Resilience Amidst Turbulence: Unraveling COVID-19's Impact on Financial Stability through Price Dynamics and Investor Behavior in GCC Markets

Mariem Talbi[1], Monia Ferchichi[1], Fatma Ismaalia[1] & Samia Samil[1]

[1] Department of Management Information Systems, Applied College, University of Ha'il, Saudi Arabia, KSA

Correspondence: Monia Ferchichi, Applied College, University of Ha'il, Saudi Arabia. Tel: 966-550-215-575. E-mail: ferchichimonia@yahoo.fr

Abstract

Conducted within the backdrop of the COVID-19 pandemic, the paper rigorously investigates the influence of this global crisis on the foreign stock markets of diverse GCC countries. Our research employs a multifaceted approach, combining an adjusted correlation test across six distinct stock markets over a substantial timeframe—from January 2, 2001, to April 31, 2021.

Employing sophisticated methodologies including FIEGARCH (1.1), DCC-MGARCH(1,1), and Switching-Markov analyses, we intricately scrutinize the impact of the pandemic on these markets. Our comprehensive analysis uncovers compelling evidence demonstrating the pandemic's profound effects across the majority of GCC countries' markets. Notably, these markets exhibit an increased vulnerability to the negative repercussions induced by the COVID-19 crisis.

The implications stemming from these findings are far-reaching, particularly in the realm of financial policy-making, risk assessment, asset valuation, and portfolio management strategies. Understanding the heightened susceptibility of these markets during financial downturns is crucial for policymakers, investors, and portfolio managers, empowering them with critical insights to navigate and formulate informed strategies amidst such challenging times.

Keywords: DCC-MGARCH, FIEGARCH, Switching-Markov analysis, investment decisions, COVID-19 Pandemic, GCC markets

JEL Classifications: G11-G41.

1. Introduction

This paper explores the impact of the COVID-19 pandemic on stock market behavior and investor sentiment, analyzing the correlation between stock market returns and global performance pre and post-outbreak. Scholars and organizations like Baker et al. (2020), Huynh et al. (2021), and Salisu and Akanni (2020) have highlighted the pandemic's significant socio-economic consequences, including forecasts of demand and supply shocks and financial disruptions (OECD, 2020; World Bank, 2020). Research indicates heightened volatility and reduced stock returns following COVID-19 (Al-Awadhi et al., 2020; Baker et al., 2020; Ramelli & Wanger, 2020; Shaikh & Huynh, 2021; Sharif et al., 2020; Zaremba et al., 2020; Zhang et al., 2020), revealing the pandemic's adverse impact on market sentiment and economic uncertainties (Capelle-Blancard & Desroziers, 2020). The intricate relationship between pandemic information intensity, investor sentiment, and stock market activity remains a relatively underexplored area.

Our study focuses on two key research questions. Firstly, we investigate the connection between investor sentiment, as gauged by the Global Investment Return (TIR), and market behavior indicated by stock market returns before and after the COVID-19 era. Understanding the interaction between pandemic uncertainty and these variables is crucial, particularly considering the notable surge in investor fear within the equity segment induced by COVID-19, a phenomenon reminiscent of past market crashes (Shaikh & Huynh, 2021).

This heightened fear could significantly influence investment sentiments and decisions (Costola et al., 2021; Huynh et al., 2021; Salisu & Akanni, 2020), potentially leading to overreactions to negative information (Chen et

al., 2021). Due to the uncertainty surrounding the full impact of pandemic-related news on market dynamics, participants may tend to either underreact or overreact to emerging information (Shiller, 2003). Behavioral finance suggests that psychological biases among investors are magnified during periods of heightened uncertainty (Donadelli et al., 2017; Garcia, 2013). Therefore, our hypothesis aligns with the idea that increased pandemic-induced uncertainty (Baker et al., 2020) is likely to fuel a pessimistic investor sentiment.

The lack of empirical evidence exploring the time-varying relationship between pandemic information demand (Pandemic uncertainty or pandemic attention) and investor sentiment underscores a critical research gap. Our study addresses two primary gaps in empirical research concerning the COVID-19 impact on aggregate stock market behavior, namely stock returns, volatility, and market liquidity. While existing studies predominantly focus on stock returns and volatility (Anastasiou et al., 2022; Costola et al., 2020; Chen et al., 2021; Tripathi & Pandey, 2021; Vasileiou, 2021; Wang et al., 2021; Zaremba et al., 2020), the effects on market liquidity have been largely overlooked. Furthermore, there is a lack of adequate control over prevailing exogenous market sentiment when analyzing the impact of COVID-19 pandemic uncertainty on stock market activity.

Our analytical framework begins by examining the correlation between Global Investment Return and Stock Market Return during the COVID-19 pandemic. We then dissect the independent impacts of pandemic uncertainty on investment return and stock market return. Using monthly data on total investment return (TIR) and stock market return, we apply the Dynamic Conditional Correlation (DCC-MGARCH), Fractionally Integrated EGARCH (FIEGARCH), and the Switching Markov-Model to capture the effects of COVID-19 on the stock market within GCC countries.

This empirical approach enables us to understand the pandemic's impact on both sentiment and stock market behavior, comprehensively elucidating their potential interrelationship. Our investigation scrutinizes the oscillations between these variables across distinct phases, meticulously considering the effects of the pandemic on stock market return and Global Investment Return. Employing DCC-MGARCH, FIEGARCH, and Switching-Markov methodologies helps neutralize the influence of common dependence between exogenous market sentiment and investor sentiment, enriching our analytical depth.

Our findings demonstrate a significant alteration in the correlation between Global Investment Return and stock market return, revealing a positive correlation before the COVID-19 outbreak. However, post-pandemic onset, this correlation diminishes, underscoring the substantial impact of COVID-19 on both market and investor behavior. The results notably indicate a surge in pessimistic investor sentiment following the pandemic spread, particularly evident from March 1, 2020, coinciding with the global declaration of COVID-19 as a pandemic. Additionally, our research highlights a clear relationship between investor sentiment and market behavior across GCC countries, a relationship that persists across alternative measures of pandemic assessment, enhancing the robustness of our findings.

This paper significantly contributes to the growing discourse on the COVID-19 impact on market behavior by providing preliminary evidence of pandemic-induced uncertainty and its effects on stock market returns. While prior literature focused primarily on returns and volatility dimensions within stock market behavior, this study pioneers by examining the impact of the pandemic on stock market returns amid its spread, filling a critical void in existing research.

Furthermore, our research enhances the ongoing dialogue concerning the interplay between market behavior and investor sentiment. While existing literature often neglects the effect of exogenous sentiment on the market and vice versa, our empirical approach introduces novelty through the utilization of DCC-MGARCH, FIEGARCH, and Switching-Markov analyses. These methodologies, particularly Dynamic Conditional Correlation, facilitate a nuanced understanding of the relationship between Global Investment Behavior and Stock Market Behavior across various periods, enriching our exploration of sentiment variations and their impact on market prices.

In essence, this paper extends the literature on the implications of COVID-19, specifically examining its impact on Stock Market Return and Global Investment Return, offering crucial insights that resonate within the evolving financial landscape.

This paper is organized as follows: The first section provides a comprehensive review of both theoretical frameworks and empirical studies. The second section outlines the methodology, data sources, and variables employed in the analysis. In the third section, the empirical findings are presented and analyzed. Lastly, the fourth section encapsulates the concluding remarks of this research.

2. Literature Review

The global financial landscape faced an unprecedented challenge with the emergence of the COVID-19 pandemic

in early 2020, as noted by Contessi and De Pace (2021), OECD (2020), and the World Bank (2020). Termed an extraordinary and uncontained epidemic by Shaikh and Huynh (2021), its disruptive impact on financial markets and consequent international health crises has been extensively documented in recent literature. Baker et al. (2020) highlighted the striking volatility in the U.S. stock market during the first quarter of 2020, surpassing historical events such as the Great Depression and the Spanish Flu pandemic, underscoring the magnitude of its effects.

Examining recent literature, a profound decline in liquidity, increased volatility, diminished returns, and cross-market economic shock transmission have been identified as direct consequences of the pandemic outbreak (Al Guindy, 2021; Baker et al., 2020; Contessi & De Pace, 2021; Huynh et al., 2021; Paule-Vianez et al., 2021; Rubbaniy et al., 2021; Shaikh & Huynh, 2021; Xu et al., 2021; Zaremba et al., 2020; Zhang et al., 2021). However, the methods employed to measure these impacts vary widely across studies, incorporating diverse metrics such as the Global COVID-19 fear index, pandemic anxiety indices, and COVID-19-positive sentiment indexes (Al-Awadhi et al., 2020; Baker et al., 2020; Costola et al., 2021; Chundakkadan & Nedumparambil, 2021; Shaikh & Huynh, 2021; Smales, 2021; Szczygielski et al., 2022; Yu et al., 2021; Vasileiou, 2021; Zhang et al., 2021).

However, despite the extensive research, several challenges persist in understanding the pandemic's impact on market sentiments and behaviors. Foremost among these is the reliance on proxies such as pandemic search intensity or fear indexes to gauge investor sentiment, often oversimplifying the complex dynamics underlying market behavior (Sun et al., 2021; Zhang et al., 2021). For instance, Wang et al. (2021) suggest that an overwhelming focus on COVID-19 may asymmetrically impact the equity market, exacerbating pessimistic sentiment. Additionally, the theoretical underpinnings of pandemic information searches as indicators of fear or uncertainty align closely with investor attention-based sentiment measures, potentially overlooking nuanced market dynamics (Da et al., 2015; Burggraf et al., 2021; Goel & Dash, 2021; Smales, 2021). Emphasizing the role of investor emotions, prior studies have shown their significant impact on market fluctuations and asset allocation strategies (Talbi et al., 2024; Al Guindy, 2021; Garcia, 2013; Sun et al., 2021; Tetlock, 2007; Wang et al., 2021).

Talbi et al. (2024) found COVID-19 contagion in foreign stock markets of developed nations. Their analysis from February 1, 1992, to April 31, 2021, revealed significant pandemic impacts, guiding decisions for policymakers, investors, and portfolio managers amidst market fluctuations.

Yusuf and Ali (2023) examined the COVID-19 impact on the Saudi Stock Exchange (Tadawul) using TASI data. They observed a significant decline in TASI performance and increased market volatility after March 2, 2020, confirmed by advanced statistical tests. Niculaescu et al. (2023) found COVID-19 influenced decision-making among US retail investors, leading to a substantial increase in investments, particularly among those directly affected by the pandemic. Zhu et al. (2023) investigated social media sentiment's impact on US stock market returns pre, during, and post the COVID-19 outbreak, noting a decline in sentiment reliability during peak pandemic periods.

Zhang et al. (2023) introduced Australia's inaugural sentiment index, revealing its correlation with global and US trends and its influence on short-term anomaly returns within the Australian stock market. Naeem et al. (2023) analyzed COVID-19's impact on US Exchange-Traded Funds (ETFs), emphasizing their interconnectedness, identifying volatility phases, and highlighting psychological indicators' influence on market fluctuations. Their recommendations stressed diversification, prudent policy adjustments, and regulatory measures to address stability concerns during extreme volatility.

Costola et al. (2023) analyzed COVID-19 news impact on early financial markets, finding significant correlation between news sentiment and the S&P 500, with varied impacts from different news categories. Almeida and Gonçalves (2023) studied cryptocurrency investor behavior, revealing trends like herding behavior and market-driven irrationality, offering insights for future research and regulatory measures.

Bossman et al. (2023) explored interactions among EU sectoral stocks, oil, volatility, and market sentiment during geopolitical unrest, noting EU stocks' potential for hedging against geopolitical risks and emphasizing volatility and market sentiment as hedging tools. Luo et al. (2023) analyzed social media emotions during crises, finding negative sentiment amplifies information volume and influence, aiming to provide insights for managing sentiment during emergencies.

Catelli et al. (2023) analyzed Italian tweets from Jan 2021 to Feb 2022 about COVID-19 vaccinations, noting overall negative sentiment, especially among Common users, and diverse attitudes during events like post-vaccination deaths. Ben Ammar et al. (2023) used TYDL causality testing to study market interdependence, proposing a portfolio management approach focused on minimizing causal intensity. They found heightened interdependence and altered causal structures during events like COVID-19 and the Russian-Ukrainian conflict, emphasizing the need for adaptable strategies.

