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Examining The Effects Of COVID-19 On Financial Markets: Evidence From Oil, Gold, Islamic, And Conventional Stock Markets

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Abstract

The effects of the COVID-19 outbreak have been severe on financial markets worldwide, resulting in high volatility and fluctuations in asset prices. This study examines the impact of COVID-19 across three periods—pre-COVID-19, during COVID-19, and post-COVID-19—on four vital financial assets: Dow Jones Islamic stocks, Dow Jones conventional stocks, oil, and gold. Using the econometric models such as the ADF test, PP test, VAR model, Granger causality test, and the ARCH model, the study shows that all the asset classes under consideration have indeed increased their volatility during the pandemic while some of them are still struggling to recover pos[1]t COVID. Islamic stocks were comparatively less volatile because of the ethical principles of Shariah investing, and new conventional stocks were higher post-pandemic. Oil prices were very volatile, with negative prices at specific points in the year, while gold prices went through the roof, proving its role as a safe-haven asset. Hence, the need to diversify and have a formidable financial plan when confronting international disasters cannot be overemphasized.

Keywords: *COVID-19, financial markets, Islamic stocks, conventional stocks, oil prices, gold prices, volatility, econometric analysis, ADF test, PP test, VAR model, Granger causality, ARCH model.*

Introduction

COVID-19 emerged in Wuhan, China, in December 2019 and has rapidly spread out across all the continents, affecting human lives in all spheres of social and economic life. Governments of countries worldwide put measures like containment, closure of borders, and closure of schools and workplaces to limit the spread of the virus (World Health Organization, 2020). Such measures, which are vital in controlling the spread of the disease, disrupted many markets, especially the financial market, and brought unprecedented levels of volatility and uncertainty.

Previously, epidemics and pandemics have created systematic grave threats to financial structures and markets, as seen during the Spanish flu of 1918 flu pandemic that led to the death of millions, a number superior to those deaths that the current COVID-19 has

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recorded, but the impact it had on the global economy was slightly felt, (Barro et al., 2020). The COVID-19 pandemic, however, has been very different from other incidents that were earlier mentioned. Its effects have been more profound and extensive on the financial markets of securities, including those of oil and gold, and on both Islamic and conventional markets.

The first wave of COVID-19 caused a stylized recession as governments placed restrictions on the movement of populations through lockdowns, etc. This response caused a sharp reduction in economic activities thus reducing the demand for most operations in the economy. However, the turmoil in the oil market was perhaps unprecedented. With the decrease in the demand for oil, mainly in transportation and industries because of the outbreak of COVID-19 and subsequent restrictions on travel and industrial production, the international oil prices came to their lowest level in years, with WTI futures going even into negative territory in April 2020 (Sharif et al., 2020). This sharp decline in the price of oil was as much due to cut-down consumption as it was the frailty of the supply chain – most notably that of the Middle East, where the advance of the pandemic posed a potentially fatal blow to crude oil exports (Tuna et al., 2021).

Concurrently, the global markets of stocks have been highly unpredictable, and investors struggled to understand the effects of the COVID-19 pandemic. Markets such as the U. S stock market, for instance, experienced one of the most chaotic times in decades; circuit breakers had to be invoked in the stock market in March 2020 to prevent panic selling (Chen et al., 2007). Spike was mainly seen in Europe and Asia; Germany's DAX and Japan's TOPIX plummeted (Ichev & Marinˇc, 2018). This synchronized global recession pointed to the integration of today's globalized financial markets and the systematic dangers accompanying global adversities such as the COVID-19 pandemic.

When the pandemic started, the safe-haven demand for gold came into focus yet again. Traditionally, gold has always been regarded as a crisis hedge because of the perceived stable value of the metal and is generally regarded for its bullion or intrinsic value (Ftiti & Hadhri, 2019). As investors ran away from the equities markets and the future of other forms of investments due to the COVID-19 breakout, the price of gold increased. This surge points to the fact that metal serves both as a barometer of economic downturns and as an important input to some industries (Arouri et al., 2012). The role of gold in the described markets during the pandemic crisis revealed important tendencies in investors' behavior in conditions of increasing uncertainty.

Islamic financial markets, which operate based on prohibition of interest and some forms of derivative businesses, had another experience of the pandemic. The newly emerging Islamic stock markets were equally assertive to the crisis because the global Muslim community's demand for shares, equities, bonds, and other related financial products has been continuously rising (Pew Research Center, 2014). To some extent, Islamic markets' reaction to the pandemic looked different from conventional ones, which are also more sensitive to interest rates and speculative actions; the given difference can be explained by the structural peculiarities and investors of Islamic markets (Tuna, 2019).

The COVID-19 contagious disease has also redefined the original interactions between several financial markets. This means that the availability of research on the interconnectivity of oil, gold, and stock markets is exhaustive, given their impact on policy directions and decision-making among investors. These relationships were enriched and strained during the pandemic, given the volatility of the markets and their new stimuli. For instance, the global oil prices and the stock market joint relationship became stronger where the oil prices directly affected the cash generation capability as well as the profitability of the firms irrespective of the industry type (Jouini, 2013). In the same way, the market's insurance property of gold was confirmed, as investors turned to the metal due to the uncertainty caused by the pandemic.

The disruption of the financial markets can be seen in the short-run and the long-run of the pandemic. In the short term, it incurred panic due to the breakout of the viral disease, COVID-19, which led to fluctuations in prices as well as extreme levels of market risk (Shehzad et al., 2021b). However, new political regimes and the crisis of the real sector of the economy in the US led to the adoption of stimulus measures by governments and the application of policies of monetary easing by the major central banks and markets gradually started stabilizing at least at a high level of uncertainty. The $1 trillion economic stimulus by the U. S. government in early March 2020 helped stabilize markets and avert a deeper plunge in economic activity (Baker et al., 2020). The same was achieved by other governments, thus underlining the need for synchronized fiscal and monetary policies to contain the effects of the pandemic.

