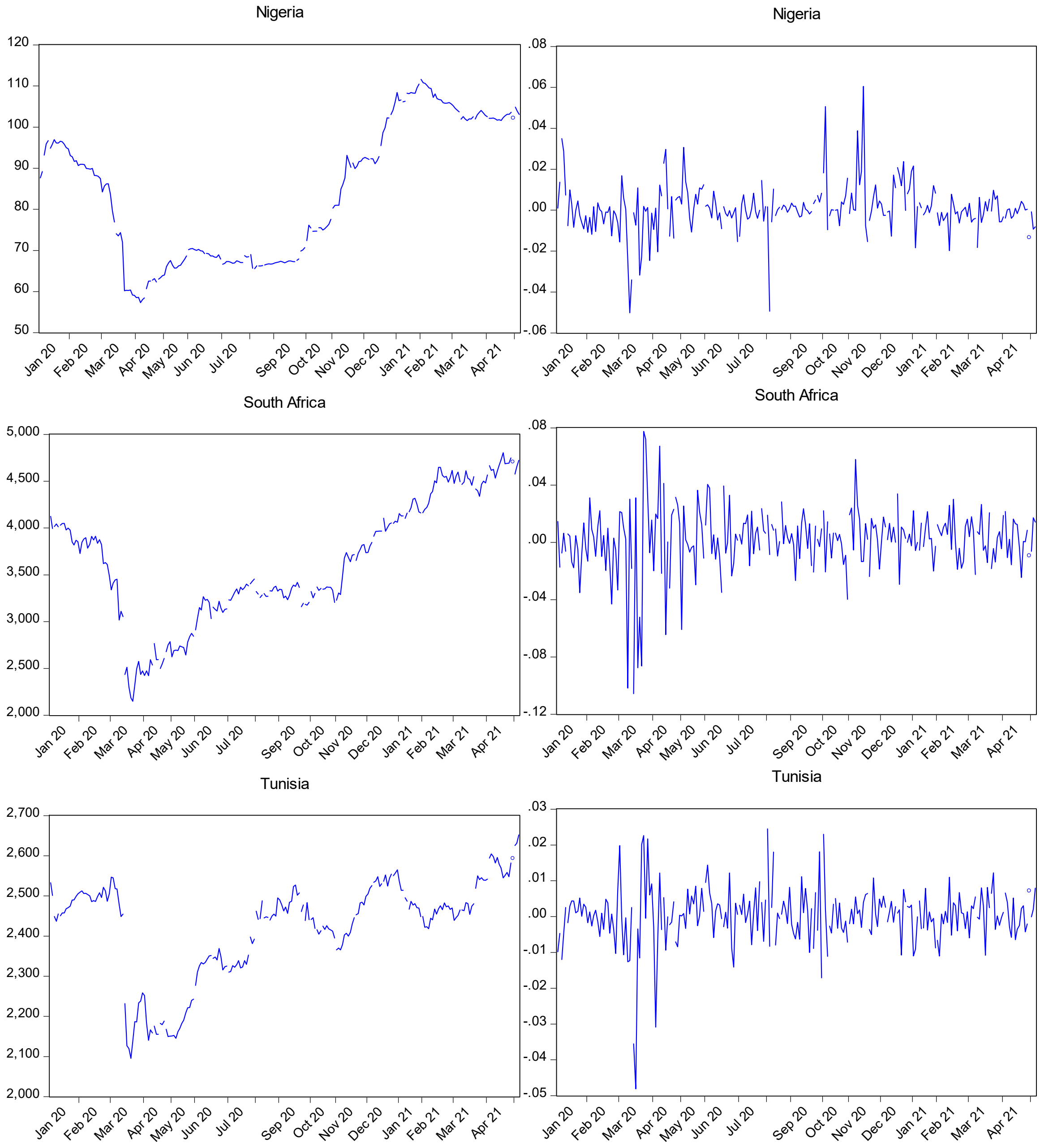

Figure 2. *Continued.*

Together with the unit root tests, Table 2 presents the descriptive statistics of the daily returns of oil prices and stock indices. It is induced from the Jarque-Bera statistics that all the return series depart from normality. Except for Egypt, the mean returns for all stock indices were positive for all stock markets and OPEC crude oil basket price—these mean returns were nearly zero for all ASMs as well as the OPEC oil price. Notably, all the stock markets had deviations in returns lower than that of the oil returns, with Tunisia realising the least deviation over the study period. The ADF and PP tests confirmed, at the first difference, the stationarity properties of the various return series.