Kyriazis et al. (2023) examined COVID-19-era Twitter sentiment's influence on cryptocurrencies, revealing diverse effects on returns and volatility, particularly among lower-value cryptocurrencies, which remained profitable due to investors' cohesive behavior. Balcilar et al. (2023) explored increasing interconnection among 26 regional house prices in Türkiye during economic instability from 2010 to 2022, revealing amplified connectivity aligned with economic volatility and a positive correlation between consumer sentiment and increased connectivity post-crisis.

Klöckner et al. (2023) categorized organizational responses to COVID-19 into five types, highlighting variations in scope and strategic focus. Positive stock market reactions to certain strategies provided insights into effective crisis management. Apergis et al. (2023) found that rising COVID-19 death rates increased market fear, influencing volatility in the US financial market. They emphasized the importance of US policies in addressing financial market impacts.

Papadamou et al. (2023) revealed that intensified COVID-19-related Google searches accelerated financial market information flow, increasing implied volatility. In Europe, such searches amplified the VIX's impact, affecting market risk perception. Hoang et al. (2023) observed a surge in insider selling after the early global COVID-19 cases, particularly in countries with weaker information systems. They emphasized the role of transparent business systems in rebuilding investor trust amid uncertainty.

Liu et al. (2023) revealed cyclic sentiment patterns in stock markets through their Investor Confidence Index (ICI), emphasizing the correlation between sentiment and market dynamics. Ben Cheikh et al. (2022) found diverse GCC stock market interconnections amid COVID-19, suggesting Gulf markets as diversification options for investors. Al-Kandari et al. (2022) highlighted consistent negative impacts of COVID-19 on GCC markets using Event Study Methodology.

Alkhatib et al. (2022) identified Bahrain and Kuwait as most affected by COVID-19 in GCC markets, suggesting measures to mitigate losses. Wasiuzzaman (2022) noted minor effects of COVID-19 on most Saudi stock market indices but significant changes in specific sectors, emphasizing the importance of diversification during crises. Dash and Maitra (2022) linked rising Google search data on pandemic uncertainty with negative investor sentiment during early COVID-19, emphasizing its global impact on stock markets.

Yuan et al. (2022) utilized Google search data to analyze COVID-19's financial contagion across 26 global stock markets, revealing diverse effects influenced by market conditions, development levels, regions, and contagion directions. Xu et al. (2022) explored global sentiments on COVID-19 vaccines on Twitter, revealing contrasting attitudes shaped by case numbers and public concerns, offering insights into cultural identity and international relations theories.

Banerjee et al. (2022) investigated the unidirectional relationship from COVID-19 news sentiment to cryptocurrency returns using transfer entropy analysis, providing valuable insights for navigating the cryptocurrency market. Aharon et al. (2022) explored the link between media sentiment on COVID-19 and sovereign yield curve components across G-7 countries, identifying significant risk transmitters and receivers.

Buchheim et al. (2022) studied the impact of COVID-19 shutdown sentiments on German firms, noting their significant influence on anticipated shutdown durations and overall outlooks, particularly for pessimistic firms opting for substantial actions. Ardiyono (2022) found that Covid-19 led to revenue declines in ASEAN-5 firms, correlating with employment reductions, reflecting varied labor adjustments.

Abuzayed and Al-Fayoumi (2021) discovered significant oil price risk spillover to GCC stock markets during the pandemic, urging investors to consider these effects in portfolio strategies. Elhassan (2021) confirmed enduring volatility in GCC stock markets due to Covid-19, advocating diversified portfolios and risk mitigation strategies. Sun et al. (2021) observed a positive sentiment toward the medical industry amidst the pandemic in markets across China, Hong Kong, Korea, Japan, and the US.

John and Li (2021) noted amplified jump volatility by Covid-19 sentiments in stock and option markets, mitigated by Government relief efforts, especially in Banking and Lockdown sentiments within the S&P 500. Abdeldayem and Al Dulaimi (2020) found a positive association between pandemic risk expectations and herding behavior in GCC stock markets during the crisis, consistent across various model specifications.

3. Methodology

Within the scope of our study, contagion is defined in accordance with the framework proposed by Forbes and Rigobon (2002). It refers to a substantial increase in inter-market linkages triggered by a shock affecting a particular country or a group of countries.

To conduct our empirical analysis, we adopt the methodology introduced by Chiang et al. (2007). Their examination of the Asian crisis employed a DCC-GARCH(1,1) model and encompassed tests focused on adjusted correlation coefficients (Talbi et al., 2024).

3.1 Dynamic Conditional Correlations' Asymmetric Model (DCC-GARCH (1.1)) Engle (2002)

We employ Engle's DCC-MGARCH model (2002) to delve into the ramifications of the COVID-19 pandemic on both Total Investment Returns and Stock Market Returns. A pivotal advantage of this model lies in its capacity to discern alterations in conditional correlations across time frames, allowing for the identification of dynamic investor responses to news and market shifts.

Furthermore, the dynamic conditional correlations gauged by this model offer a fitting avenue to scrutinize potential contagion effects, notably herding behavior, within emerging financial markets during periods of crisis. Corsetti et al. (2005), Chiang et al. (2007), and Syllignakis and Kouretas (2011) lent credence to this observation.

The DCC-MGARCH model, noted by Chiang et al. (2007), computes correlation coefficients of standardized residuals while adjusting for heteroscedasticity and remains insensitive to volatility fluctuations. Cho and Parhizgari (2008) demonstrated that unlike the volatility-adjusted cross-market correlations by Forbes and Rigobon (2002), the DCC-GARCH model offers a more robust measure of correlation by dynamically adjusting correlation measurements to evolving volatility.

Engle's DCC-GARCH model estimation involves two main steps: initially, estimating the multivariate GARCH model, followed by estimating the time-varying conditional correlations. Described by Talbi et al. (2024), the multivariate DCC-GARCH model is characterized as follows:

$$X^t = \mu_t + H_t^{1/2}\varepsilon_t \tag{1}$$

$$H_t = D_t R_t D_t \tag{2}$$

$$R_t = (diag(Q_t))^{-1/2} Q_t (diag(Q_t))^{-1/2} \tag{3}$$

$$D_t = diag\left(\sqrt{h_{11,t}}, \sqrt{h_{22,t}}, \sqrt{h_{NN,t}}\right) \tag{4}$$

where $X_t = (X_{1t}, X_{2t}, \dots X_{Nt})$ is the vector of the past observations, H_t is the multivariate conditional variance, $\mu_t = (\mu_{1t}, \mu_{2t}, \dots \mu_{Nt})$ is the vector of conditional returns, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \dots \varepsilon_{Nt})$ is the vector of the standardized residuals, R_t is a N×N symmetric dynamic correlations matrix and D_t is a diagonal matrix of conditional standard deviations for return series, obtained from estimating a multivariate GARCH model with $\sqrt{h_{ii,t}}$ on the ith diagonal, i=1, 2,....N.

The DCC specification is defined as follows:

$$R_t = Q^{-1/t} * Q * Q^{-1/t} \tag{5}$$

$$Q_t = (1 - \alpha - \beta)\overline{Q} + \alpha\varepsilon_{t-1}\varepsilon'_{t-1} + \beta Q_{t-1} \tag{6}$$

Where Q_t is a positive matrix, it defines the structure and dynamic $Q^{-1/t}$ resizes the items in Q_t to ensure that $|q_{i,j}| \leq 1$. $Q^{-1/t}$ is the inverse matrix of the matrix Q_t. Q_t Is the conditional variance of standard errors.

And α and β are two scalar

$\lambda_1 = \alpha$ and $\lambda_2 = \beta$ are parameters that govern the dynamics of conditional quasi-correlations.

λ_1 and λ_2 are nonnegative and satisfy $0 \leq \lambda_1 + \lambda_2 < 1$.

We rely on t-statistics to evaluate the consistency of dynamic correlation coefficients between foreign Stock market returns and Total Investment returns during both pre-COVID-19 and COVID-19 periods, aiming to assess the pandemic's impact.

This statistical approach allows us to gauge whether there are significant differences in the correlation dynamics across these distinct time frames (Talbi et al., 2024). By comparing these coefficients, we aim to discern any notable shifts or alterations in the relationship between foreign Stock markets and Total Investment returns, offering insight into the influence of the pandemic on these interconnected financial metrics.

Hypothesis test:

We define null and alternative hypotheses as:

$$H_0 = \mu_\rho^{Covid-19} = \mu_\rho^{pre-Covid-19}, \ H_1 = \mu_\rho^{Covid-19} \neq \mu_\rho^{pre-Covid-19}$$

Where $\mu_\rho^{Covid-19}$ and $\mu_\rho^{pre-Covid-19}$ are the conditional correlation coefficient means of population in the pre-Covid-19 and Covid-19 periods.

If the sample sizes are $n^{Covid-19}$ and $n^{pre-Covid-19}$ the population variances $\sigma^{2\,Covid-19}$ and $\sigma^{2\,pre-Covid-19}$ are different. If the means of dynamic correlation coefficients estimated by DCC are $\rho_{ij}{}^{Covid-19}$ and $\rho_{ij}{}^{pre-Covid-19}$, and the variances are $S^{2Covid-19}$ and $S^{2pre-Covid-19}$, the t-statistic is calculated as:

$$t = \frac{(\rho_{ij}{}^{Covid-19} - \rho_{ij}{}^{pre-Covid-19}) - (\mu_\rho^{Covid-19} - \mu_\rho^{pre-Covid-19})}{\sqrt{\frac{S^{2Covid-19} + S^{2pre-Covid-19}}{n^{Covid-19} + n^{pre-Covid-19}}}} \tag{7}$$

If t-statistics is significantly greater than the critical value, H0 is rejected supporting the existence of pandemic effect.

3.2 Correlation Test: Measurement of Pure Pandemic Effect

The correlation coefficient is a statistical metric that illuminates the connection between two variables. When two variables display analogous patterns of progression, it is acknowledged that they are correlated (Lescaroux & Mignon, 2008). Consider two stochastic variables, denoted as ri and rj, representing returns within two distinct markets. To scrutinize the relationship between these returns, we will ll utilize the following straightforward linear model (Talbi et al., 2024):

$$Y_{it} = \alpha + \beta X_{it} + \varepsilon_{it} \tag{8}$$

$$E(\varepsilon_{i,t}) = 0, \; E(\varepsilon_{it}^2) < \infty, \; E(X_{j,t}, \; \varepsilon_{i,t}) = 0$$

In this context, Forbes and Rigobon (2002) propose an adjusted correlation coefficient defined as follows:

$$\frac{\rho}{\sqrt{1 + \delta[1 - (\rho)^2]}} \tag{9}$$

And $\delta = \frac{V^c(x_t)}{V^t(x_t)} = 1$; where «c» and «t» respectively denote the Covid-19 and the stability periods. Indeed, (δ)

denotes the relative increase within V(xt) between the stable and the Covid-19 periods. Hence, in order to statistically test the increase of an adjusted correlation coefficient, we use the following two hypotheses:

$$\begin{cases} H_0 = \rho_1 = \rho_2 \\ H_1 = \rho_1 \neq \rho_2 \end{cases}$$

With

ρ_1: The Covid-19 period correlation coefficient.

ρ_2: The stable period correlation coefficient.

Still, to test the two hypotheses, we will use a Student test where the test statistics is defined as follows:

$$t = (\rho_1 - \rho_2)\sqrt{\frac{n_1 + n_2 - 4}{1 - (\rho_1 - \rho_2)^2}} \tag{10}$$

In this scenario, follows a Student (t) distribution with degrees of freedom (n1 + n2 – 4). The acceptance of H1 accentuates the correlation between two pivotal variables: Total Investment return and Stock Market return. Conversely, the null hypothesis H0 suggests that any elevation in the correlation coefficient purely signifies interdependence between these two variables.

3.3 Fractionally Integrated EGARCH

We apply the Fractionally Integrated Exponential GARCH (FIEGARCH) model, pioneered by Baillie, Bollerslev, and Mikkelsen (1996), specifically crafted to capture enduring memory patterns in EGARCH processes. It is crucial to acknowledge that while FIEGARCH models can be tailored for diverse ARCH and GARCH orders, researchers frequently constrain both to a single lag. Presently, our focus is on these FIEGARCH(1,1) models due to our current framework's limitations.