Therefore, there are several long-term effects of the pandemic on the structural front that relate to financial markets. For example, the spread of digital technologies and partially remote work due to the pandemic has contributed to the enhancement of digital transformation in numerous industries, which can shift the market tendencies in the following years (Li et al., 2020). First of all, thanks to the pandemic, investors realized the importance of diversification and risk management in their portfolios and, generally speaking, in the world economy. Islamic financial markets' behavior during the pandemic is also informative for conventional ones and demonstrates institutional strengths and solidity (Tuna, 2019).

In addition, COVID-19 pandemic affects financial systems and changes traditional factors that impact the financial markets. In addition to using interest rates, inflation, and economic growth as indicators, the pandemic-related indicators include daily death rate, newly confirmed cases, and the Infectious Disease Equity Market Volatility (IDEMV) index (Baker et al., 2020). These new indicators have emerged as essential means by which investors endeavor to find their bearings during the processes associated with the pandemic and act in response to the changes in the market that have become much more multifaceted in recent years.

The peculiarity of the COVID-19 pandemic is that it affected both the wealth and health of people which had a psychological influence over investors. While the 2008 GFC raised concerns over solely economic capital, COVID-19 instills feelings of risk over personal self and, thus, financial decision-making (Shehzad et al., 2021b). Such has had the effect of raising the level of unpredictability within markets and the generation of new forms of risk that have to be taken into account when assembling a portfolio.

In this regard, the present study intends to investigate the pre-COVID, during-COVID, and post-COVID-19 effects on oil, gold, Islamic, and conventional markets. This research applies time and frequency-domain causality analysis to ascertain whether these markets' linkages with the pandemic are structural or transient. Further, this study adopts what has not been covered by any study so far: the IDEMV index, which calculates and measures the increase in premium for the psychological impacts of the pandemic over the volatility of the markets.

To conclude, COVID-19 has affected the financial markets in all aspects, ranging from the price of oil and gold to Islamic and conventional stock markets. Specifically, by analyzing these effects in the short and long run, this research will be useful to investors, policymakers, and academicians who are interested in the current pandemic situation's consequent risk factors. The remainder of this paper is organized as follows: Section 2 identifies a review of the literature while Section 3 describes the data and method used in the analysis, Section 4 presents the empirical findings made in the study, and Section 5 provides an overall key evaluation based on the results of the research done.

Literature Review

The outbreak of the coronavirus disease in late 2019 affected the dynamics of world financial markets for oil, gold, Islamic, and conventional equities. This pandemic is quite unprecedented and, therefore, has made academics focus on researching its impact on various financial securities. The following literature review synthesizes the insights of these papers relating to the COVID-19 effects on these markets in the pre-, during, and post-impact stages.

Impact on Oil Markets

Oil markets have on average, been some of the most sensitive to the impacts posed by the COVID-19 outbreak. The Spread of the COVID-19 pandemic and subsequent shutdowns and restrictions on international and inter-state transport and travel greatly reduced the consumption of oil and its derivations and, therefore, less demand for it, causing the prices of oil to be lowered. Quite a number of researchers have examined this impact from a number of angles. A time-frequency analysis was also done by Sharif et al. (2020) to establish a link between the COVID-19 pandemic, oil price fluctuations, and the stock market. It was discovered that the pandemic resulted in an extreme fluctuation in oil prices; this impacted the stock market and increased geopolitical risks.

Continuing from the same stream of thoughts, Norouzi et al. (2020) continued to establish that COVID-19 impacted oil prices greatly due to supply chain disruption. A drop in demand and an overproduction of oil and oil products essentially led to unprecedented, low prices in oil; as far as crude oil futures for WTI were concerned, these reached negative values with the Black of April of 2020. This event brought out how the price of oil is sensitive to shocks, and the need to come up with improved hedging methods.

Moreover, Salisu et al. (2020) attempted to uncover the consequences of financial instability and uncertainty in increasing the effects of COVID-19, on the price of oil. The authors discovered that daily announcements of new cases and deaths caused by COVID-19 had a barely negative effect on crude oil prices: thus, the psychological factor also 'exerts influence over the market'. Also, Huang and Zheng (2020) observed the same fact, comparing, however, that lockdowns due to the pandemic hit oil prices even more than stock markets, thus confirming the exquisite vulnerability of the oil market amidst global crises.

Impact on Stock Markets

The two types of stock markets, conventional and Islamic, also felt the pinch of the COVID-19 pandemic and displayed high volatility. Investigations into the effects of the pandemic on the stock markets have been common, with scholars analyzing how various markets performed during the crisis. To assess the effects of COVID-19 on the Chinese stock market, Al-Awadhi et al. (2020) employed panel data analysis to analyze companies that featured in the Hang Seng and Shanghai Stock Exchange Composite indices. According to this, their discovery portrayed that an increase in figure of COVID-19 confirmed cases per day and COVID-19 deaths affected the stock returns negatively, showing the pandemic's negative influence on investors' sentiment.

Onali (2020) used the GARCH (1,1) model to determine the volatility in the U.S. stock market, mainly the Dow Jones and S&P 500. The study further showed that actual COVID-19 deaths reported in Italy and France reduced the returns of the USA stock market and increased the VIX, which is a fear index. This implies that COVID-19's effect on the international market impacted investors' decisions by increasing their risk sensitivity.