Table 2. Descriptive statistics of crude oil prices and stock market indices.

Variable	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	ADF	PP	Obs
ROIL	0.0010	0.0505	−1.3704	18.7121	2543.8020***	−5.9431***	−16.3313***	240
REG	−0.0004	0.0136	−1.3768	12.1644	915.6892***	−14.5013***	−14.4717***	240
RGH	0.0003	0.0096	0.1710	9.6086	437.8991***	−4.3768***	−19.1479***	240
RMC	0.0003	0.0119	−2.2196	20.5157	3265.0510***	−13.5982***	−13.5517***	240
RNG	0.0009	0.0119	0.3455	9.3501	408.0108***	−11.1450***	−11.1450***	240
RSA	0.0019	0.0229	−1.0972	8.2750	326.4131***	−15.8695***	−15.8686***	240
RTN	0.0003	0.0080	−1.0901	10.7466	647.6327***	−13.8495***	−13.8864***	240

Notes: ROIL, REG, RGH, RMC, RNG, RSA, and RTN represent returns on OPEC oil prices, and stock market returns in respect of Egypt, Ghana, Morocco, Nigeria, South Africa, and Tunisia; Obs is observations; *** signifies 1% level of significance.

5. Empirical results

5.1. Main results

The results from the traditional OLS model in Equation (1) and the QR model in Equation (8) are reported by the study in Tables 3, 4, and 5. This is supplemented by the QR coefficient estimates plotted under a confidence interval (CI) of 95% in Figure 3.

The results from the traditional OLS model suggest a positive and significant effect of oil market shocks on stock returns in ASMs—this situation exists among all the sampled countries except for Ghana (where the existing relationship cannot be established statistically at any of the conventional levels of significance) and slightly Tunisia (where the significance of the relationship could be established at the 10% significance level only). This finding from the OLS model is commensurate with those of Arouri and Rault (2012), Jouini (2013) Mohanty et al. (2011), Mensi et al. (2014), Nusair and Al-Khasawneh (2018), Smyth and Narayan (2018), Tzeremes (2021), You et al. (2017) and Yurteri Kösedağlı et al. (2021) who all found a positive influence of oil market volatilities on SMR. The results, however, fail to complement Kelikume and Muritala’s (2019) study which employed a panel estimation and data analysis technique and found that oil price shocks have an adverse impact on stock market returns in Africa. Yet, the findings also support extant literature that proves that oil price shocks directly affect the stock markets of oil-exporting countries (Enwereuzoh et al., 2021; Smyth & Narayan, 2018).

Nevertheless, as empirically established, OLS presents a summary of the middling relationship between the predicted variable and a set of predictor variables, not creating room for variations in the relationship across different market environments. The QR, relative to OLS, provides an all-encompassing view of the relationship by modelling it at specified quantiles of the regressand—offering reliable evidence on the connection between the dependent variable (stock returns) and the independent variable (oil returns) at precise market circumstances such as in a normal market, in a strong market, or a bearish market (Mensi et al., 2014; Naifar, 2016; Nusair & Al-Khasawneh, 2018). In addition, given that financial data is characterised by heterogeneity, normality issues, extreme values, and lop-sidedness, as suggested by Zhu et al. (2016), it is essential to employ a more vigorous estimation technique such as QR, which is capable of handling these issues. Therefore, the study turns attention toward the QR results presented in Table 3. As a supplement to the QR results in Tables 3, 4 and 5, Figure 3 presents summarised plots for the QR coefficients together with the OLS approximations.