The FIEGARCH model extends the EGARCH model by integrating a long-term lag polynomial. The logarithm of the conditional variance in this modified EGARCH formulation is expressed as follows:

$$Log(\sigma_t^2) = \omega + \frac{\alpha(L)}{\beta(L)}\pi(L)g(Z_{t-1}) \tag{11}$$

The corresponding FIEGARCH(1, 1) is given by:

$$Log(\sigma_t^2) = (1-\beta)\omega + g(Z_{t-1}) + \sum_{k=1}^{\infty}\pi_k\,g(Z_{t-1-k}) - \alpha g(Z_{t-2}) - \alpha\sum_{k=1}^{\infty}\pi_k\,g(Z_{t-2-k}) + \beta\log(\sigma_{t-1}^2) \tag{12}$$

Substituting using $Z_t = \epsilon_t/\sigma_t$ yields.

3.4 The Markov Switching Model

The Markov switching regression model expands upon the basic exogenous probability framework by integrating a first-order Markov process to determine the regime probabilities. As a component of the regime-switching models, it posits that unobserved states are governed by an underlying stochastic process referred to as a Markov chain. As denoted by Talbi et al., 2024, this model allows for dynamic shifts between distinct regimes, enriching the understanding of how observed variables relate within different states or conditions.

The Markov process involves a latent state denoted as S_t at time t, unseen by econometricians, taking values in k∈{1,2,…,K}, where K signifies the total number of states. This latent variable S_t signifies the current system's state at time t, commonly referred to as a state or regime indicator.

This state indicator's dynamics are governed by a Markov process where the probability distribution of S_t given the entire path {S_{t-1}, S_{t-2},…, S_1} relies solely on the most recent state S_{t-1}. The transition probability, represented as $P_r(S_t$=j|S_{t-1}=i) or P_{ij}, indicates the probability of transitioning from state i to state j in the next period. These transition probabilities are organized in a K×K matrix called the transition matrix, P= [P_{ij}] K×K, where each row's elements sum to one. The diagonal elements of this matrix determine the expected state duration $(1-P_{ij})-1$ for state i. The vector of unconditional state probabilities, denoted as π≡P_r [S_0], remains time-invariant. The solution for π given l′K π=1 is expressed in Hamilton (1994, Chapter 22), involving the matrix P and π is given as a function of P.

The distribution of the initial state at t=0, represented by S_0, is shown as a K-vector:

$$\pi_0 \equiv [P_r \ (S_0=k)]K \times 1$$

In an ergodic Markov process, setting the initial distribution as the stationary distribution π is a common practice. However, when the Markov process lacks stationarity, theory typically informs the selection of π_0. For example, in a change-point model, designating S_0=1 signifies the process initiating within the first regime. This approach aligns with theoretical frameworks (Talbi et al., 2024) to appropriately define the initial state when stationarity is not present in the process.

4. Empirical Evidence

The study aims to empirically evaluate the impact of the Covid-19 pandemic on GCC markets. It commences by examining the Covid-19 period's effects on six countries through the application of FIEGARCH(1,1), MGARCH-DCC(1,1), and a Switching-Markov-Model. Subsequently, it endeavors to discern significant negative correlations by assessing the statistical significance of increased heteroscedasticity-adjusted correlation coefficients between calm periods and the Covid-19 period, drawing insights from Forbes and Rigobon's work in 2002.

4.1 Data

The research delves deep into the worldwide impact of the Covid-19 financial crisis, spotlighting stock market indices and total investment as pivotal variables. To analyze these factors, the study relies on monthly stock market data and corresponding monthly total investment returns, tracked through stock market indices across six scrutinized markets (P_t, t). The monthly returns of these indices are calculated as follows:

$$R_{i,t} = \frac{\{MarketPriceClose(0m)+DividendsPerShareByExDate(QuarterlyPeriod(0m)/3)-MarketPriceclose(-1m)\}}{Market\ Priceclose(-1m)} * 100 \quad (13)$$

With, P_t: Stock market's index i at day t;

P_{t-1}: Stock market's index i at day t-1;

$R_{i,t}$: index's return of stock market i at day t.

The second variable is The Total investment Return mean the Stock performance ratio

$$TIR = \frac{Received\ products-Costs}{Investment\ amount} \quad (14)$$

The internal rate of return represents the percentage return on cash flows involved in an entity's monthly investments. These cash flows encompass all transactions classified as investing activities on a Statement of Cash Flow. Total Investments signify the entity's investment in securities that directly or indirectly generate loans made by the entity. This category encompasses treasury securities, Federal agency securities, State and municipal securities, Federal funds sold, Trading accounts securities, Securities purchased under resale agreements,

Mortgage-backed securities, and Other investments. These investments constitute the interest-earning assets of the company (Talbi et al., 2024).

Insurance companies invest in Fixed income securities, Equity securities, Real estate assets, Mortgage & Policy loans, and Other Investments, while other financial institutions focus on Loans, Real estate assets, Finance Receivables, and Other Investments. The analysis dataset comprises stock indices and Total Investments, serving as benchmarks for various markets, sourced online in US dollars to offset exchange rate fluctuations.

The study encompasses six stock markets, categorized based on their economic positions: GCC Countries: Bahrain_ALL_Shares, Kuwait_ALL_SHALL_General, MSM_30_Oman, QE_General_Qatar, ALTADWEL_ALL_Shares_Saudi_Arabia, FTSE_ADX_General_UAE, representing Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates, respectively. The study period spans from 02/01/2001 to 31/04/2021, utilizing monthly data and totaling 244 observations for each market. This duration is partitioned into two sub-periods:

- Pre-Covid-19 period: 01/02/2001 to 11/31/2019.
- Post-Covid-19 period: 12/01/2019 to 04/31/2021.

We compute the monthly return for all entities and the average monthly return for the two variables—Stock index and Total Investments—for each country. The first period comprises 227 observations, while the second period consists of 17 observations.

4.2 Results and Interpretations

4.2.1 Descriptive Statistics of the Variables

We start our analysis by reviewing the descriptive statistics of stock index and total investment returns across six countries from January 2, 2001, to April 31, 2021, offering insightful observations on means and standard deviations.

Across all series, it is evident that skewness and kurtosis statistics deviate notably from 0 and 3, respectively. Additionally, the Jarque-Bera statistic yields a probability (0.0000) lower than the 5% significance level, leading us to reject the assumption of a normal distribution for the series. This rejection suggests that the distributions' normality significantly differs from a Gaussian distribution. Notably, the kurtosis coefficient substantially exceeds three, indicating leptokurtic characteristics in the variables across all countries.

Moreover, the presence of non-zero skewness coefficients, suggests asymmetry, possibly indicative of non-linearity, as linear Gaussian models necessitate symmetry. Examining standard deviations during the Covid-19 period reveals a noteworthy increase. Volatility analysis confirms this rise, demonstrating heightened standard deviations between the pre-Covid and Covid-19 periods. This surge in risk across all countries manifests through relatively high standard deviations, signifying increased price volatility and return instability.

Further statistical scrutiny reveals that most series exhibit either leftward or rightward flat skewness. Specifically, skewness coefficients in most GCC countries' returns showcase distributions that are either left-skewed or right-skewed. Regarding kurtosis, the majority of examined variables demonstrate significant coefficients exceeding 3 across all countries. These observations collectively underscore the non-normal distribution of the variables, prompting our subsequent choice to employ an ARCH model. Subsequently, we will assess the stationarity of the distributions for all variables.

Through Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) stationary tests on the daily series, we confirm that all utilized series exhibit stationarity. Across various specifications (with constant, constant and trend, constant Ni or trend) in the ADF test, all series register ADF values below critical values. Similar observations hold for the PP test, where all variables display t-test values lower than various critical thresholds in Eviews PP. The rejection of the null hypothesis (H0) of a unit root in both the ADF and PP tests, with probabilities approaching zero, affirms the stationarity of all series in levels.

4.2.2 Estimation of the Asymmetric DCC-GARCH (1.1) Model

4.2.2.1 Estimation of Dynamic Conditional Correlations

The application of the DCC-GARCH (1.1) model provided insights into the impact of Covid-19 on the relationship between stock market behavior and global investments in GCC markets. The analysis revealed dynamic conditional correlations, with notable decreases during the pandemic periods, particularly in certain GCC markets. These findings underscore the pandemic's influence on market and investor behavior, suggesting significant effects on specific GCC market stock prices.

4.2.2.2 The Results and Interpretation of the Correlation Coefficient

Table 1 showcases the Correlation coefficients (DCC-MGARCH(1.1)) depicting the relationship between Stock Market Returns and Total Investment Returns in GCC countries, pre-Covid-19. Specifically, it examines the relationship between stock market returns and total investment returns in the GCC (Gulf Cooperation Council) region before the Covid-19 pandemic. For each GCC country:

- The intercept (α) stands at (0.015791) with a standard error of 0.001888, indicating a positive constant term in the model. This suggests that even without stock market returns, there is a baseline positive return on total investment.

- The β value of (0.000365) with a very low standard error (4.48E-05) reflects a highly significant relationship between stock market returns and total investment returns ($p < 0.05$).

- The coefficient of (0.557440) at lag 1 and 2 periods exhibits a considerable positive correlation between the stock market and total investment returns in Bahrain.

Interpreting the results country by country provides a more insightful analysis:

Bahrain-Steady Impact: With a moderate α and significant β and ρ (1.2) coefficients, Bahrain showcases a stable, statistically meaningful relationship between stock market fluctuations and overall investment returns. In fact, the α coefficient is (0.015791), suggesting a positive intercept. Both β and ρ (1.2) coefficients are significant ($p < 0.05$), indicating a meaningful relationship between stock market returns and total investment returns.

Kuwait-Moderate Association: Kuwait's model presents a moderately strong correlation (β) between stock market and total investment returns, along with a robust lagged correlation (ρ) despite a slightly less significant β coefficient. The α coefficient is (0.015244), showing a positive constant term. The β coefficient is significant ($p < 0.05$), implying a notable relationship, while the ρ (1.2) coefficient is also significant.

Oman-Robust Lagged Relationship: Despite a relatively weaker β coefficient, Oman displays a notably strong historical correlation (ρ) between stock market and total investment returns, suggesting a significant influence of past market performance. The α coefficient stands at (0.021156), indicating a positive constant. Both β and ρ (1.2) coefficients are significant ($p < 0.05$), suggesting a strong association between stock market returns and total investment returns.

Table 1. Correlation coefficient (DCC-MGARCH(1.1) (Pre-Covid-19) between Stock market return and Total investment return of GCC countries

Country	Parameter (Pre-Covid-19)	Coefficient	Std.Error	Z-Statistic	Prob.
Bahrain	α	0.015791	0.001888	8.364062	0.0000
	β	0.000365	4.48E-05	8.146716	0.0000
	ρ (1.2)	0.557440	0.068110	8.184361	0.0000
Kuwait	α	0.015244	0.002813	5.419564	0.0000
	β	0.000292	0.000162	1.805322	0.0710
	ρ (1.2)	0.590795	0.056752	10.41011	0.0000
Oman	α	0.021156	0.002945	7.184530	0.0000
	β	0.000186	0.000102	1.814006	0.0697
	ρ (1.2)	0.666323	0.050472	13.20193	0.0000
Qatar	α	0.018490	0.003387	5.459907	0.0000
	β	0.000436	0.000152	2.868337	0.0041
	ρ (1.2)	0.839424	0.024493	34.27174	0.0000
Saudi_Arabia	α	0.012551	0.004170	3.009618	0.0026
	β	0.000140	0.000169	0.830197	0.4064
	ρ (1.2)	0.772595	0.034291	22.53086	0.0000
United_Arabes_Emirates	α	0.007740	0.003430	2.256641	0.0240
	β	0.000180	0.000100	1.797126	0.0723
	ρ (1.2)	0.658957	0.049931	13.19736	0.0000

Qatar-Highly Correlated: Qatar demonstrates a compelling and statistically significant relationship between stock market and total investment returns, with both β and ρ (1.2) coefficients exhibiting remarkably high values, indicating a strong and immediate connection. With an α coefficient of (0.018490), a positive constant is evident.