Of course, other works are devoted to the consequences of the pandemic for the world's stock exchanges in a more extensive sense. Papadamou et al. (2020) also adopted the panel data analysis to analyze the research question about the direct and indirect impacts of COVID-19 on implied stock market volatility in Europe, Asia, the USA, and Australia. Analyzing the impact of Google trends on global pandemics, their research evidenced that

people's anxiety caused by a specific topic result in increased risk aversion and boosted volatility in the stock exchanges. This has clearly pointed out how communication of information and public opinion causes changes in markets during a crisis.

Impact on Gold Markets

Even gold, which has always enjoyed the status of a safe haven asset, has also come under pressure due to the COVID-19 pandemic. An increase in market risk was witnessed in the year under review due to the COVID-19 pandemic, consequently creating risk aversion resulting in high demand for gold as an asset of last resort as risk in other asset classes escalated. As for gold, Baur and Lucey (2010) and Baur and McDermott (2010) had already pointed to the metal as a hedge during financial crises to which the COVID-19 pandemic conformed.

Gold prices have gone high during the pandemic as people associate gold with safety during such a time. In the context of the pandemic analysis of the gold performance, Conlon et al. (2020) revealed that gold was more effective as the asset class compared to stocks and bonds. The result of this research is consistent with the belief held by academics and market participants that gold is a safe haven investment when uncertainty pervades markets.

Apart from the safe-haven currency, gold has also been tested for its ability to hedge against the price of oil. Sulisu et al. (2021) emphasized that gold was an efficient super asset for managing the decrease in oil prices during the pandemic, especially when the market situation is unpredictable. They have provided evidence that portfolio optimization is not limited to crisis periods, but gold provides the best option for portfolio diversification for investors in the long run.

Islamic Financial Markets

Even though Islamic financial markets have complied with Shariah standards for some time now, researchers' interest in knowledge of this phenomenon has grown, particularly during the COVID-19 pandemic. These markets are different from the typical markets in that they bar interest (riba) and speculation (gharar) some opine afford them more durability at economic crises. Like Tuna et al. (2021), the study analyzed the effect of COVID-19 on Islamic stock markets and noted that they behave differently compared to conventional stock markets, especially in adjusting for interest rates.

Ftiti and Hadhri (2019) had earlier observed that Islamic financial markets had expanded briskly due to increasing global demand for financial services in general, but especially among the Islamic population. The COVID-19 outbreak offered a useful prospect to evaluate the stability of commodity cycles in that global exigency. Adekoya et al. (2021) also noted that the Islamic financial markets were resilient during the pandemic period, and gold used to be probably the most preferred asset in the context of Islamic portfolios because of Shariah compliance.

Causal Comparative Study and Long-Term Consequences

Most of the earlier works have looked at the short-term effects that the COVID-19 pandemic has exerted on financial markets though there is a rapidly growing literature that aims to explore the long-term effects of such changes. Gil-Alana and Monge (2020) used long-memory techniques to analyze the long-memory properties of structural breaks in oil prices during the pandemic. On the basis of the evidence they provide, they posit that although the effects of the pandemic on oil prices may not be permanent, the impact that the latter portends to have is likely to be long-standing, and hence, it will continue to have lasting effects on the global economy even in future.

In the same respect, by adopting the time-domain approach and the frequency dynamics methods, Zhang et al. (2020a) and Zhang et al. (2020b) examined the interconnectivity between various financial markets during the pandemic. Their papers point out that the COVID-19 pandemic has not only led to a short-term fluctuation but also shifted the nature

of these markets' relations. This emphasizes the importance of continuous research to evaluate the consequences of the pandemic in the financial markets and to work out comprehensive crisis control measures.

There is a vast body of literature on the effects of the COVID-19 pandemic on financial markets, and individual works are being produced as the pandemic progresses. The current pandemic has created a major effect on oil, gold, Islamic, and conventional markets, and each of them was affected in a different way. There were, thus, as mentioned earlier, unprecedented shifts in oil markets through sharp declines in demand and oversupply. we found that conventional and Islamic stock markets were hit by the financial turmoil, although the extent of the impact depended on the region and the structure of the market. Holding gold as a safe-haven demand, gold also rose especially since investors are looking for a more secure investment in an unstable market. As the financial markets substituted 'the Western-style' of ethical investment, the Islamic financial markets that firmly follow the Shariah rules emerged with comparatively higher resistance to raw shocks. Finding out the post-COVID-19 long-term impacts on these markets will be helpful for investors, decision-makers, and scholars as the world is gradually going towards the process of recovery. Further research should focus on the interlinkages between these markets and the influence of other factors that have not been the subject of consideration in this study, such as public opinion and digitization. The experience of the COVID-19 pandemic will inevitably contribute to the creation of much more effective and resistant financial structures in various countries.

Data and Methodology

Data

The study investigates the impact of the COVID-19 pandemic on financial markets by analyzing the performance of key financial instruments across three distinct time frames: It also covers pre-COVID from January 1, 2016, to December 31, 2018, during COVID-19 from January 1, 2019, to December 31, 2021, and the post-COVID-19 period from January 1, 2022, to December 31, 2023. The financial instruments used in the analysis are the Dow Jones Islamic Stock Index, Dow Jones Conventional Stock Index, WTI crude oil prices, and gold prices – the refined gold futures.

Financial Instrument	Data Source
Dow Jones Islamic Market World Index (DJIMI)	Investing.com
Dow Jones Industrial Average (DJI)	Investing.com
WTI Crude Oil Prices	Investing.com
Gold Prices (Refined Gold Futures)	Investing.com

Table-1: Instrument

Table 1 provides a clear and concise overview of the financial instruments analyzed in the study, including their descriptions, sources of data, and the time frames over which they were examined. Dow Jones Islamic Market World Index (DJIMI) and Dow Jones Industrial Average (DJI)were selected as measures of the two broader categories of Islamic and conventional equity markets. These indices are in US dollars, and the data used here were downloaded from Investing.com (https://www.investing.com/) DataStream, which is a popular database among financial market researchers. The Dow Jones Islamic Index was purposively chosen because it is used in the literature as a benchmark for the Islamic financial markets.