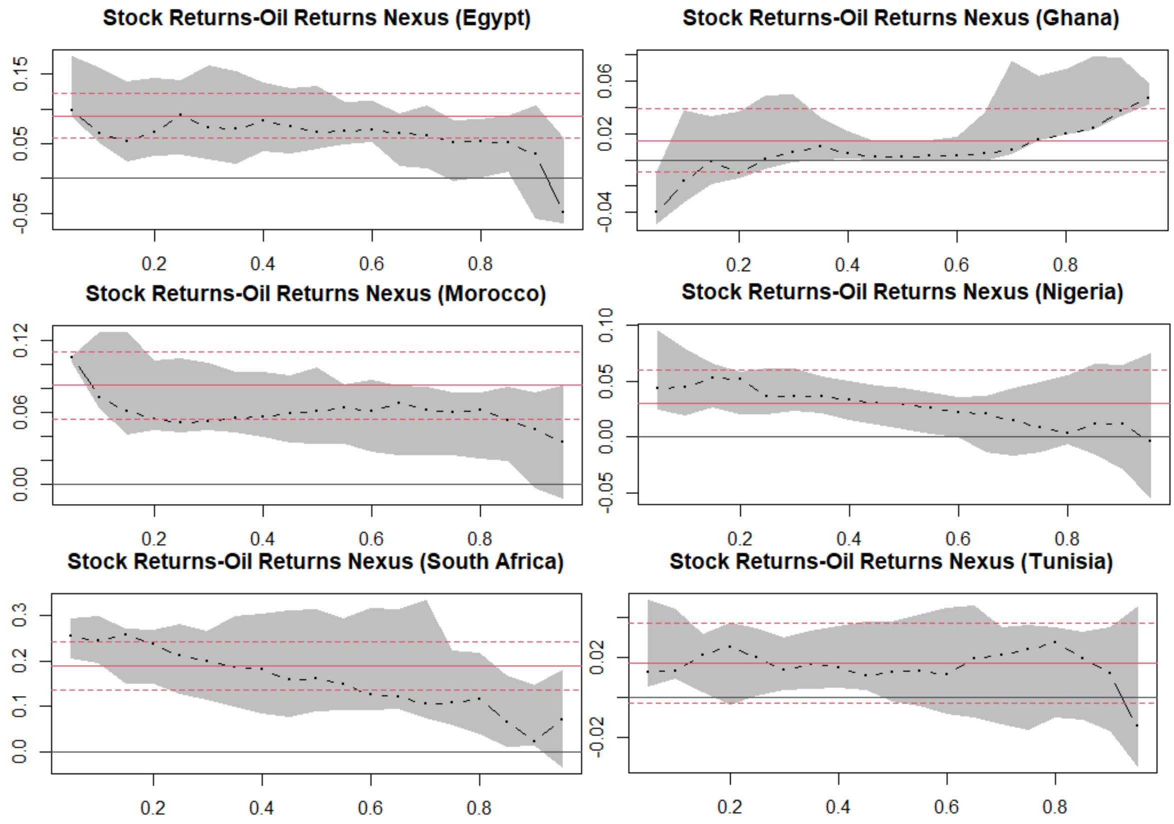

Figure 3. Estimated oil price Coefficients under Quantile Regression.

There is no variation in the OLS approximations of the conditional mean—this is represented by the red solid line, within 95% CI (represented by the red dashed lines). The QR coefficients are represented by black dashed curves within 95% CI (represented by the shaded portions). A total of 19 quantiles ($\tau = 0.05, 0.10, 0.15, \ldots 0.95$) are plotted in Figure 3 for each stock market[1].

At the lower quantiles, the results suggest that across all conditional distributions of stock returns in all the stock markets except for a few quantiles in Ghana ($Q_{0.10\text{-}0.30}$,) and Tunisia (at $Q_{0.20}$), oil price movements significantly influence returns on ASMs, indicating that shocks in oil markets would translate to ASMs with Ghana being an exception. There exists a similar relationship at the intermediate quantiles in all ASMs except for the 50th, 55th, and 60th quantiles ($Q_{0.50,0.55,0.60}$) in Tunisia. Notably, the positive and significant co-movement between the oil and stock markets in the

[1]For the purpose of presentation and identification of variations in market intensity amid the COVID-19, the QR estimates are presented in three levels: Lower Quantiles (extreme market circumstances during the pandemic), Intermediate Quantiles (somewhat normal market circumstances during the pandemic), and Upper Quantiles (strong/active market circumstances during the pandemic).

upper quantiles is inconsistent. The co-movement lacks significance in Egypt ($Q_{0.75,0.90}$), Ghana ($Q_{0.65}$) Morocco ($Q_{90,95}$), Nigeria ($Q_{0.65\text{-}0.95}$), and Tunisia ($Q_{0.65\text{-}0.95}$). This suggests that oil market shocks may not translate in stock markets at upper distributions of stock returns in Africa.

The findings suggest that stock market returns in Africa are more responsive to shocks in oil prices in lower (market stress) and middle (normal market conditions) quantiles—returns on African stocks are less responsive in upper quantiles (strong market environment).

Table 3. OLS and QR coefficients estimates for oil returns at Lower Quantiles.