Both β and ρ (1.2) coefficients are significant (p < 0.05), indicating a robust relationship between the variables, especially a notably high correlation (ρ = 0.839424).

Saudi Arabia-Weaker Connection: Saudi Arabia's model shows a weaker statistical association (β) between stock market and total investment returns compared to other GCC nations. However, a significant ρ (1.2) coefficient implies a meaningful historical correlation despite the weaker immediate relationship. The α coefficient is (0.012551), portraying a positive constant. However, the β coefficient is not significant (p > 0.05), suggesting a weaker relationship between stock market returns and total investment returns compared to other countries. The ρ (1.2) coefficient is significant, indicating a meaningful lagged correlation.

United Arab Emirates (UAE)-Subtle but Evident: UAE exhibits a slightly less significant β coefficient, suggesting a relationship that is just above the conventional threshold. However, a notable ρ (1.2) coefficient highlights a considerable lagged correlation between stock market and total investment returns.The α coefficient is (0.007740), indicating a positive constant. The β coefficient is significant (p < 0.05), suggesting a relationship between the variables. The ρ (1.2) coefficient is also significant, showing a notable lagged correlation.

The in-depth analysis of correlation coefficients using the DCC-MGARCH(1.1) model before the Covid-19 era in GCC countries reveals distinct financial intricacies within each nation's market. Significant correlations in Bahrain, Kuwait, and Qatar indicate strong connections between stock market returns and total investment returns, enabling informed decision-making for stakeholders. Conversely, Saudi Arabia and the United Arab Emirates show weaker correlations, suggesting less immediate relationships between the variables. This nuanced understanding of the GCC financial landscape enables tailored investment strategies and policy interventions, promoting targeted and effective approaches to risk management, portfolio diversification, and economic policymaking.

Table 2 presents the correlation coefficients (DCC-MGARCH(1.1)) between stock market returns and total investment returns for GCC countries, emphasizing the Post-Covid-19 period.

Table 2. Correlation coefficient (DCC-MGARCH(1.1) (Post-Covid-19) between Stock market return and Total investment return of GCC countries

Country	Parameter (Post-Covid-19)	Coefficient	Std.Error	Z-Statistic	Prob.
Bahrain	α	0.006566	0.009322	0.704348	0.4812
	β	0.000130	0.000464	0.281225	0.7785
	ρ (1.2)	0.463493	0.355745	1.302880	0.1926
Kuwait	α	0.011260	0.012146	0.927067	0.3539
	β	0.001385	0.000422	3.282630	0.0010
	ρ (1.2)	0.342098	0.331421	1.032215	0.3020
Oman	α	0.011114	0.007874	1.411467	0.1581
	β	0.001480	0.001625	0.910467	0.3626
	ρ (1.2)	0.362614	0.640888	0.565800	0.5715
Qatar	α	0.039586	0.016778	2.359425	0.0183
	β	-0.012370	0.053804	-0.229902	0.8182
	ρ (1.2)	0.073732	1.056823	0.069768	0.9444
Saudi_Arabia	α	0.041312	0.015184	2.720721	0.0065
	β	2.20E-05	0.000865	0.025454	0.9797
	ρ (1.2)	0.754179	0.163081	4.624560	0.0000
United_Arabes_Emirates	α	0.026526	0.013517	1.962441	0.0497
	β	0.000553	0.001136	0.487096	0.6262
	ρ (1.2)	0.595678	0.250356	2.379325	0.0173

Bahrain demonstrates an α coefficient of (0.006566), indicating a positive constant term that lacks statistical significance (p = 0.4812). The β coefficient stands at (0.000130) and (p = 0.7785), suggesting a weak and statistically insignificant relationship between stock market and total investment returns. Moreover, the lagged correlation (ρ (1.2)) of (0.463493) and (p = 0.1926) in Bahrain signifies a moderate but statistically insignificant relationship between these financial variables.

In Kuwait, the α coefficient of (0.011260) and (p = 0.3539) represents a positive constant term without statistical significance, akin to Bahrain. However, the β coefficient of (0.001385) is statistically significant (p = 0.0010),

indicating a stronger positive relationship between stock market returns and total investment returns compared to Bahrain. The lagged correlation (ρ (1.2)) in Kuwait stands at 0.342098 (p = 0.3020), reflecting a moderate correlation without statistical significance.

Moving to Oman, the α coefficient of (0.011114) and (p = 0.1581) showcases a positive constant term without statistical significance, similar to Bahrain and Kuwait. The β coefficient of (0.001480) and (p = 0.3626) indicates a weak and statistically insignificant relationship between these financial variables. Additionally, the lagged correlation (ρ (1.2)) of (0.362614) and (p = 0.5715) implies a moderate correlation without statistical significance.

Contrarily, Qatar presents a statistically significant α coefficient of (0.039586) and (p = 0.0183), suggesting a positive constant term. However, the β coefficient of (-0.012370) with (p = 0.8182) indicates a weak and statistically insignificant negative relationship between stock market returns and total investment returns. Furthermore, the lagged correlation (ρ (1.2)) in Qatar is (0.073732) and (p = 0.9444), signifying a weak and statistically insignificant relationship, distinct from other GCC countries.

Saudi Arabia stands out with a significant α coefficient of (0.041312) and (p = 0.0065), implying a positive constant term with statistical significance. However, the extremely weak and statistically insignificant β coefficient of (2.20E-05) with (p = 0.9797) suggests a lack of immediate relationship between stock market and total investment returns. The lagged correlation (ρ (1.2)) of (0.754179) and (p = 0.0000) stands notably strong and statistically significant, highlighting a robust connection between past market performance and current total investment returns.

Finally, the United Arab Emirates showcases a significant α coefficient of (0.026526) and (p = 0.0497), indicating a positive constant term. The β coefficient of (0.000553) with (p = 0.6262) suggests a weak and statistically insignificant relationship, like several other countries. However, the lagged correlation (ρ (1.2)) of (0.595678) and (p = 0.0173) demonstrates a moderate and statistically significant relationship between stock market and total investment returns.

The detailed coefficients reveal varied relationships between stock market returns and total investment returns across GCC countries post-Covid-19. While some countries show significant constants or correlations, most coefficients lack statistical significance, indicating weaker immediate relationships. This highlights the complexities of financial dynamics in the GCC region post-Covid-19, emphasizing the need for nuanced assessments for informed decision-making by investors, policymakers, and financial analysts.

For investors, these assessments refine risk evaluation and optimize portfolio diversification. Understanding the intricate relationships among financial variables informs asset allocation and risk management decisions, tailored to each GCC country's financial characteristics. Policymakers use these analyses to craft precise policies addressing economic challenges, guiding regulatory adjustments and interventions for financial stability and growth. Financial analysts utilize nuanced assessments to improve forecast accuracy and recommendations, offering tailored insights for investment strategies and financial planning. Overall, these assessments equip stakeholders with profound insights, fostering informed decision-making, stability, and growth in the GCC financial markets.

Figure 1 displays the Correlation Coefficient (DCC-MGARCH(1.1)), illustrating the correlation between Stock Market Return and Total Investment Return across GCC nations before and after COVID-19. It visually represents significant correlations during stable periods, supported by positive and highly significant coefficients and t-statistics of the dynamic Conditional Correlation. For example, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates show correlation coefficients ranging from approximately 0.56 to 0.84, indicating financial stability in these markets.

The coefficients, supported by t-statistics from DDC-MAGARCH model estimations, exhibit statistical significance, surpassing the critical value of 1.96 for a 5% significance level during stable periods, affirming financial stability across all stock markets. However, for the remaining sample, most GCC countries lack significance, with t-student values falling below the critical threshold. Bahrain, Kuwait, Oman, and Qatar show correlations ranging from approximately 0.07 to 0.46, suggesting financial instability. These results challenge the theory of geographical proximity as the primary source of Covid-19 contagion, accepting the null hypothesis of statistically insignificant effects of stock returns on investment returns in these markets. The correlation is influenced by periods of instability and crisis, with adjusted correlation coefficients of stock price returns, indicating a negative spillover effect and vulnerability to external shocks. Post-Covid-19, DCC notably declines, indicating a weakened relationship between stock market returns and total investment returns.

The outcomes of our empirical study signify a nuanced picture of the correlation dynamics between stock market

returns and total investment returns, particularly amidst stable periods versus the Covid-19 crisis. The pronounced decrease in correlation during and after the Covid-19 outbreak underscores its disruptive impact on financial markets across diverse economies. These observed variations, emphasized by the statistical robustness of the t-statistics surpassing critical values, validate the substantial deviation from the previously established correlations. This deviation, postulated by the rejection of the null hypothesis, illuminates the Covid-19 crisis as a pivotal factor altering the traditional relationship between stock market and total investment returns. The discernible decline in average DCC values post-Covid-19 notably highlights the disproportionate influence of this crisis on select countries, suggesting an asymmetric susceptibility to contagion effects. This revelation of reduced transactional conditional correlations in current yields across the GCC countries indicates not only the extent of Covid-19's impact but also underscores the need for a recalibration of risk assessment models and investment strategies. Additionally, it accentuates the necessity for policymakers and financial institutions to adapt swiftly to these changing correlations, devising resilient strategies to fortify financial stability and navigate the volatile landscape brought about by the pandemic's repercussions.
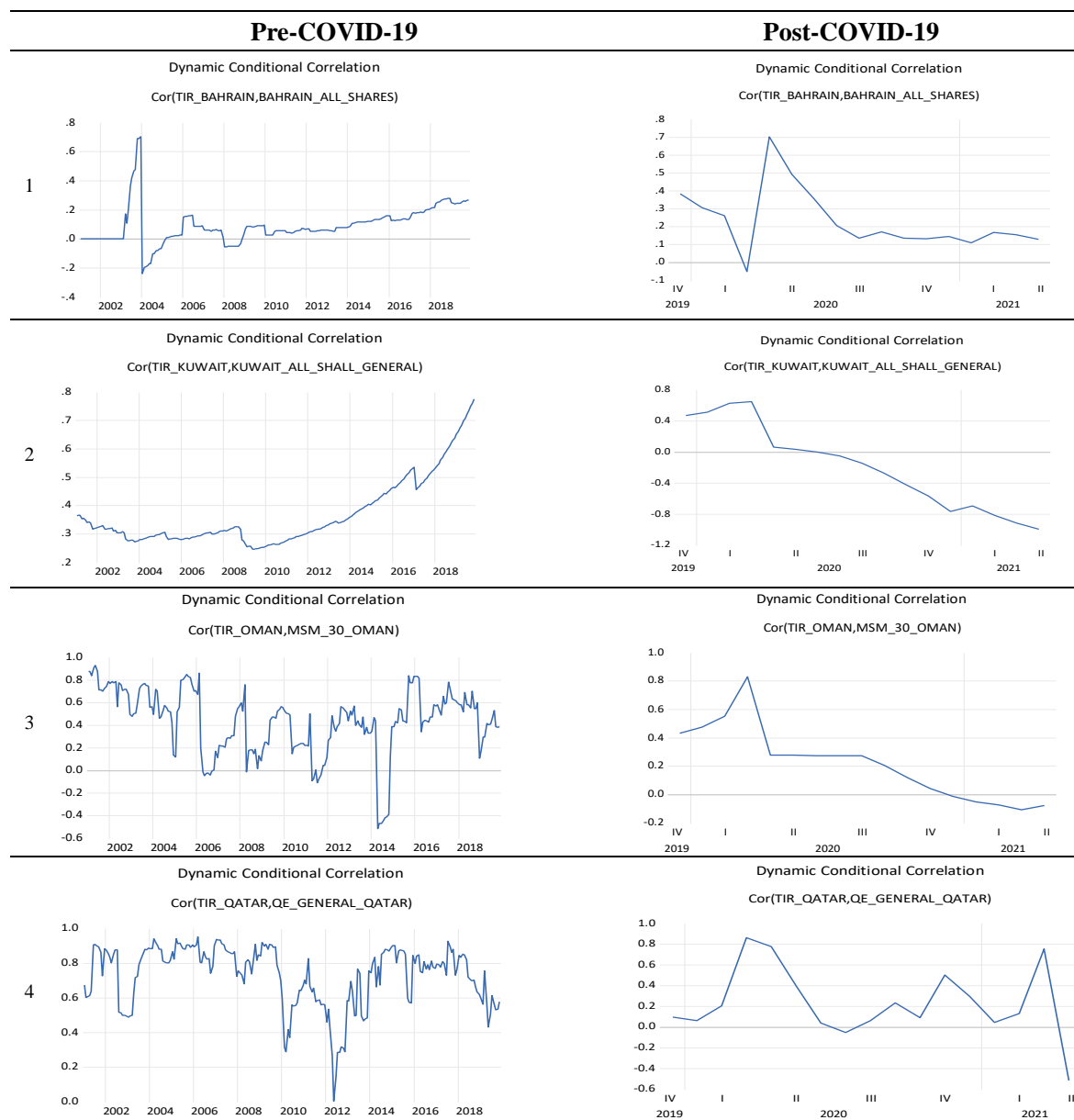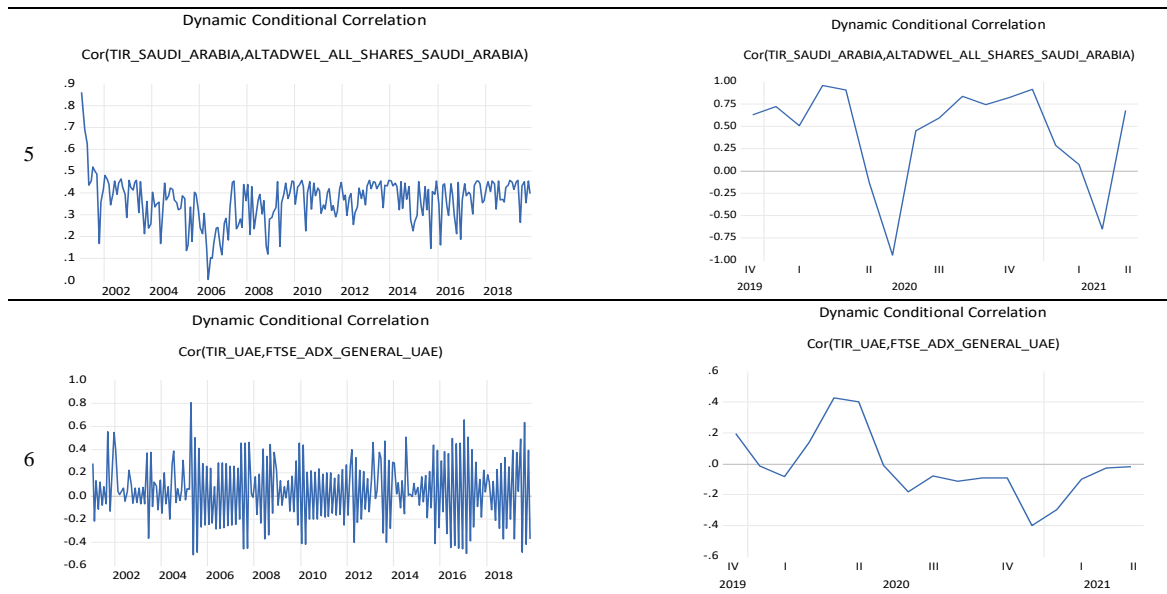
Figure 1. Correlation coefficient (DCC-MGARCH(1.1) (Pre&Post-Covid-19) between Stock market return and Total investment return of GCC countries