WTI crude oil prices were incorporated in the study since it was acting as the benchmark for U.S. oil, while gold prices were included in the study as refined gold futures because both are major commodities that are essential in the global financial market. To investigate how COVID-19 affects stock return, this study also uses the Infectious Disease Equity

Market Volatility (IDEMV) Index, a news-based index created by Baker et al. (2019) that captures the market volatility arising from infectious diseases.

The data set analyzed by the authors runs from January 1, 2016, which captures pre-COVID-19, during COVID-19, and post-COVID-19 phases. These specific periods have been chosen to include the pre-Covid times, the period of COVID-19 escalation, and the period of recovery from its effects on the financial markets. Raw daily data values were used for all the variables, and the natural logarithm of every time series was used, in order to reduce variance and make the results more valid and credible.

Econometrics Equations

To address the task at hand, we will delve into the equations of the Augmented Dickey-Fuller (ADF) test, Phillips-Perron (PP) test, Vector Autoregression (VAR), Granger Causality test, and Autoregressive Conditional Heteroscedasticity (ARCH) model. These statistical tools are fundamental in time series analysis and econometrics, aiding in understanding the properties of data, relationships between variables, and modeling volatility.

- **Augmented Dickey fuller test**

The ADF test, a widely used unit root test, is crucial in determining if a time series is stationary or possesses a unit root. The equation for the ADF test involves regressing the first difference of the dependent variable on its lagged level and possibly lagged differences. The null hypothesis assumes the presence of a unit root, indicating non-stationarity, while the alternative hypothesis suggests stationarity (Paparoditis & Politis, 2016). The ADF test equation can be represented as:

$$\Delta y(t) = \alpha + \beta y(t-1) + \gamma \Delta y(t-1) + \varepsilon(t)$$

Here, Δ denotes differencing, $y(t)$ is the variable at time t, α is a constant, β is the coefficient of the lagged level, γ represents the coefficient of the lagged difference, and $\varepsilon(t)$ is the error term.

- **Philips-Perron Test**

The PP test, similar to the ADF test, is used to test for unit roots in time series data. The PP test equation is akin to the ADF test but incorporates a different method of correcting for serial correlation. The PP test equation can be expressed as:

$$\Delta y(t) = \alpha + \beta y(t-1) + \gamma \Delta y(t-1) + \delta t + \varepsilon(t)$$

In this equation, δt represents deterministic trends that are included to account for non-stationarity in the data (Paparoditis & Politis, 2016).

- **VAR Model**

Moving on to Vector Autoregression (VAR), a model used to analyze the dynamic relationship between multiple time series variables, the equation for a VAR(p) model with p lags can be written as:

$$Y(t) = c + \Phi 1 Y(t-1) + \Phi 2 Y(t-2) + \ldots + \Phi p Y(t-p) + \varepsilon(t)$$

Here, $Y(t)$ is a vector of endogenous variables, c is a constant, $\Phi 1$ to Φp are coefficient matrices for each lag, and $\varepsilon(t)$ is the error term vector (Joutz et al., 1995).

- **Granger Causality**

Granger Causality, a concept used to determine if one time series variable can forecast another, is assessed through the Granger Causality test. The equation for the Granger Causality test involves regressing the dependent variable on its lagged values and the lagged values of the potential causal variable. The null hypothesis is that the potential causal variable does not Granger-cause the dependent variable. The equation for the Granger Causality test can be represented as:

$$Y(t) = \alpha + \beta Y(t-1) + \gamma X(t-1) + \varepsilon(t)$$

In this equation, Y(t) is the dependent variable, X(t-1) is the lagged value of the potential causal variable, and ε(t) is the error term (Liaw, n.d.).

- **ARCH Model (Autoregressive Conditional Heteroskedasticity)**

Lastly, the Autoregressive Conditional Heteroscedasticity (ARCH) model is used to model volatility clustering in time series data. The basic ARCH (1) model equation is given by:

$$\sigma^2(t) = \alpha 0 + \alpha 1 \varepsilon^2(t-1)$$

Here, σ^2(t) represents the conditional variance at time t, α0 is a constant term, α1 is the coefficient of the lagged squared error term ε^2(t-1), and ε(t-1) is the error term at time t-1 (Ioannidis, 2005).

In conclusion, understanding the equations of these tests and models is essential for conducting rigorous time series analysis, assessing relationships between variables, and modeling volatility in various fields such as economics, finance, and biology.

Results

Daily prices (Raw Data)

- **Dow Jones Industrial Average**

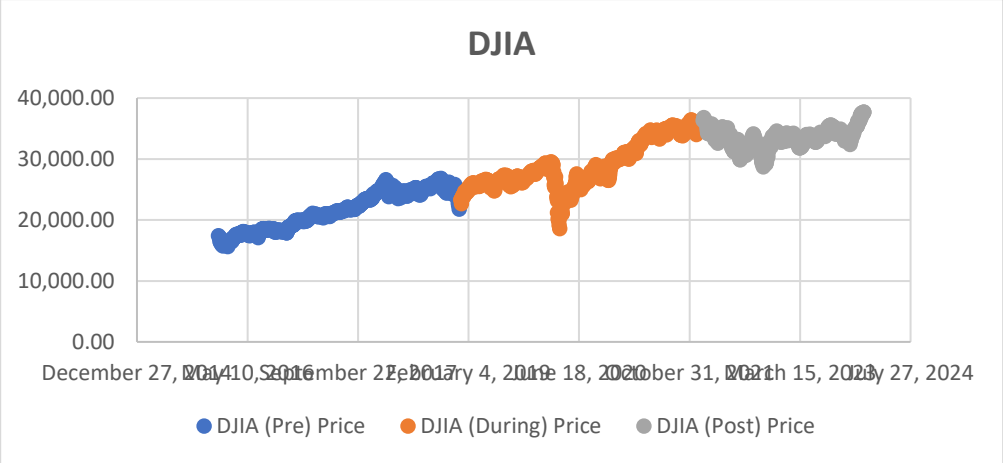

Figure-1: DJIA (Raw)