Country	Variable	OLS	Lower Quantiles					
			$Q_{0.05}$	$Q_{0.10}$	$Q_{0.15}$	$Q_{0.20}$	$Q_{0.25}$	$Q_{0.30}$
Egypt	Intercept	−0.001	−0.020**	−0.014**	−0.011**	−0.009**	−0.007**	−0.005**
	OilR	0.090***	0.098**	0.065**	0.054**	0.066**	0.091**	0.074**
Ghana	Intercept	0.000	−0.014**	−0.009**	−0.006**	−0.004**	−0.002**	−0.001**
	OilR	0.015	−0.040**	−0.017	−0.001	−0.010	0.001	0.006
Morocco	Intercept	0.000	−0.016**	−0.008**	−0.005**	−0.004**	−0.003**	−0.002**
	OilR	0.082***	0.106**	0.072**	0.061**	0.055**	0.051**	0.052**
Nigeria	Intercept	0.001	−0.016**	−0.010**	−0.007**	−0.005**	−0.003**	−0.002**
	OilR	0.030**	0.043**	0.044**	0.053**	0.051**	0.037**	0.036**
South Africa	Intercept	0.002	−0.033**	−0.021**	−0.017**	−0.012**	−0.007**	−0.005**
	OilR	0.189***	0.255**	0.244**	0.257**	0.236**	0.211**	0.198**
Tunisia	Intercept	0.000	−0.011**	−0.008**	−0.006**	−0.004**	−0.004**	−0.003**
	OilR	0.017*	0.013**	0.013**	0.021**	0.025	0.020**	0.014**

OilR is the returns on OPEC oil prices; *, **, and *** signify significance in respect of 10%, 5%, and 1% levels.

Table 4. OLS and QR coefficients estimates for oil returns at Intermediate Quantiles.

Country	Variable	OLS	Intermediate Quantiles					
			$Q_{0.35}$	$Q_{0.40}$	$Q_{0.45}$	$Q_{0.50}$	$Q_{0.55}$	$Q_{0.60}$
Egypt	Intercept	−0.001	−0.003**	−0.002**	0.000	0.001	0.001**	0.002**
	OilR	0.090***	0.071**	0.082**	0.075**	0.067**	0.068**	0.070**
Ghana	Intercept	0.000	−0.001**	0.000**	0.000**	0.000	0.000	0.000**
	OilR	0.015	0.010**	0.005**	0.002**	0.003**	0.003**	0.003**
Morocco	Intercept	0.000	−0.001**	−0.001	0.000	0.001**	0.002**	0.002**
	OilR	0.082***	0.055**	0.056**	0.058**	0.061**	0.064**	0.061**
Nigeria	Intercept	0.001	−0.002**	−0.001**	−0.001**	0.000	0.000	0.001**
	OilR	0.030**	0.036**	0.033**	0.030**	0.029**	0.026**	0.022**
South Africa	Intercept	0.002	−0.003**	−0.001	0.002	0.003**	0.004**	0.007**
	OilR	0.189***	0.187**	0.180**	0.159**	0.160**	0.149**	0.125**
Tunisia	Intercept	0.000	−0.002**	−0.001	0.000	0.001**	0.001**	0.002**
	OilR	0.017*	0.017**	0.015**	0.011**	0.013	0.013	0.011

OilR is the returns on OPEC oil prices; *, **, and *** signify significance in respect of 10%, 5%, and 1% levels.

Table 5. OLS and QR coefficients estimates for oil returns at Upper Quantiles.

Country	Variable	OLS	Upper Quantiles						
			$Q_{0.65}$	$Q_{0.70}$	$Q_{0.75}$	$Q_{0.80}$	$Q_{0.85}$	$Q_{0.90}$	$Q_{0.95}$
Egypt	Intercept	−0.001	0.003**	0.004**	0.006**	0.007**	0.009**	0.012**	0.020**
	OilR	0.090***	0.065**	0.062**	0.052	0.053**	0.051**	0.034	−0.049
Ghana	Intercept	0.000	0.001**	0.002**	0.004**	0.006**	0.007**	0.011**	0.014**
	OilR	0.015	0.005	0.007**	0.016**	0.020**	0.024**	0.037**	0.047**
Morocco	Intercept	0.000	0.003**	0.004**	0.004**	0.005**	0.007**	0.008**	0.014**
	OilR	0.082***	0.068**	0.062**	0.059**	0.062**	0.053**	0.045	0.035
Nigeria	Intercept	0.001	0.002**	0.003**	0.005**	0.007**	0.009**	0.012**	0.019**
	OilR	0.030**	0.021	0.014	0.009	0.003	0.011	0.011	−0.004
South Africa	Intercept	0.002	0.009**	0.011**	0.012**	0.014**	0.020**	0.023**	0.032**
	OilR	0.189***	0.120**	0.106**	0.107**	0.116**	0.066**	0.022**	0.069
Tunisia	Intercept	0.000	0.003**	0.003**	0.004**	0.005**	0.007**	0.008**	0.012**
	OilR	0.017*	0.019	0.021	0.024	0.027	0.020	0.012	−0.014

OilR is the returns on OPEC oil prices; *, **, and *** signify significance in respect of 10%, 5%, and 1% levels.