4.2.2.3 Estimation of Fractionally Integrated EGARCH: FIEGARCH (1.1)

Table 3 presents the FIEGARCH (1.1) model's analysis depicting the interrelationship between Stock Market Returns and Total Investment Returns across GCC countries in the Pre-COVID-19 era. This model provides a detailed examination of the dynamic interactions and dependencies between these crucial financial variables, shedding light on their associations within the specified period.

Table 3. FIEGARCH (1.1) (Pre-COVID-19) between Stock market return and Total investment return of GCC countries

Variable (Pre-Covid-19)	Coefficient	Std.Error	Z-Statistic	Prob.
TIR_Bahrain=f(Bahrain_All_Shares)	0.898614	0.274408	3.274741	0.0011
C	0.010890	0.001610	6.763708	0.0000
TIR_Kuwait=f(Kuwait_All_Shall_General)	0.641445	0.207482	3.091570	0.0020
C	0.014990	0.003474	4.315478	0.0000
TIR_Oman=f(MSM_30_Oman)	0.837458	0.088272	9.487209	0.0000
C	0.016279	0.001557	10.45541	0.0000
TIR_Qatar=f(Qe_General_Qatar)	2.001493	0.021934	91.25142	0.0000
C	0.010585	0.001711	6.186435	0.0000
TIR_Saudi_Arabia=f(AlTadwel_All_Shares)	0.353138	0.154328	2.288236	0.0221
C	0.011189	0.002801	3.995033	0.0001
TIR_UAE=f(FTSE_ADX_General_UAE)	0.658957	0.049931	13.19736	0.0000
C	0.006151	0.002550	2.412596	0.0158

In Bahrain, the analysis reveals a robust connection between Bahrain's stock market returns and total investment returns, with a coefficient of (0.898614). This coefficient indicates a statistically significant relationship, supported by a Z-Statistic of (3.274741) and a probability value of (0.0011). Moreover, the constant term (C) at (0.010890) underscores a fundamental baseline relationship, demonstrating statistical significance with a Z-Statistic of (6.763708) and a probability value of (0.0000).

Similarly, Kuwait exhibits a notable relationship between its stock market returns and total investment returns, with a coefficient of (0.641445). The Z-Statistic of (3.091570) and a probability value of (0.0020) reinforce the statistical significance. Kuwait's constant term (C) at (0.014990) is also statistically significant (Z-Statistic: 4.315478, Prob.: 0.0000), emphasizing its pivotal baseline influence.

Oman showcases a remarkably strong association between stock market and total investment returns, evident from the coefficient of (0.837458), with a Z-Statistic of (9.487209) and a probability value of (0.0000), signifying high statistical significance. The constant term (C) of (0.016279) further validates a strong foundational relationship (Z-Statistic: 10.45541, Prob.: 0.0000).

Qatar's relationship between stock market returns and total investment returns is incredibly robust, reflected in the coefficient of (2.001493). This extraordinarily high coefficient, coupled with a Z-Statistic of (91.25142) and a probability value of (0.0000), signifies an exceptionally strong and statistically significant relationship. The constant term (C) at (0.010585) further solidifies this foundational relationship (Z-Statistic: 6.186435, Prob.: 0.0000).

Conversely, Saudi Arabia demonstrates a moderate relationship between stock market and total investment returns, with a coefficient of (0.353138). While this coefficient is lower compared to other countries, it remains statistically significant with a Z-Statistic of (2.288236) and a probability value of (0.0221). The constant term (C) at (0.011189) also shows statistical significance (Z-Statistic: 3.995033, Prob.: 0.0001), indicating a foundational baseline.

Finally, the United Arab Emirates (UAE) exhibits a robust relationship between stock market returns and total investment returns, with a coefficient of (0.658957). This coefficient demonstrates a statistically significant association (Z-Statistic: 13.19736, Prob.: 0.0000). Additionally, the constant term (C) at (0.006151) remains statistically significant (Z-Statistic: 2.412596, Prob.: 0.0158), reflecting a foundational relationship in the absence of market returns.

These findings provide crucial insights into the relationships between stock market returns and total investment returns across GCC countries before the onset of the COVID-19 pandemic. These coefficients and constants signify not only the strength but also the statistical significance of these associations, offering valuable implications for investors, policymakers, and financial analysts. Understanding the nuanced connections between stock market performance and overall investment returns in each GCC country can aid investors in shaping more informed and tailored investment strategies. Policymakers can leverage these insights to craft targeted economic policies aimed at bolstering financial stability and fostering growth. Moreover, financial analysts can utilize these findings to provide more accurate forecasts and recommendations, guiding investment decisions and financial planning. This comprehensive understanding of the financial dynamics within the GCC countries can lead to more informed and strategic decision-making, ultimately contributing to the stability and growth of these markets.

Table 4 demonstrates the FIEGARCH (1.1) model's assessment of the correlation between Stock Market Return and Total Investment Return of GCC countries throughout the Post-COVID-19 period.

Table 4. FIEGARCH (1.1) (Post-COVID-19) between Stock market return and Total investment return of GCC countries

Variable (Post-Covid-19)	Coefficient	Std.Error	Z-Statistic	Prob
TIR_Bahrain=f(Bahrain_All_Shares)	0.273558	1.676985	0.163125	0.8704
C	0.019521	0.006528	2.990327	0.0028
TIR_Kuwait=f(Kuwait_All_Shall_General)	-0.273423	3.736916	-0.073168	0.9417
C	-0.004058	0.004037	-1.005062	0.3149
TIR_Oman=f(MSM_30_Oman)	-0.348976	0.414941	-0.841025	0.4003
C	0.014280	0.005837	2.446669	0.0144
TIR_Qatar=f(Qe_General_Qatar)	-0.001051	0.059629	-0.017623	0.9859
C	0.040136	0.025147	1.596040	0.1105
TIR_Saudi_Arabia=f(AlTadwel_All_Shares)	1.076658	0.194851	5.525558	0.0000
C	0.082206	0.006649	12.36265	0.0000
TIR_UAE=f(FTSE_ADX_General_UAE)	-1.212634	0.146260	-8.290934	0.0000
C	0.050909	0.002083	24.43836	0.0000

For Bahrain, the coefficient stands at (0.273558), indicating a relatively weak positive relationship between Stock Market Return and Total Investment Return. The associated Z-statistic of (0.163125) and a high probability of (0.8704) suggest insignificance in this correlation. However, the constant term (C) at (0.019521) holds statistical significance (Z-statistic = 2.990327, Prob = 0.0028), implying an influential baseline factor in the model.

In contrast, Kuwait displays a negative coefficient of (-0.273423), suggesting an inverse relationship between Stock Market Return and Total Investment Return. The Z-statistic of (-0.073168) and probability of (0.9417)

reinforce the insignificance of this correlation. The constant term (C) at (-0.004058) lacks statistical significance (Z-statistic = -1.005062, Prob = 0.3149).

Oman's coefficient of (-0.348976) reflects a weak negative relationship between these variables, supported by a Z-statistic of (-0.841025) and a probability of (0.4003), indicating insignificance. However, the constant term (C) at (0.014280) shows statistical significance (Z-statistic = 2.446669, Prob = 0.0144).

In the case of Qatar, the coefficient of (-0.001051) points to an extremely weak negative correlation between Stock Market Return and Total Investment Return, supported by a Z-statistic of (-0.017623) and a probability of (0.9859), rendering the correlation statistically insignificant. The constant term (C) at (0.040136) also lacks significance (Z-statistic = 1.596040, Prob = 0.1105).

Saudi Arabia exhibits a substantial positive coefficient of (1.076658), signifying a strong positive relationship between the two variables. The Z-statistic of (5.525558) and a probability of (0.0000) validate the statistical significance of this correlation. The constant term (C) at (0.082206) also shows high significance (Z-statistic = 12.36265, Prob = 0.0000), emphasizing its influential role.

For the United Arab Emirates (UAE), the coefficient of (-1.212634) indicates a robust negative correlation between Stock Market Return and Total Investment Return. Supported by a Z-statistic of (-8.290934) and a probability of (0.0000), this negative correlation is highly significant. The constant term (C) at (0.050909) is also statistically significant (Z-statistic = 24.43836, Prob = 0.0000), underlining its substantial impact within the model.

The implications of these varied correlations are pivotal for investors, policymakers, and analysts. Understanding the divergent post-COVID-19 financial dynamics across these GCC nations can guide strategic decisions. For instance, markets like Saudi Arabia, showing a robust positive correlation, may present opportunities for aligned investment strategies between stock market performance and overall investment returns. Conversely, the negative correlation in the UAE market might indicate the need for cautious and divergent investment strategies due to the inverse relationship between these financial variables. This depth of analysis facilitates more informed decision-making, aiding stakeholders in navigating the complex post-pandemic financial landscapes within the GCC region.