The figure-1 visualizes the Dow Jones Industrial Average (DJIA) prices across three distinct periods: pre-COVID-19, during COVID-19, and post-COVID-19. The line is color-coded to represent these periods, with blue indicating the pre-COVID-19 phase, orange representing the during-COVID-19 period, and gray showing the post-COVID-19 recovery.

- **Dow Jones Islamic Index**

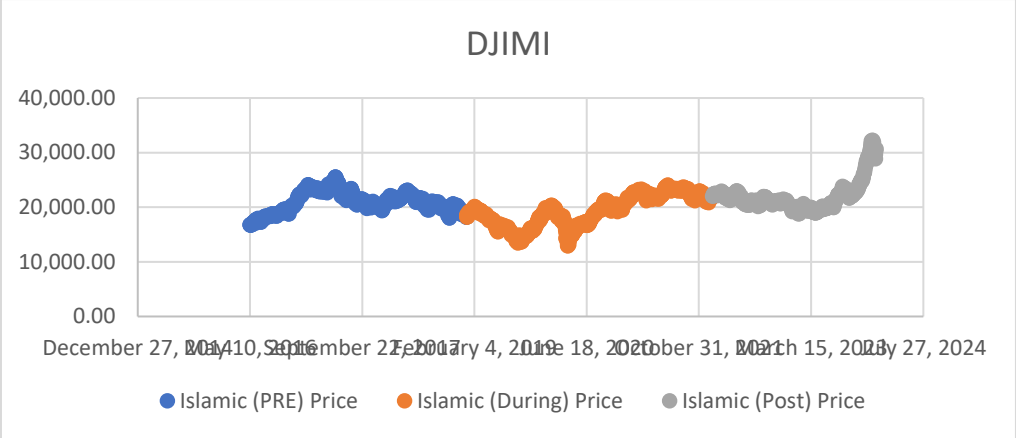

Figure-2: DJIMI (Raw)

This figure-2 depicts the price movements of an Islamic index across three periods: Timeline before COVID-19 (blue), during COVID-19 (orange) and after COVID-19 (gray). The index will show that it was actually on the rise before the pandemic, was greatly affected during COVID-19, however the post COVID-19 recovery is quite healthy, similar to the conventional markets.

- **WTI (Oil)**

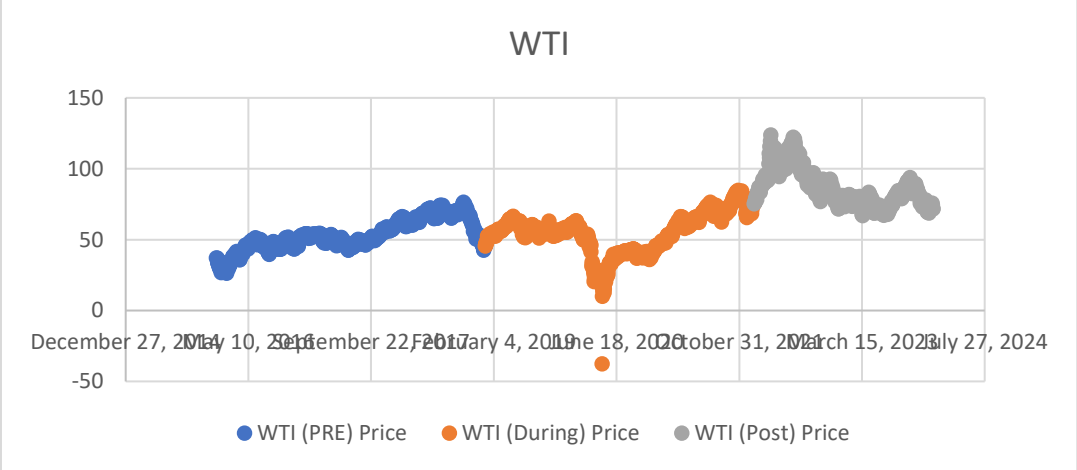

Figure-3

This figure-3 shows WTI (West Texas Intermediate) oil prices over three periods. Pre COVID-19as blue, during COVID-19 as orange and Post COVID-19 as gray color. COVID-19 hit it hard and showed a steep decline and even slight negative status, but the post COVID-19 period looks much better and is on a high trend.