The intuition behind the results is that oil-exporting economies that are yet to develop largely depend on oil reserves and so when there are shocks in the oil market, they tend to benefit in the form of GDP growth when prices are on the rise whereas GDP declines are experienced when there are reductions in oil prices (Nusair, 2016; Nusair & Al-Khasawneh, 2018)—hence, at lower tails (market stress) in the COVID-19 pandemic, volatilities in oil markets tend to greatly impact stock markets, just as Nusair and Al-Khasawneh (2018) establish in GCC economies. The effect of oil returns' shocks was generally found to be intense at the lower tails than in the intermediate and upper tails. The responsiveness of oil producers to shocks could further be substantiated by the financial resource curse, as highlighted by Kassouri et al. (2020).

Amid the COVID-19 pandemic, when there are low returns on stocks, investors would rather venture into oil to diversify the risk associated with stock returns. Hence, declining oil prices in market stress would cause investors to dispose of their shares as a result of panic and sentiments about the state of the economy—they may fail to achieve diversification when crude oil is combined with stocks. Rather, the fairly satisfactory co-movement of crude oil and stocks at the mid-tails could lure investors to commit funds into crude oil in addition to stocks to diversify their portfolio. This reaction, according to Nusair and Al-Khasawneh (2018), could be attributed to the "herd behaviour"—implying the propensity that investors would mimic the actions of a larger group. Thus, the safe haven properties of crude oil may fail to manifest during the COVID-19 pandemic in ASMs. This finding is commensurate with the discoveries of Zhu et al. (2016), who discovered significant interrelations at the lower tails but no connection at the upper tails when they studied the interdependence between oil and stock markets returns in the Chinese context.

In the case of Ghana, where a significant negative co-movement is spotted at the 5th quantile but no other significant relationship in the remaining lower quantiles, the findings suggest that a very weak safe haven property of oil could be enjoyed by investors only when there is extreme market stress (in respect of stock returns) amid the COVID-19 pandemic. However, this condition is inconsistent with other quantiles. Besides, the condition may fail to hold given that the slope estimates are statistically not different from other quantiles. Besides, neither diversification nor safe haven opportunities could be viable when crude oil is combined with stocks in a portfolio in the Ghanaian economy when there exists extreme market stress. However, the results suggest that diversification in the Ghanaian context, in addition to Egypt, Morocco, South Africa, and Tunisia, is viable when the market condition resembles either a normal one or a strong one during the pandemic.

It is important to note that the results confirm hypothesis *H1* that a change in crude oil returns causes a change in stock returns. Likewise, hypothesis *H2* is confirmed given that the comovement between oil and stock returns is statistically distinct across quantiles of the traditional quantile regression model.

To test for equality of quantile slopes, the Joint test equality of slopes was undertaken with the results presented in Tables 6 and 7. The test evaluates the null hypothesis (H_0) that the parameters of the slope are statistically indifferent across all quantiles. A rejection of the H_0 suggests that the slopes differ statistically across quantiles. Tables 6 and 7 present the *p*-values for the H_0 for Joint Test Equality of Slopes. The first half of the test distribution is presented in Table 6 whereas Table 7 contains the second half of the test distribution.

Table 6. Joint test equality of Quantile Slopes (first half of the distribution).

Country	$Q_{0.05}=Q_{0.10}$	$Q_{0.10}=Q_{0.15}$	$Q_{0.15}=Q_{0.20}$	$Q_{0.20}=Q_{0.25}$	$Q_{0.25}=Q_{0.30}$	$Q_{0.30}=Q_{0.35}$	$Q_{0.35}=Q_{0.40}$	$Q_{0.40}=Q_{0.45}$	$Q_{0.45}=Q_{0.50}$	$Q_{0.50}=Q_{0.55}$
Egypt	0.259	0.618	0.510	**0.009**	**0.031**	0.717	0.117	0.370	0.250	0.904
Ghana	0.432	0.312	0.199	**0.039**	0.434	0.666	**0.003**	0.210	0.883	0.949
Morocco	0.495	0.273	0.406	0.612	0.861	0.569	0.704	0.348	0.186	0.528
Nigeria	0.986	0.651	0.909	0.110	0.952	0.988	0.399	0.534	0.450	**0.033**
South Africa	0.886	0.721	0.438	0.180	0.537	0.539	0.709	0.067	0.874	0.532
Tunisia	0.977	0.274	0.564	0.364	0.316	0.518	0.722	0.309	0.600	0.904

p-values in bold fonts suggest a refusal to accept the null hypothesis of slope equality—hence, a rejection of H_0.