4.2.2.4 Estimation of Switching-Markov Model

Table 5 showcases the insightful findings from the Switching-Markov-Model analysis, meticulously conducted to examine the nuanced relationship between Stock Market Return and Total Investment Return across GCC countries specifically during the Pre-COVID-19 period.

Table 5. Switching-Markov-Model (Pre-COVID-19) between Stock market return and Total investment return of GCC countries

Regime 1	Coefficient	Std. Error	z-Statistic	Prob.
TIR_Bahrain/Bahrain_All_Shares	0.209516	0.046728	4.483704	0.0000
TIR_Kuwait/Kuwait_All_Shall_General	0.327504	0.094536	3.464346	0.0005
TIR_Oman/MSM_30_Oman	0.140424	0.014853	9.453928	0.0000
TIR_Qatar/Qe_General_Qatar	5.077453	1.327525	3.824751	0.0001
TIR_Saudi_Arabia/AlTadwel_All_Shares	0.019163	0.007705	2.486989	0.0129
TIR_UAE/FTSE_ADX_General_UAE	0.515571	0.072324	7.128651	0.0000

The Switching-Markov-Model analysis depicted in Table 5 during the Pre-COVID-19 period offers nuanced insights into how fluctuations in stock market returns influenced total investment returns across GCC countries. The coefficients provided in the table indicate the strength and direction of this relationship within each country's financial context.

For instance, the positive coefficients across most countries in "Regime 1"—Bahrain, Kuwait, Oman, and Saudi Arabia—suggest that during this period, increases in stock market returns were positively associated with higher total investment returns. These findings could imply that investors in these markets tended to allocate more capital or increase their investment activity when stock markets were performing well.

However, Qatar stands out notably with an exceptionally high coefficient, indicating an extremely strong positive correlation between stock market returns and total investment returns. This implies that in Qatar, the impact of stock market fluctuations on total investment returns was particularly profound compared to other GCC countries in this specific period.

Conversely, Saudi Arabia exhibits a smaller coefficient, suggesting a weaker relationship between stock market returns and total investment returns compared to other countries within "Regime 1". This observation could imply that the Saudi Arabian market might have had different dynamics or factors influencing investment decisions during this period.

The detailed statistical measures, such as standard errors, z-statistics, and associated probabilities, lend credibility to these relationships, providing a clearer understanding of the reliability and significance of these findings. The diversity in coefficients among these GCC countries indicates varying levels of sensitivity in investment returns to changes in the stock market, highlighting the unique financial landscapes and investment behaviors prevailing in each country before the COVID-19 pandemic.

Table 6 illustrates the outcomes of the Switching-Markov-Model analysis conducted post-COVID-19, delving into the intricate relationship between Stock Market Return and Total Investment Return across the GCC countries.

Table 6. Switching-Markov-Model (Post-COVID-19) between Stock market return and Total investment return of GCC countries

Regime 2	Coefficient	Std. Error	z-Statistic	Prob.
TIR_Bahrain/Bahrain_All_Shares	0.066132	0.047954	4.700274	0.0000
TIR_Kuwait/Kuwait_All_Shall_General	-0.235696	0.151769	-1.552988	0.1204
TIR_Oman/MSM_30_Oman	-0.636226	6.456623	-0.098538	0.9215
TIR_Qatar/Qe_General_Qatar	-0.059525	0.088393	-0.673419	0.5007
TIR_Saudi_Arabia/AlTadwel_All_Shares	0.155493	0.069731	-0.024287	0.9806
TIR_UAE/FTSE_ADX_General_UAE	-0.196328	0.080113	-2.450634	0.0143

In "Regime 2" of the Switching-Markov-Model post-COVID-19, the coefficients and statistical measures offer valuable insights into the relationship between Stock Market Return and Total Investment Return across GCC countries. The coefficient for Bahrain_All_Shares indicates a positive association with a coefficient of (0.066132), suggesting a modest rise in Total Investment Return concerning the stock market in Bahrain. Conversely, in Kuwait, the Kuwait_All_Shall_General presents a negative coefficient of (-0.235696), albeit not statistically significant, indicating a potential reduction in Total Investment Return post-COVID-19, but the result lacks robustness due to its p-value of (0.1204). Oman's MSM_30_Oman displays a substantially negative coefficient of (-0.636226); however, the wide standard error of (6.456623) makes this coefficient statistically insignificant. Qatar's Qe_General_Qatar portrays a minor negative coefficient of (-0.059525), suggesting a slight downward trend in Total Investment Return but lacks statistical significance with a p-value of (0.5007). The AlTadwel_All_Shares in Saudi Arabia demonstrates a positive coefficient of (0.155493), but its insignificance p-value of 0.9806) negates any meaningful interpretation. Lastly, UAE's FTSE_ADX_General_UAE shows a noteworthy negative coefficient of (-0.196328), signifying a potential decrease in Total Investment Return post-COVID-19, supported by statistical significance (p-value of 0.0143).

The findings of "Regime 2" highlight varied trends across GCC countries in terms of the relationship between Stock Market Return and Total Investment Return post-COVID-19. While Bahrain suggests a slight positive inclination, Kuwait, Qatar, and Saudi Arabia depict inconclusive results due to statistically insignificant coefficients. Oman shows a strong negative coefficient but lacks statistical robustness. On the contrary, UAE demonstrates a noteworthy negative association, implying a potential decline in Total Investment Return that aligns with the statistical significance, hinting at a more tangible impact of the pandemic on investment dynamics.

Figure 2 presents the Filtered Regime Probabilities for GCC countries, illustrating the probabilities associated with distinct regimes across the observed period. This visual representation offers a dynamic insight into the varying probabilities of different regimes within the GCC countries, depicting shifts in market behavior and illustrating potential transitions between regimes over time.

The outcomes derived from the DDC MGARCH Model affirm the substantial negative impact of the Covid-19 pandemic on financial markets. The investigation delves into the correlation coefficients within the DCC-MGARCH(1.1) framework, examining monthly stock market returns and total investment returns. These analyses, rooted in the fluctuations of stock market prices and investments, yield several critical observations.

Across the considered performance series, distinct patterns of high and low correlations manifest, emblematic of the persistence phenomenon. The graphical evolution post-correlation coefficient estimations during the pandemic highlights a significant and widespread decrease, attaining their respective lows around the beginning of

2020-2021. This stark decline notably intensified from early 2021, coinciding with the escalating impact of Covid-19 across nations.

This confluence of factors points to a heightened volatility within stock market index series. An intriguing asymmetry emerges upon analyzing correlation and conditional variances—higher volatility tends to follow a decline or decrease in correlation. Yet, for specific indexes, correlations ascend amidst relatively volatile markets.
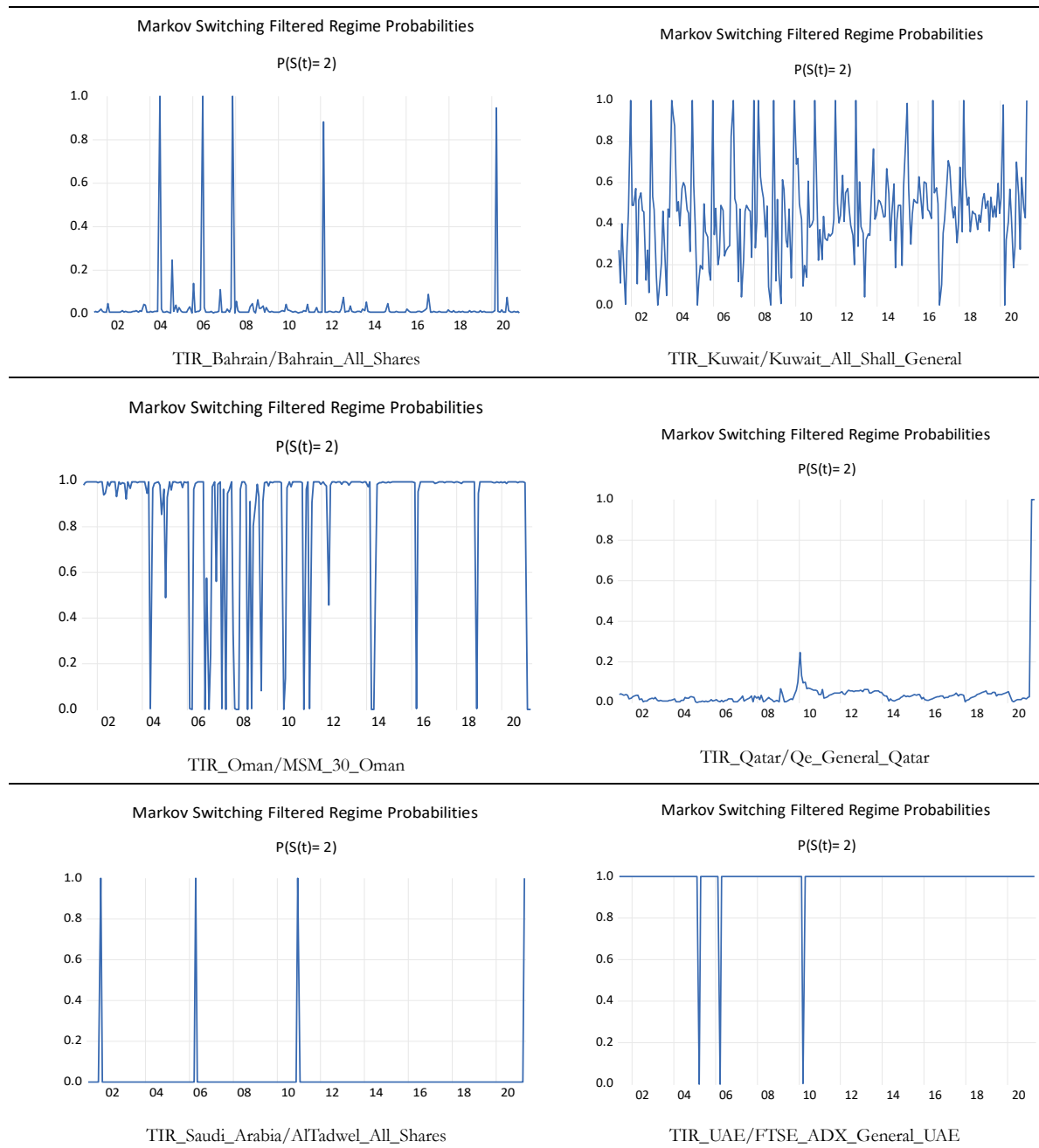

Figure 2. Filtered Regime Probabilities (GCC countries)

Validating the hypothesis of non-temporal variation in Pearson correlations proves challenging in this study. The approach advocated by Nelson (1991), aimed at elucidating performance evolution and volatility, serves as an extension, highlighting complexities in temporal variations.

Traditionally, analyses investigating shock transmission across financial markets rely on correlation coefficients, often based on Gaussian distribution assumptions. However, classical multivariate linear models grounded in

Gaussian distributions, as noted by Granger (2002), exhibit limitations in explaining observed stylized facts in economic and financial time series. Hence, two alternative dependence measures, FIEGARCH and the Switching-Markov, are considered. These rank correlation coefficients, emphasizing joint distributions beyond marginal variables, present themselves as comprehensive measures of agreement, serving as critical references in this study's explorations. Evaluating their efficacy compared to the traditional DCC seeks to unveil potential shifts in the analytical outcomes. These additional measures offer a nuanced perspective, accounting for complexities often overlooked by linear correlation models, thereby enriching our understanding of financial market interdependencies.

The outcomes from both the FIEGARCH-Model and the Switching-Markov-Model echo the findings observed in the DCC-MGARCH-Model estimations. The correlation coefficients for GCC countries pre-Covid-19 depict values of (0.458258) for Bahrain, (-0.126890) for Kuwait, (18.23466) for Oman, (17.01798) for Qatar, (20.11735) for Saudi Arabia, and (20.00245) for the United Arab Emirates. These results suggest a state of financial stability in these markets. The significance of these findings is underscored by the robust t-statistics derived from the FIEGARCH-Model estimations, far exceeding the critical threshold of 1.96 at the 5% significance level. This compellingly supports the assertion of financial stability across all stock markets during the stable period.