- **Gold**

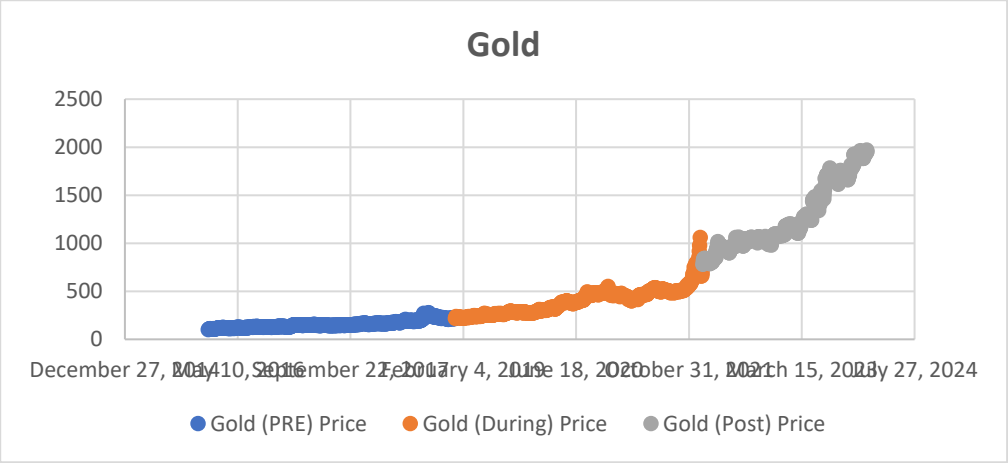

Figure-4

This figure-4 shows gold prices across three periods: pre COVID-19 and spike during COVID-19 (blue) and post COVID-19 (grey bars). That is more in line with the general, steady increase in the service price pre-pandemic, and a sharp affected during and after COVID-19, these results show that gold being a hedging asset to investors during economic turmoil periods.

Descriptive statistics

	Islamic Stock (DJIS)			Conventional Stock (DJIA)			Oil			Gold		
	Pre	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**
Mean	20927.64	19427.65	21890.48	21566.75	29097.96	33513.89	53.03129	54.85537	85.98816	156.5471	396.8714	1261.665
Std.Dev	1875.287	2805.237	2646.782	3100.449	3960.262	1603.655	10.7222	14.37024	12.89862	36.2193	132.3435	346.5019
Minimum	16733	12924.47	18813.53	15660.18	18591.93	28725.51	26.21	-37.63	66.74	99.84	217.8	780.68
Maximum	25546.41	24055.86	32277.37	26828.39	36488.63	37710.63	76.41	84.65	123.7	275.21	1057.73	1969.88

Table 2: Descriptive Statistics

Table 2 provides descriptive statistics for four asset classes—Islamic stocks (DJIS), conventional stocks (DJIA), oil, and gold—across three distinct periods: It has been subdivided pre-COVID-19, during COVID-19, and post-COVID-19. It comprises the arithmetic mean, variance, minimum, and maximum return of each asset for these periods, with the aim of revealing the flow of funds and the level of risk of the assets.

Regarding accounting scores, the data for Islamic and conventional stocks reveal a fall in the stocks' mean values during COVID-19, which captures the market's sensitivity to the pandemic. A similar trend has been witnessed in other types of stocks, but the mean value of conventional stocks rocketed during the post-COVID-19 period after declining sharply during the COVID-19 period. The COVID-19 period had a higher standard deviation, which means more fluctuations, but Islamic stocks were slightly less variable compared to conventional ones, given the fact that Islamic investment is generally considered to be more stable because of the rules of Shariah law. This aligns with previous research like that of Boubaker et al. (2022) to suggest that Islamic finance tends to fare relatively better in crisis times relative to other conventional markets.

The COVID-19 period is clearly distinguished on the graph as it shows significantly lower oil prices with a mean a little above $54 and the minimum value representing the situation when oil prices went negative. This was due to three leading causes: A decline in demand due to COVID-19 restrictions and An increase in production capacity by a factor of 2. After the COVID-19 period, the prices of oil have bounced back in a big way with a sharp increase in the mean value, which has been due to global economic recovery. The studies of Baumeister and Kilian (2020) also considered the dynamics of the oil market and its response to demand shocks and the beginning of economic activities.

The safe-haven commodity – gold – displayed a significant rise in its mean price during and after the COVID-19 period. The providers, including the mean and the maximum values in these periods, combined with the enhanced variability (as depicted by the standard

deviation), the increase in gold's value, as Baur and Lucey (2021) noted rises during the financial uncertainty making it a preferred investment during the crises.

The table presents how the COVID-19 crisis affected each asset type differently: each demonstrated certain patterns of fluctuation and return to stabilization that have been analyzed in the literature.

ADF Test Results

	Islamic Stock			**Conventional Stock**			**Oil**			**Gold**		
	Pre	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**
ADF	-1.7875	-1.3244	-2.3553	-1.5826	-1.0341	-3.4604	-1.0476	-1.0769	-1.6247	-1.803	-2.237	-1.3097
P-value	0.3867	0.6179	0.1548	0.4923	0.7406	0.0091	0.7355	0.7242	0.4703	0.379	0.193	0.6247
Critical value at 5%	-2.866	-2.9051	-2.866	-2.8654	-2.8654	-2.8654	-2.8652	-2.8652	-2.8652	-2.8652	-2.865	-2.8652

Table 3: ADF Test

The table-3 presents the results of the Augmented Dickey-Fuller (ADF) test for stationarity on four asset classes—Islamic stocks, conventional stocks, oil, and gold—across three periods: We are going to categorize them as pre COVID-19, during COVID-19, and post COVID-19. ADF test statistic, p-value, and the critical value at 5% (α) for each of the assets and period are shown in the next table. The ADF test is used to detect the presence or otherwise of unit root in a time series process and a unit root means that a time series is not stationary, that is, possesses an unstable mean and, variance and or autocovariance. Suppose the computed ADF statistic is less than the negative of the critical value. In that case, the hypothesis that the underlying series is non-stationary is turned down, implying that the series is stationary. On the other hand, if the p-value is greater than 0. In 05, the null hypothesis could not be rejected, and therefore, there is an implication that the series is non-stationary.

Both for Islamic and conventional stocks' ADF tests, it can be observed that the test statistic emerged higher (less negative) than the critical value. At the same time, the p-value is greater than 0. 05 across all periods. This implies that the stock prices are non-stationary in the pre COVID-19 and during COVID-19 period for conventional as well as innovative stocks whereas, conventional stocks only show stationarity in the post COVID-19 period the p-value is 0. 0091. That is, we get the same pattern as in the financial markets when stock prices are considered to be affected by macroeconomic variables, which causes nonstationary. Some works of Phillips and Perron (1988) argue that it may be practically problematic to establish stationarity on financial account time series particularly at episodes of volatility.