Table 7. Joint test equality of Quantile Slopes (second half of the distribution).

Country	$Q_{0.55}=Q_{0.60}$	$Q_{0.60}=Q_{0.65}$	$Q_{0.65}=Q_{0.70}$	$Q_{0.70}=Q_{0.75}$	$Q_{0.75}=Q_{0.80}$	$Q_{0.80}=Q_{0.85}$	$Q_{0.85}=Q_{0.90}$	$Q_{0.90}=Q_{0.95}$	$Q_{0.05}=Q_{0.50}$	$Q_{0.50}=Q_{0.95}$
Egypt	0.549	0.545	0.667	**0.025**	0.939	0.942	0.552	0.162	0.404	0.127
Ghana	0.925	0.449	0.499	**0.032**	0.292	0.368	0.688	0.770	0.285	**0.000**
Morocco	0.460	0.079	0.174	0.434	0.451	0.360	0.711	0.838	0.446	0.684
Nigeria	0.216	0.710	0.560	0.599	0.648	0.647	0.991	0.800	0.856	0.670
South Africa	0.154	0.776	0.455	0.963	0.651	**0.000**	0.232	0.514	0.348	0.323
Tunisia	0.782	0.468	0.859	0.652	0.581	0.269	0.321	0.608	0.993	0.624

p-values in bold fonts suggest a refusal to accept the null hypothesis of slope equality—hence, a rejection of H_0.

The test is undertaken for each pair of quantiles (for instance, $Q_{0.05} = Q_{0.10}$), together with the lower quantile versus the mid-quantile ($Q_{0.05} = Q_{0.50}$) and the mid-quantile versus the upper quantile ($Q_{0.50} = Q_{0.95}$). In totality, the results indicate that the H_0 of equality of slopes across quantiles cannot be rejected at diverse quantiles as well as low and upper quantiles in all the markets with only a few country-and quantile-specific exceptions. The intuition is that the approximated coefficients are statistically not different across quantiles. Thus, across all distributions of stock returns, the estimated slopes are statistically equal– thus, the linear QR model holds for this study. Since the traditional QR suffices for our estimated model and results, there is no need to go ahead with a quantile-on-quantile regression. This is confirmed through a robustness check of the results.

5.2. Robustness

To assess the robustness of the results, we follow Balcilar et al. (2016) to establish causality in means, using the non-parametric Granger-quantile-causality approach. The nonparametric causality-in-quantiles includes all quantiles in the distribution, as opposed to the basic Granger test that only examines the median (Jena et al., 2019). As a result, this method may demonstrate how causality works in both low and high crude oil returns. The results are pictorially shown in Figure 4.

The quantile causality tests between crude oil returns and African stock markets' (ASMs) returns in mean for daily data are shown in Figure 4. In each plot, test statistics are shown (the vertical axis) against the matching quantiles on the horizontal axis. The horizontal solid line corresponds to a crucial value (CV) of 1.96 at the 5% significance level.

The null hypothesis, in this case, holds that a change in crude oil returns does not Granger-cause a change in stock returns. For instance, the null hypothesis—that crude oil does not Granger-cause stock returns—is rejected ($p < 0.05$) spanning the quantile ranges of 0.55–0.60 in the causality test for crude oil to the Egyptian stock returns; 0.05–0.80 for Ghanaian stock returns, and between 0.20–0.75 for Nigerian stock returns. Exceptional countries are Morocco, South Africa, and Tunisia. Thus, aside from Moroccan, South African, and Tunisian stocks, we reject the null hypothesis for all other stock markets such that changes in crude oil returns have a strong predictive power on changes in their stock market returns. The differences may be ascribed to jurisdictional peculiarities and variations in the measures taken against the containment of the COVID-19 pandemic (Agyei et al., 2021; Agyei et al., 2022a; Bossman et al., 2022a).

Asymmetric and nonlinear impact of COVID-19 on financial markets has been established (Agyei et al., 2022b; Asafo-Adjei et al., 2021b; Bahloul & Khemakhem, 2021; Bahloul et al., 2021; Bossman et al., 2022b). Hence, the different relationships across quantiles and markets revealed in this study are not so different from some of the conclusions attributable to the extant literature.