Conversely, the correlation coefficients for GCC countries post-Covid-19 reveal values of (0.273558) for Bahrain, (-0.273423) for Kuwait, (-0.348976) for Oman, (-0.001051) for Qatar, (1.076658) for Saudi Arabia, and (-1.212634) for the United Arab Emirates. These outcomes signal financial instability within these markets, a trend reinforced by the markedly insignificant t-statistics resulting from the FIEGARCH-Model estimations, significantly lower than the critical threshold of 1.96 at the 5% level. Additionally, the Switching-Markov-Model results further underscore this shift, indicating a transformation in the nature of the relationship between stock market returns and total investment returns, substantiating a regime transition. (Refer to Figure 2.)

These substantial alterations in correlation coefficients post-Covid-19 indicate a notable shift from the previously stable financial conditions to a more volatile landscape. The emergence of negative correlations in certain markets and the stark variations in their statistical significance highlight the profound impact of the pandemic on financial stability across these regions. This shift not only confirms the volatility but also suggests a need for a nuanced understanding of the evolving relationship between stock market returns and total investment returns in the wake of the pandemic's effects.

5. Conclusion

This study undertook an exploration of the intricate relationship between Global Investment Return and Stock Market Return within the GCC countries, investigating the correlation underpinning investor behavior in the financial market. Leveraging a multifaceted approach, we employed a multivariate dynamics model to estimate conditional GARCH dynamic correlations, utilizing monthly data spanning the performance period from January 2001 to April 2021. Our objective was to discern potential channels of correlation and unravel the complex interplay between these variables across six distinct countries.

Using the DCC-MGARCH model, we concurrently evaluated conditional correlation coefficients and their determinants over time, enabling the identification of contagion channels. This model's distinct advantage lies in its capability to derive all possible correlation coefficients for each index in the sample, illuminating their behavior during critical periods, notably financial turmoil.

The statistically significant coefficients uncovered in our analysis highlight the profound influence of market behavior on investor behavior. This influential correlation indicates a trend where a group of investors consistently traded in the same direction over an extended period, as evidenced by a notable and statistically significant increase in conditional correlations across all examined rates of return at a 5% significance level.

Moreover, our findings highlighted the magnitude of the COVID-19 pandemic's impact on these correlation coefficients, notably lower than previous financial crises. This suggests compelling evidence of herding behavior during the pandemic, elucidating a critical aspect of market dynamics during such crises.

Our validation through the DCC-MGARCH, Fractionally Integrated EGARCH (FIEGARCH), and the equality of coefficients test using the Switching-Markov Model bolstered our conclusions. This comprehensive validation sought to understand the dynamic conditional correlation between Global Investment Return and Stock Market Return within a sample of international markets, particularly in terms of volatility.

The delineation of different correlation periods pre-COVID-19 pandemic was insightful. Strong correlations indicated a robust relationship between market behavior and investor behavior, whereas periods of low correlations underscored the influence of the COVID-19 pandemic. This validation aligns with the prevailing

literature, substantiating the presence of excess volatility that defies explanation by the efficient financial market theory.

Moving ahead, forthcoming research endeavors should aim to delve deeper into comprehending the underlying behavioral determinants driving these observed correlations, particularly in times of crisis such as the COVID-19 pandemic. An exploration of the psychological underpinnings influencing investor decisions and their consequential impact on market correlations presents a promising avenue for invaluable insights. Analyzing the interplay between investor sentiment, cognitive biases, and market behavior could illuminate previously uncharted territories.

Moreover, a closer examination of the role played by information dissemination channels, sentiment analysis techniques, and the evolving landscape of technological advancements in trading platforms is warranted. Investigating how these factors shape and reshape market correlations in contemporary financial environments could unveil new dimensions in understanding market dynamics.

Expanding the scope of this study to encompass emerging markets or other global economic clusters would enrich our comprehension of correlation dynamics within diverse financial landscapes. By juxtaposing correlation behaviors across various economic environments, a more comprehensive and comparative analysis could offer nuanced insights into the contextual nature of market correlations.

Finally, an exploration into the efficacy of regulatory measures or policy interventions in mitigating excessive market volatility during crises emerges as a critical area deserving focused investigation. Evaluating the impact of regulatory actions on moderating market fluctuations and ensuring financial stability amid turbulent periods holds substantial relevance for policymakers and market participants alike.

These avenues for future research stand poised to deepen our understanding of market correlations, contributing invaluable insights into the intricate interplay between investor behavior and market dynamics, particularly in times of upheaval.

References

Abdeldayem, M. M., & Al Dulaimi, S. H. (2020). Investors' herd behavior related to the pandemic-risk reflected on the GCC stock markets. *Zbornik radova Ekonomskog fakulteta u Rijeci/Proceedings of Rijeka Faculty of Economics, 38*(2), 563-584. https://doi.org/10.18045/zbefri.2020.2.563

Abuzayed, B., & Al-Fayoumi, N. (2021). Risk spillover from crude oil prices to GCC stock market returns: New evidence during the COVID-19 outbreak. *The North American Journal of Economics and Finance, 58*, 101476. https://doi.org/10.1016/j.najef.2021.101476

Aharon, D. Y., Umar, Z., Aziz, M. I. A. A., & Vo, X. V. (2022). COVID-19 related media sentiment and the yield curve of G-7 economies. *The North American Journal of Economics and Finance, 61*, 101678. https://doi.org/10.1016/j.najef.2022.101678

Al Guindy, M. (2021). Fear and hope in financial social networks: Evidence from COVID-19. *Finance Research Letters*, 102271. https://doi.org/10.1016/j.frl.2021.102271

Al-Awadhi, A. M., Al-Saifi, K., Al-Awadhi, A., & Alhamadi, S. (2020). Death and contagious infectious diseases: Impact of the COVID-19 virus on stock market returns. *Journal of Behavioral and Experimental Finance, 27*, 100326. https://doi.org/10.1016/j.jbef.2020.100326.

Al-Kandari, A., AlRoomy, M., & Al-Roumi, K. (2023). The Influence of COVID-19 on the GCC Stock Markets. *International Journal of Business and Management, 17*(4), 1-42. https://doi.org/10.5539/ijbm.v17n4p42

Alkhatib, K., Almahmood, M., Elayan, O., & Abualigah, L. (2022). Regional analytics and forecasting for most affected stock markets: The case of GCC stock markets during COVID-19 pandemic. *International Journal of System Assurance Engineering and Management, 13*, 1298-1308. https://doi.org/10.1007/s13198-021-01445-9

Almeida, J., & Gonçalves, T. C. (2023). A systematic literature review of investor behavior in the cryptocurrency markets. *Journal of Behavioral and Experimental Finance, 37*, 100785. https://doi.org/10.1016/j.jbef.2022.100785

Anastasiou, D., Ballis, A., & Drakos, K. (2022). Constructing a positive sentiment index for COVID-19: Evidence from G20 stock markets. *International Review of Financial Analysis, 81*(C). https://doi.org/10.1016/j.irfa.2022.102111

Apergis, N., Mustafa, G., & Malik, S. (2023). The role of the COVID-19 pandemic in US market volatility:

Evidence from the VIX index. *The Quarterly Review of Economics and Finance, 89*, 27-35. https://doi.org/10.1016/j.qref.2023.03.004

Ardiyono, S. K. (2022). Covid-19 pandemic, firms' responses, and unemployment in the ASEAN-5. *Economic Analysis and Policy*, 76(3), 337-372. https://doi.org/10.1016/j.eap.2022.08.021.

Baillie, R. T., Bollerslev, T., & Mikkelsen, H. O. (1996). Fractionally integrated generalized autoregressive conditional heteroskedasticity. *Journal of Econometrics, 74*(1), 3-30. https://doi.org/10.1016/S0304-4076(95)01749-6

Baker, S. R., Bloom, N., Davis, S. J., Kost, K. J., Sammon, M. C., & Viratyosin, T. (2020). *The Review of Asset Pricing Studies, 10*(4), 742-758. https://doi.org/10.1093/rapstu/raaa008

Balcılar, M., Usman, O., Yülek, M., Ağan, B., & Erdal, B. (2023). House price connectedness and consumer sentiment in an era of destabilizing macroeconomic conditions: Empirical evidence from Türkiye. *Borsa Istanbul Review*, 1-21. https://doi.org/10.1016/j.bir.2023.08.006

Banerjee, A. K., Akhtaruzzaman, M., Dionisio, A., Almeida, D., & Sensoy, A. (2022). Nonlinear nexus between cryptocurrency returns and COVID-19 news sentiment. *Journal of Behavioral and Experimental Finance, 36*, 100747. https://doi.org/10.1016/j.jbef.2022.100747

Ben Amar, A., Bouattour, M., Bellalah, M., & Goutte, S. (2023). Shift contagion and minimum causal intensity portfolio during the COVID-19 and the ongoing Russia-Ukraine conflict. *Finance Research Letters, 55*, 103853. https://doi.org/10.1016/j.frl.2023.103853

Ben Cheikh, N., Ben Zaied, Y., Saidi S., & Sellami, M. (2022). Global pandemic crisis and risk contagion in GCC stock markets. *Journal of Economic Behavior & Organization, 202*, 746-761. https://doi.org/10.1016/j.jebo.2022.08.036

Bossman, A., Gubareva, M., & Teplova, T. (2023). EU sectoral stocks amid geopolitical risk, market sentiment, and crude oil implied volatility: An asymmetric analysis of the Russia-Ukraine tensions. *Resources Policy, 82*, 103515. https://doi.org/10.1016/j.resourpol.2023.103515

Buchheim, L., Dovern, J., Krolage, C., & Link, S. (2022). Sentiment and firm behavior during the COVID-19 pandemic. *Journal of Economic Behavior & Organization, 195*, 186-198. https://doi.org/10.1016/j.jebo.2022.01.011

Burggraf, T., Huynh, T. L. D., Rudolf, M., & Wang, M. (2021). Do FEARS drive Bitcoin? *Review of Behavioral Finance, 13*(3), 229-258. https://doi.org/10.1108/RBF-11-2019-0161

Capelle-Blancard, G., & Desroziers, A. (2020). The Stock Market Is not the Economy? Insights from the COVID-19 crisis. *CEPR Covid Economics*, 2020. https://doi.org/10.2139/ssrn.3638208

Catelli, R., Pelosi, S., Comito, C., Pizzuti, C., & Esposito, M. (2023). Lexicon-based sentiment analysis to detect opinions and attitude towards COVID-19 vaccines on Twitter in Italy. *Computers in Biology and Medicine, 158*, 106876. https://doi.org/10.1016/j.compbiomed.2023.106876

Chen, Q., Su, X., Liu, S., Miao, K., & Fang, H. (2021). The relationship between moral sensitivity and professional values and ethical decision-making in nursing students. *Nurse Educ Today, 105*, 105056. https://doi.org/10.1016/j.nedt.2021.105056

Chiang, T. C., Jeon, B. N., & Li, H. (2007). Dynamic Correlation Analysis of Financial Contagion: Evidence from Asian Markets. *Journal of International Money and Finance, 26*, 1206-1228. https://doi.org/10.1016/j.jimonfin.2007.06.005

Cho, J. H., & Parhizgari, A. M. (2008). East Asian financial Contagion under DCC-GARCH. *International Journal of Banking and Finance, 6*, 17-30. https://doi.org/ 10.32890/IJBF2009.6.1.8380

Chundakkadan, R., & Nedumparambil, E. (2021). In search of COVID-19 and stock market behavior. *Global Finance Journal*, 100639. https://doi.org/10.1016/j.gfj.2021.100639

Contessi, P., & De Pace, P. (2021). The international spread of COVID-19 stock market collapses. *Finance Research Letters*, 101894. https://doi.org/10.1016/j.frl.2020.101894

Corsetti, G., Pericoli, M., & Sbracia, M. (2005). Some contagion, some interdependence: More pitfalls in tests of financial contagion. *Journal of International Money and Finance, 24*(8), 1177-1199. https://doi.org/10.1016/j.jimonfin.2005.08.012

Costola, M., Hinz, O., Nofer, M., & Pelizzon, L. (2023). Machine learning sentiment analysis, COVID-19 news

and stock market reactions. *Research in International Business and Finance, 64*, 101881. https://doi.org/10.1016/j.ribaf.2023.101881

Costola, M., Iacopini, M., & Santagiustina, C. R. (2021). Google search volumes and the financial markets during the COVID-19 outbreak. *Finance Research Letters, 42*, 101884. https://doi.org/10.1016/j.frl.2020.101884

Da, J. Z., & Engelberg, P. G. (2015). The sum of all FEARS investor sentiment and asset prices. *The Review of Financial Studies, 28*(1), 1-32. https://doi.org/10.1093/rfs/hhu072.