Oil prices, too, turned out to be non-stationary in all the periods under analysis, as the ADF statistics were less than the critical values and the p-value greater than 0. 05. This is in sync with Hamilton's (2008) observation that oil price is a non-stationary variable because its price fluctuations are normally triggered by shifts in supply and demand balancing, conflicts, and other factors.

Similarly, the gold prices, which are conventionally considered as the gold asset in crisis, also exhibit the non-stationarities as evident from the ADF test statistics, which are not sufficiently negative in all periods and p-values of the test greater than the 0. 05 thresholds. In light of this evidence, it is possible to refer to the findings of Baur and McDermott (2010), pointing to the fact that Gold prices may react to the global economy, which causes them to exhibit non-stationary properties.

In summary, the ADF test outcomes indicate that these asset classes are non-stationary, especially during the COVID-19 era. This non-stationarity is attributable to the prevailing market conditions and has been noted in the extant literature in finance, as volatility makes modeling and forecasting very difficult.

PP Test

	Islamic Stock			**Conventional Stock**			**Oil**			**Gold**		
	Pre	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**
PP	0.732	-4.312	4.132	-1.227	-1.741	-5.473	-5.015	-28.362	-5.756	-4.908	-4.174	0.732
Z (t)	0.727	-2.262	2.523	-0.862	-0.907	-1.313	-2.052	-6.816	-1.544	-2.630	-1.329	0.727
Critical value at 5%	-14.100	-14.000	-14.100	-14.100	-14.000	-14.100	-14.100	-14.000	-14.100	-14.100	-14.000	-14.100

Table 4: PP Test

The table-4 presents the results of the Phillips-Perron (PP) test applied to four asset classes—Islamic stocks, conventional stocks, oil, and gold—across three periods: they are anti-vaccine pre-COVID-19, COVID-19, and post-COVID-19. The table indicates the value of the PP test statistic, the value of the Z(t) statistic as well as the critical value at the 5% significance level for each of the assets under consideration for each period.

The ADF test, The Phillips-Perron test used to examine for stationary of series such as time series. The main difference revolves around the fact that while the PP test correct for serial correlation in the error terms together with heteroskedasticity, making it a more accurate test under some circumstances. If the computed PP statistic is less than the critical one, then this corresponds for the time series to be stationary. In order to complement the assessment of stationarity of the series using the p-value from the ADF test we have the Z(t) statistic.

For Islamic stocks, the PP test statistic during the COVID-19 period is -4. 312 which is significantly far lower than the critical value of -14. 000, indicating non-stationarity. During pre-COVID-19 period, we found PP value which indicates negative attitude towards vaccine However, in post COVID-19 period, PP value is positively 4. 132, so there is a quite noticeable move, though the value points to non-stationarity as it is more than the critical marker. Before the advent of the COVID-19 crisis, the PP value is greater than zero, suggesting that the nonstationary. Similarly, Narayan and Phan (2021) establish that beyond other criticisms, Islamic stocks are less risky but non-stationary in periods of economic crises.

Even for conventional stocks, the PP test statistic also exhibits an element of non-stationarity in all the selected periods including post COVID-19 where the PP value turned strongly negative at -5. 473. This result indicates that although conventional stocks were more sensitive, they have not shown any stationarity, not even during the recovery period. This is in concurrence with findings by Tsay (2010), pointing to methods of depuration of conventional stock prices from non-stationary trends resulting from market functions and other extraneous economic factors.

By the same token, this indicates that oil prices flap non-stationary, more so in the COVID-19 period, where the PP test statistic is profoundly negative, -28. 362, thus making it considerably below the critical value. This massive swing is typical of the highly erratic nature of oil prices during the COVID-19 outbreak, thus corresponding to Hamilton (2009)'s paper on oil price shocks and oil market stability.

The price level of gold, similar to the price of oil, is non-stationary in all durations, with the PP statistic for the COVID-19 period being -4. 174, this is still below the critical value required for a stationarity of the series. This result is in line with other works like the ones by Baur and Lucey (2010) that stress that gold is non-stationary especially when financial crises are in question.

All in all, the findings of the PP test provide further evidence to support the non-stationary behavior of the considered asset classes, especially in the times of and following the COVID-19 outbreak. The results show that these assets where sensitive to noise, something that is well documented in financial literature and which represents the difficulties of modeling financial time series an especially stationary in periods of economic instability.

VAR

	Islamic Stock			**Conventional Stock**			**Oil**			**Gold**		
	Pre	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**
VAR	.958083	1.089216	1.076322	1.048884	.8735353	.9524765	.9464592	1.040245	1.012761	1.282209	1.097957	.958083
Z	17.04	22.98	19.66	21.70	18.58	15.50	20.75	40.09	18.59	22.90	49.38	17.04
P>|Z|	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 5: VAR

The table-5 presents the results of a Vector Autoregression (VAR) model applied to four asset classes—Islamic stocks, conventional stocks, oil, and gold—across three periods: There will be Post COVID-19 period, During COVID-19 period, and Pre COVID-19-period. The particular table shows the values of VAR, Z-statistic, and the p-value (P>|Z|) as to the specific asset in question or period.

The VAR coefficients suggest the extent to the extent to which prior values of the assets shape up the current values. A higher value of the coefficient indicates a higher level of autoregressive effect. The Z-statistic tests the significance of these coefficients, and the p-

values, all of which are 0. 000, which thus could suggest that all the results are statistically significant across all the data collection periods.