Since causality is established in different quantiles, the significance and robustness of the findings from the QR approach could be substantiated.

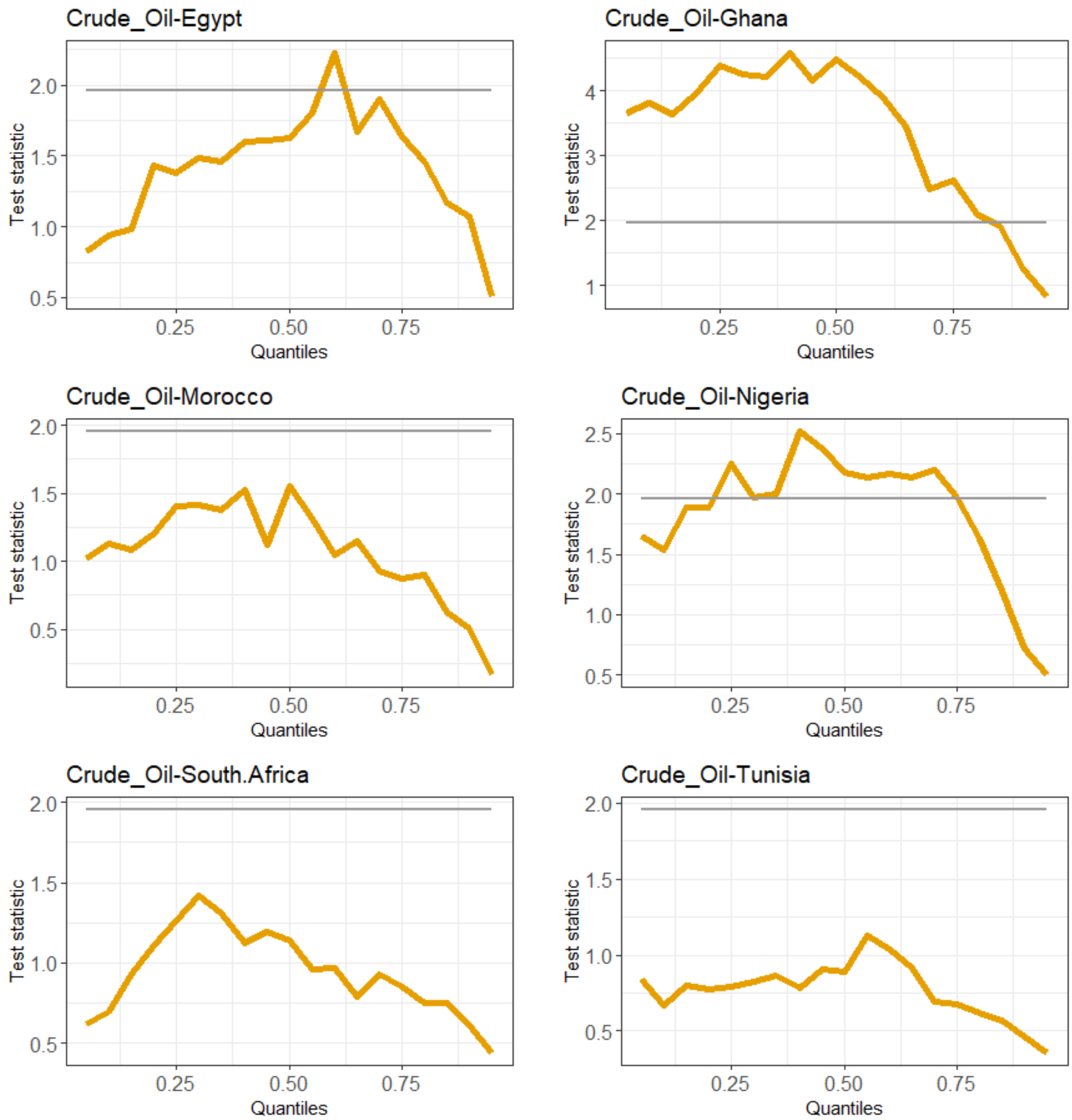

Figure 4. Causality in means test across quantiles.

5.3. Practical implications of findings

The study's findings emphasise the use of the quantile approach to examine the oil-stock nexus among African oil exporters. We highlight the asymmetries in the oil-stock relationship even in the COVID-19 era. These asymmetries suggest that policy responses may not follow a usual approach where issues (i.e., oil price volatilities) are responded to as and when they occur, particularly in the case of African markets. Rather, proactive and dynamic policy responses are required to withstand the non-linear effects of oil price shocks on African stock markets since the relationship varies significantly across quantiles. This explains why using a linear approach to study the link between oil price volatilities and returns on other assets may conceal asymmetric relationships that exist between the variables (Kassouri & Altıntaş, 2020).