Dash, S. R., & Maitra, D. (2022). The COVID-19 pandemic uncertainty, investor sentiment, and global equity markets: Evidence from the time-frequency co-movements. *The North American Journal of Economics and Finance, 62*, 101712. https://doi.org/10.1016/j.najef.2022.101712

Donadelli, M., Kizys, R., & Riedel, M. (2017). Dangerous infectious diseases: Bad news for Main Street, good news for Wall Street? *Journal of Financial Markets, 35*(C), 84-103. https://doi.org/10.1016/j.finmar.2016.12.003

Elhassan, T. (2021). Impact of Covid-19 pandemic on stock market returns volatility of Gulf Cooperation Council countries. *Investment Management and Financial Innovations, 18*(4), 45-56. https://doi.org/10.21511/imfi.18(4).2021.05

Engle, R. (2002). Dynamic Conditional Correlation: A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics, 20*(3), 339-350. http://www.jstor.org/stable/1392121

Forbes, K. J., & Rigobon, R. (2002). No Contagion, Only Interdependence: Measuring Stock Market Comovements. *Journal of Finance, 57*(5), 2223-2261. https://doi.org/10.1111/0022-1082.00494

Garcia, D. (2013). Sentiment during recessions. *The Journal of Finance, 68*(3), 1267-1300. https://doi.org/10.1111/jofi.12027

Goel, G., & Dash, S. R. (2022). Investor sentiment and government policy interventions: Evidence from COVID-19 spread. *Journal of Financial Economic Policy, 14*(2), 242-267. https://doi.org/10.1108/JFEP-02-2021-0038

Hamilton, J. D. (1994). *Time Series Analysis.* Princeton: Princeton University Press. https://doi.org/10.1515/9780691218632.

Hoang, K., Nguyen, C., Nguyen, H., & Vo, L. V. (2023). Disaster response: The COVID-19 pandemic and insider trading around the world. *Global Finance Journal, 56*, 100814. https://doi.org/10.1016/j.gfj.2023.100814

Huynh, T. L. D., Foglia, M., Nasir, M. A., & Angelini, E. (2021). Feverish sentiment and global equity markets during the COVID-19 pandemic. *Journal of Economic Behavior & Organization, 188*, 1088-1108. https://doi.org/10.1016/j.jebo.2021.06.016

John, K., & Li, J. (2021). COVID-19, volatility dynamics, and sentiment trading. *Journal of Banking & Finance*, *133*, 106162. https://doi.org/10.1016/j.jbankfin.2021.106162

Klöckner, M., Schmidt, C. G., Wagner, S. M., & Swink, M. (2023). Firms' responses to the COVID-19 pandemic. *Journal of Business Research, 158*, 113664. https://doi.org/10.1016/j.jbusres.2023.113664

Kyriazis, N., Papadamou, S., Tzeremes, P., & Corbet, S. (2023). The differential influence of social media sentiment on cryptocurrency returns and volatility during COVID-19. *The Quarterly Review of Economics and Finance, 89*, 307-317. https://doi.org/10.1016/j.qref.2022.09.004

Lescaroux, F., & Mignon, V. (2008). On the Influence of Oil Prices on Economic Activity and Other Macroeconomic and Financial Variables. *OPEC Energy Review, 32*(4), 343-380. https://doi.org/10.1111/j.1753-0237.2009.00157.x

Liu, Q., Wang, X., & Du, Y. (2023). The weekly cycle of investor sentiment and the holiday effect-- An empirical study of Chinese stock market based on natural language processing. *Heliyon, 8*(12), e12646. https://doi.org/10.1016/j.heliyon.2022.e12646

Luo, H., Meng, X., Zhao, Y., & Cai, M. (2023). Exploring the impact of sentiment on multi-dimensional information dissemination using COVID-19 data in China. *Computers in Human Behavior, 144*, 107733. https://doi.org/10.1016/j.chb.2023.107733

Naeem, M. A., Karim, S., Yarovaya, L., & Lucey, B. M. (2023). COVID-induced sentiment and the intraday volatility spillovers between energy and other ETFs. *Energy Economics, 122*, 106677. https://doi.org/10.1016/j.eneco.2023.106677

Niculescu, C. E., Sangiorgi, I., & Bell, A. R. (2023). Does personal experience with COVID-19 impact investment decisions? Evidence from a survey of US retail investors. *International Review of Financial Analysis, 88*, 102703. https://doi.org/10.1016/j.irfa.2023.102703

OECD. (2020). *OECD Economic Outlook*. Paris: OECD Publishing. https://doi.org/10.1787/0d1d1e2e-en

Papadamou, S., Fassas, A. P., Kenourgios, D., & Dimitriou, D. (2023). Effects of the first wave of COVID-19 pandemic on implied stock market volatility: International evidence using a Google trend measure. *The Journal of Economic Asymmetries, 28*(1), e00317. https://doi.org/10.1016/j.jeca.2023.e00317

Paule-Vianez, J., Orden-Cruz, C., & Escamilla-Solano, S. (2021), Influence of COVID-induced fear on sovereign bond yield. *Economic Research-Ekonomska Istraživanja, 35*(1), 2173-2190. https://doi.org/10.1080/1331677X.2021.1934509

Ramelli, S. & Wagner, A. (2020). Feverish Stock Price Reactions to COVID-19. *The Review of Corporate Finance Studies, 9*(3), 622-655. https://doi.org/10.1093/rcfs/cfaa012

Rubbaniy, G. A. A., & Khalid, A. S. (2021). Are Cryptos Safe-Haven Assets During Covid-19? Evidence from Wavelet Coherence Analysis. *Emerging Markets Finance and Trade, 57*(6), 1741-1756. https://doi.org/10.1080/1540496X.2021.1897004

Salisu, A., & Akanni, L. (2020). Constructing a Global Fear Index for the COVID-19 Pandemic. *Emerging Markets Finance and Trade, 56*(10), 2310-2331. https://doi.org/10.1080/1540496X.2020.1785424

Shaikh, T. I., & Huynh,L.D. (2021). Does disease outbreak news impact equity, commodity and foreign exchange market? Investors' fear of the pandemic COVID-19. *Journal of Economic Studies, 49*(4), 647-664. https://doi.org/10.1108/JES-10-2020-0503

Sharif, A., Aloui, C., & Yarovaya, L. (2020). COVID-19 pandemic, oil prices, stock market, geopolitical risk and policy uncertainty nexus in the US economy: Fresh evidence from the wavelet-based approach. *International Review of Financial Analysis, 70*, 1057-5219. https://doi.org/10.1016/j.irfa.2020.101496

Shiller, R. (2003). From Efficient Markets Theory to Behavioral Finance. *Journal of Economic Perspectives, 17*(1), 83-104. https://doi.org/10.1257/089533003321164967.

Smales, L. A. (2021). Investor attention and global market returns during the COVID-19 crisis. *International Review of Financial Analysis, 73*, 101616. https://doi.org/10.1016/j.irfa.2020.101616

Sun, Y., Bao, Q., & Lu, Z. (2021). Coronavirus (Covid-19) outbreak, investor sentiment, and medical portfolio: Evidence from China, Hong Kong, Korea, Japan, and U.S. Pacific-Basin. *Finance Journal, 65*, 101463. https://doi.org/10.1016/j.pacfin.2020.101463

Syllignakis, M. N., & Kouretas, G. P. (2011). Dynamic correlation analysis of financial contagion: Evidence from the Central and Eastern European markets. *International Review of Economics and Finance, 20*, 717-732. https://doi.org/10.1016/j.iref.2011.01.006

Szczygielski, J. J., Charteris, A., Bwanya, P. R., & Brzeszczyński, J. (2022). The impact and role of COVID-19 uncertainty: A global industry analysis. *International Review of Financial Analysis, 80*, 101837. https://doi.org/10.1016/j.irfa.2021.101837

Talbi, M., Ferchichi, M., Ismaalia, F., & Samil, S. (2024). Unveiling COVID-19's impact on Financial Stability: A Comprehensive Study of Price Dynamics and Investor Behavior in G7 Markets. *International Journal of Economics and Financial Issues, 14*(1), 216-232. https://doi.org/ 10.32479/ijefi.15643

Tetlock, P. C. (2007). Giving content to investor sentiment: The role of media in the stock market. *Journal of Finance, 62*(3), 1139-1168. https://doi.org/10.1111/j.1540-6261.2007.01232

Tripathi, A., & Pandey, A. (2021). Information dissemination across global markets during the spread of COVID-19 pandemic. *International Review of Economics & Finance, 74*, 103-115. https://doi.org/10.1016/j.iref.2021.02.004

Vasileiou, E. (2021). Behavioral finance and market efficiency in the time of the COVID-19 pandemic: Does fear drive the market? *International Review of Applied Economics, 35*(2), 224-241. https://doi.org/10.1080/02692171.2020.1864301

Wang, L. H., Xu, S. S., & Sharma. (2021). Does investor attention increase stock market volatility during the COVID-19 pandemic? *Pacific-Basin Finance Journal, 69*, 101638. https://doi.org/10.1016/j.pacfin.2021.101638

Wasiuzzaman, S. (2022). Impact of COVID-19 on the Saudi stock market: analysis of return, volatility and trading volume. *Journal of Asset Management, 23*(4), 350-363. https://doi.org/10.1057/s41260-022-00269-x

World Bank. (2020). *Global Economic Prospects, June 2020*. Washington, DC: World Bank. https://doi.org/10.1596/978-1-4648-1553-9

Xu, H., Liu, R., Luo, Z., & Xu, M. (2022). COVID-19 vaccine sensing: Sentiment analysis and subject distillation from Twitter data. *Telematics and Informatics Reports, 8*, 100016. https://doi.org/10.1016/j.teler.2022.100016

Xu, L., Chen, J., Zhang, X., & Zhao, J. (2021). COVID-19, public attention and the stock market. *Accounting & Finance, 61*(3), 4741-4756. https://doi.org/10.1016/j.frl.2020.101597

Yu, X., Xiao, K., & Liu, J. (2021). Dynamic co-movements of COVID-19 pandemic anxieties and stock market returns. *Finance Research Letters*, 102219. https://doi.org/10.1016/j.frl.2021.102219

Yuan, Y., Wang, H., & Jin, X. (2022). Pandemic-driven financial contagion and investor behavior: Evidence from the COVID-19. *International Review of Financial Analysis, 83*, 102315. https://doi.org/10.1016/j.irfa.2022.102315

Yusuf, N., & Ali, I., S. (2023). Assessing the Impact of the COVID-19 Pandemic on the Saudi Stock Market's Performance and Sustainability. *European Journal of Sustainable Development, 12*(3), 364-376. https://doi.org/10.14207/ejsd.2023.v12n3p364

Zaremba, A., Kizys, R., Aharon, D. Y., & Demir, E. (2020). Infected markets: Novel coronavirus, government interventions, and stock return volatility around the globe. *Finance Research Letters*, 2020, 101597. https://doi.org/10.1016/j.frl.2020.101597

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of COVID-19. *Finance Research Letters, 36*, 101528. https://doi.org/10.1016/j.frl.2020.101528

Zhang, H., Ding, Y., & Li, J. (2021). Impact of the COVID-19 pandemic on economic sentiment: A cross-country study. *Emerging Markets Finance and Trade, 57*(6), 1603-1612. https://doi.org/10.1080/1540496X.2021.1897005.

Zhang, X., Bissoondoyal-Bheenick, E., & Zhong, A. (2023). Investor sentiment and stock market anomalies in Australia. *International Review of Economics & Finance, 86*(C), 284-303. https://doi.org/10.1016/j.iref.2023.03.024

Zhu, X., Li, S., Srinivasan, K., & Lash, M. T. (2023). Impact of the COVID-19 pandemic on the stock market and investor online word of mouth. *Decision Support Systems, 176*, 114074. https://doi.org/10.1016/j.dss.2023.114074