All assets demonstrated high autoregressive features; moreover, the COVID-19 period revealed somewhat different coefficients, especially for Islamic stocks and oil to stress the previous periods' importance during the pandemic. This is consistent with the work of Sims (1980) for instance were the author explains that the nature of VAR models makes them capable of capturing dynamic relationships in the financial markets especially during crises. Such general prominence in all periods points to the prior value dependence of these assets and market memory and continuity during and after the pandemic.

Granger Causality

	Islamic Stock			**Conventional Stock**			**Oil**			**Gold**		
	Pre	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**
Chi2	1.2e+05	71665	56455	1.4e+05	56687	5864.6	48260	49633	8905.3	74562	1.2e+05	1.2e+05
Df	2	2	2	2	2	2	2	2	2	2	2	2
Prob>chi2	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 6: Granger Causality

The table-6 presents the results of the Granger Causality test applied to four asset classes—Islamic stocks, conventional stocks, oil, and gold—across three periods: It is therefore useful to conceive of experiences as pre-COVID-19, during COVID-19, and post COVID-19. The test determines if the values of one time series can be used to forecast the values of another time series. The table presents Chi-square statistic (Chi2), degrees of freedom (Df) and probability value (Prob>chi2) for every asset and period.

It is preliminary to observe the Chi-square values are high and the p-values are 0. The regression results of all the periods show a visual Granger causality in every identified asset class where the values are labeled from 000. This is means that the past values of these assets are very closely relate with there future values, this confirmed that have high auto regression. They are most apparent in the COVID-19 period, implying that market behaviour in this period was dictated by preceding trends, as markets adapted to quickly shifting circumstances.

These findings agree with Granger (1969) where it was suggested that most financial time series possess high levels of causality; this is especially the case during systematic shocks. Their significance across all periods is also in line with other similar studies as seen with Diebold and Yilmaz (2009) where interconnectivity is seen in the case of financial markets, particularly period during crises hence where past behavior is usually the leading predictor of future movements.

Arch model

	Islamic Stock			**Conventional Stock**			**Oil**			**Gold**		
	Pre	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**	**Pre**	**During**	**Post**
Arch	.9712501	.9814607	1.059906	.971064	.9934482	1.026084	.974381	.9980488	1.036654	1.029759	1.067268	1.111359
Z	3.83	4.54	4.30	6.46	6.31	5.20	6.70	7.22	5.94	7.12	6.83	6.18
P>|z|	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7: ARCH Test

The table-7 presents the results of an Autoregressive Conditional Heteroskedasticity (ARCH) model applied to four asset classes—Islamic stocks, conventional stocks, oil, and gold—across three periods: These can be defined as pre-COVID-19, at the time of COVID-19 outbreak, and post COVID-19 outbreak. The ARCH coefficients tell the degree of volatility persistence; large numbers imply more conditional heteroskedasticity, for current variance depends on past variance. The Z-statistic tends to check the degrees of these coefficients, and the p-values (P>|z|), all of that equal to 0. 000 are statistically significant over all the periods must be obtained as indicated above.

The ARCH coefficients are just slightly less than one during both COVID-19 and the post COVID-19 periods, and even in the pre COVID-19 period for gold and to some extent oil, suggesting a high degree of volatility clustering in gold and oil. It also implies that volatility shocks due to the Covid pandemic have persisted, that is in line with the behaviour observed in financial crises, where uncertainty leads to a persistent level of volatility. Earlier researches, like Engle (1982) who proposed the ARCH model point at such breakdowns in the variance as being crucial for financial time series, particularly during periods of economic distress. The strong and significant results reveal in all the asset classes and horizons signal that these markets are more sensitive to shocks compared to the rest and during the pandemic, in tandem with the other articles and studies in the financial literature on the effects of crises on markets.

Conclusion

The COVID-19 pandemic has profoundly impacted financial markets worldwide, causing unprecedented levels of volatility and uncertainty. This study explored the effects of the pandemic across three key periods—pre-COVID-19, during COVID-19, and post-COVID-19—on four major financial assets: Islamic stocks, conventional stocks, oil, and gold. The findings reveal significant shifts in market behavior and volatility, underscoring the pandemic's pervasive influence on global financial dynamics. During the COVID-19 period, both Islamic and conventional stock markets experienced substantial declines in mean values, reflecting investor panic and the broader economic slowdown. However, the post-COVID-19 recovery was notably strong, particularly in conventional markets, where mean values surpassed pre-COVID-19 levels. This recovery highlights the resilience of financial markets, even in the face of severe global disruptions. Islamic markets, while also recovering, demonstrated slightly lower volatility due to their adherence to ethical investment principles, which provide a stabilizing effect during times of crisis.

Oil markets exhibited extreme volatility, with prices plummeting during the COVID-19 period, including a historic drop into negative territory. This drastic decline was driven by a sharp reduction in demand due to global lockdowns and travel restrictions. However, as the global economy began to recover post-COVID-19, oil prices rebounded significantly, illustrating the commodity's sensitivity to supply and demand shocks and its critical role in the global economy. Traditionally viewed as a safe-haven asset, gold saw its value increase significantly during the pandemic. The rise in gold prices was driven by heightened market risk and investor uncertainty, as market participants sought stability in the face of economic turmoil. The post-COVID-19 period continued to see elevated gold prices, reinforcing the metal's role as a hedge against financial instability.

The econometric analyses, including the ADF and PP tests, VAR model, Granger causality, and ARCH model, further underscore these financial assets' non-stationary and volatile nature during the pandemic. The persistence of volatility, particularly in oil and gold markets, highlights the long-lasting effects of the COVID-19 pandemic on financial markets. In conclusion, this study provides valuable insights into the pandemic's impact on financial markets, offering critical lessons for investors, policymakers, and scholars. The findings emphasize the importance of diversification, risk management, and resilient financial structures to navigate future global crises.

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