Furthermore, the findings indicate that African stock markets respond to oil price shocks in stressed market conditions and from a theoretical standpoint, we attribute this to the financial resource curse hypothesis. African oil exporters are yet to develop owing to their largescale dependence on oil reserves. As a collar to their high dependence on oil reserves and the high susceptibility of African economies to crude oil price shocks, any unfavourable shocks to the crude oil market, such as the one occasioned by the COVID-19 pandemic, tend to result in declines in their level of national output, which would translate into the worse performance of the various sectors in the economy.

To attract investors into various African economies, the reliance on crude oil reserves may have to be limited to mitigate the shocks that transmit to African economies in market downturns. Investors should note that the diversification and/or safe haven prospects between crude oil and African stock markets differ across market conditions and even across economies. As a result, investors must adapt to market conditions after taking note of any dynamic market trends owing to structural breaks, as hypothesised by the adaptive markets hypothesis. The focus on proactive regulatory measures may render African stocks lucrative for investors who hold oil in their portfolios. Hence, market participants should align their policies to create attractive economies from which their stock markets could be a means of attracting capital flows.

6. Conclusions

Undoubtedly, the world is still at a battle with possible containment of the COVID-19 pandemic, as it presents uncertainties in global economic activities. Notably, empirical works project more predicaments and related consequences to hit financial markets. Scholars and pressure groups are hence, calling for further inquiry into the pandemic to unveil practical measures as to its containment. Moreover, it is essential to note that the COVID-19 pandemic stands the chance to further modify the role of investable instruments such as safe haven assets. Therefore, assessing the intrinsic characteristics of investable instruments during the pandemic is unshakingly important because the request for safe haven instruments is at its peak during pandemics. One notable asset that has experienced sharp and unprecedented volatilities in the market for crude oil. The safe haven properties of crude oil should, therefore, be re-assessed.

The study examined the co-movement of oil and stocks amid the COVID-19 period under a nonparametric approach to reveal the nature of the relationships that exist between the two assets across different market conditions. The quantile regression estimation technique was employed to overcome the weaknesses of the traditional OLS regression. The QR allows provides an all-encompassing overview of the oil-stock nexus at specified tails of the dependent variable (stock returns), when the market is either weak, normal, or strong.

By employing daily OPEC basket price for crude oil and daily data on stock market indices for six major stock markets of oil-exporting economies in Africa—Egypt, Ghana, Morocco, Nigeria, South Africa, and Tunisia from 02 January 2020 to 06 May 2021—yielding 240 observations, the results suggest that shocks in the crude market are directly related to stock market returns. Notably, positive movements in oil prices translate positively in ASMs at the lower tails more than at the mid-and upper tails. The extent of the effect of oil price shocks is tail dependent. No signs of safe haven were spotted in ASMs across the various conditional distributions of stock returns. However, the results suggest diversification rather than safe haven opportunities for investors. Pandemic-related sentiments of investors are likely to induce investment patterns in times of oil price shocks in the pandemic. For investors in search of safe haven assets in their portfolios, reductions in oil prices at the higher tails of stock returns may cause them to sell their shares. However, investors aiming at diversification could easily benefit from oil price volatilities in the pandemic. In oil-exporting economies in Africa, a minimum variance portfolio may fail with crude oil during the COVID-19 pandemic.

Investors should consider crude oil markets for diversification rather than safe haven assets in their portfolios. Policymakers in Africa, especially in oil-exporting economies are recommended to critically follow oil price movements since volatilities in oil prices have a significant influence on stock market returns. Information flows across the markets should be properly regulated to prevent panic investment decisions on the part of investors. Since safe haven may not be viable with crude oil, regulators and/or governments should devise strategies to strengthen the market for crude oil to lessen adverse volatilities during the COVID-19 pandemic—thereby, mitigating downward returns in stock markets.

Future works could fully extend Kassouri et al.'s (2020) analysis of the financial resource curse hypothesis in the African context. Similarly, the information flow dynamics between oil exporters and the level of economic activity and stock market performance could be quantified, taking into consideration the nonlinearities and market asymmetries.

Data availability statement

The OPEC basket of crude oil prices used in the analysis was assessed from the Database of OPEC (https://www.opec.org/opec_web/en/data_graphs/40.htm) and the data on stock indices were supplied by EquityRT.

Conflicts of interest

The authors declare that they hold no form of conflicting interests.

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