



Are effects of COVID-19 pandemic on financial markets permanent or temporary? Evidence from gold, oil and stock markets

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ABSTRACT

The purpose of this study is to examine the effect of COVID-19 pandemic on gold, oil, conventional and Islamic stock markets. Two variables as the number of new COVID-19 cases and Infectious Disease Equity Market Volatility (IDEMV) Index developed by Baker, Bloom, Davis and Kost (2019) are used in order to discuss the effect of COVID-19 pandemic. Other variables used in the research are oil prices, gold prices and S&P Dow Jones Index values for conventional and Islamic stock markets. The data set used in the study is the daily data set between 31st December 2019 and 5th May 2020 for all variables. Time and frequency domain causality test is used in the study. According to the study results, there is a permanent causality in long term between stock markets, gold and oil prices and the number of COVID-19 cases. There is also a permanent causality in long term between IDEMV and gold and oil prices. However, in short term, there is a temporary causality between gold and oil prices and the number of COVID-19 cases. These results are highly important especially for policy performers and portfolio managers to determine the portfolio strategies.

1. Introduction

COVID-19 Pandemic has outcome in Wuhan, China for the first time in December 2019 and since then it has rapidly spread across the world and negatively influenced both social life and economic life. As a part of economic and social protection from COVID-19 Pandemic, precautions such as lockdown, travel restriction among countries, stopping education, pause for full capacity work have been taken across the world. These precautions taken to decline the spreading speed of the pandemic have also led to stagnation in financial markets as in the real sector. It is estimated that financial markets will be more strongly affected by COVID-19 Pandemic than “1918 Influenza Outbreak” (Barro et al., 2020; Garrett, 2008).

COVID-19 Pandemic as health crisis, which is a surprise outbreak of 2020, is a significant systematic risk resource for financial markets. Pandemics are important health crisis. The response of stock markets to pandemics was analyzed in the literature for severe acute respiratory syndrome (SARS) outbreak (Chen et al., 2007, 2009), and Ebola virus disease (EVD) outbreak (Ichev and Marinč, 2018). Today, we need more studies on the effects of the spread of COVID-19 Pandemic, a pandemic of 2020, on financial markets (Sharif et al., 2020). In the literature, the effect of COVID-19 Pandemic on financial markets pertains to either the

relationship among investment tools or determining the feature of being a safe investment tool. This study is highly important for examining the long and short term temporary and permanent effect of the causality between gold, oil, Islamic and conventional stock markets with the COVID-19 Pandemic. Because it is impossible to evaluate the gold, oil and stock markets separately from each other. In addition to being an important investment tool, oil is a tool that affects the stock price of companies as a production input. Gold is both a hedging tool and a significant production input for some sectors. Therefore, the investors in financial markets always want to know the relationship between gold, oil and stock markets. Therefore, with this research, “Does the COVID-19 Pandemic have a long or short term, permanent or temporary effect on financial markets?” search for an answer to the question. This information obtained in this research will provide useful information for theorists and practitioners interested in financial markets in the processes of creating new strategies and information.

The Covid-19 Pandemic has affected the oil, gold and stock markets differently. For example; significant fluctuations have been experienced in oil prices during the COVID-19 Pandemic. These fluctuations have directly affected both economies of countries and businesses. Oil prices have a direct effect on cash flows and profitability of companies. Oil prices have a direct effect on cash flows and profitability of companies.

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Oil prices have a direct effect on the cash flows and profitability of companies (Arouri et al., 2012). Discounted cash flows also includes the effects of macroeconomic conditions such as, inflation, interest rates and economic growth (Arouri and Nguyen, 2010; Jouini, 2013). At this point, the change in oil prices emerges as a factor that affects both the energy input cost directly and the economic conditions that affect the cash flows of the enterprise indirectly. Therefore, oil prices can be an important factor affecting stock prices (Tuna et al., 2021). For this reason, it is thought that obtaining information about the relationship between oil prices and other investment instruments in the research will fill an important gap in the literature for both theorists and practitioners.

Stock markets are important systems that enable small investors to be included in financial markets. Additionally, the fact that stock markets are considered separately as conventional and Islamic is one of the most important features that differentiates it from the existing literature. Because, Islamic stock markets are emerging as a rising value in financial markets around the world due to increasing demand. Islamic stock markets have emerged as an alternative to traditional markets (Fiti and Hadhri, 2019). According to Pew research center research, with the increasing Muslim population, Islamic financial markets can have a significant share in the world's financial markets. Additionally, approximately 23% of the world's population consists of Muslims. According to 2014 data, the growth rate of the Islamic Stock Market is around 15%–20%. Considering both the rapid growth in the Securities Markets and the population density; It is seen that Islamic Stock Markets will have an increasing importance in the future (Tuna, 2019). Therefore, knowing the effect of COVID-19 Pandemic on conventional and Islamic financial markets is highly important for new strategy and knowledge generation processes of theoreticians and executes. Also, with this study, it is filled another gap in the literature in terms of evaluating how the COVID-19 pandemic affects Islamic and conventional stock markets in the long or short term as permanently or temporarily.

Gold is both a significant hedging tool in fluctuation period of the market and an effective diversification tool as always valid and reliable investment tool. The reason why gold is included in this study is to analyze how the price of this haven that investors shelter in all financial crisis has changed during the COVID-19 Pandemic. Another important point for the study is about the variables that can be used to evaluate the effects of COVID-19 Pandemic. The investors in those markets use some economic and social indicators as estimator tools to protect from the uncertainty for the future. Variables such as currency rate, gold prices and economic growth commonly used as estimators in financial markets have begun to be different along with the COVID-19 pandemic. Because human beings who are the most important factor in financial markets are social creatures and they are affected very quickly from all kinds of event in the world. This leads the taken financial decisions to be influenced and changed. Although the 2008 Global Financial Crisis affected the whole world economically, it only affected people's wealth; it did not lead them to worry about their health. However, COVID-19 Pandemic lead investors' wealth to decline due to economic problems and leads them to worry about their health due to the possibility of infection and disease. This cause the financial decisions of investors to be affected.

COVID-19 Pandemic, has caused vicious impact on the global economy (Shehzad et al., 2021b). Unlike the health system crises experienced in the past, the volatility in the financial markets has increased a lot in the COVID-19 Pandemic (Baker et al., 2020; Shehzad et al., 2021b). One of the most important reasons in this situation is the rapid flow of information to the financial markets. In this environment of high volatility, the estimation of financial asset prices becomes even more important for investors who want to make optimal portfolio choices. At this point, it is important to estimate the prices of financial assets by using new estimators depending on the changing market conditions (Tuna, 2021).

Thus, investors have begun using new estimators belonging to gold,

oil and stock market tools, which are popular financial tools. The variables commonly used in literature to analyze the effect of COVID-19 Pandemic on financial markets are either daily death rates or the number of new cases (Al-Awadhi et al., 2020). The number of new COVID-19 cases is another significant indicator that investors include in their portfolios and use while predicting financial tools during the pandemic period. In addition to the number of new COVID-19 cases per day, the IDEMV is used in this study. IDEMV is an index based on newspaper news created by Baker et al. (2020). Baker et al. (2020) in their study analyzed the actions of 18 stocks in 22 transaction days between 24th February and 24th March. According to the study results, 16 and 18 of those stocks react for the "bad news" about this new epidemic (Baker et al., 2020). IDEMV used in the study and created by using only the news about epidemics in the market is an indicator that can be used to evaluate the effect of pandemics on markets in terms of presenting the level of concerns or in other words the level of fear due to the pandemic. The use of IDEMV, which is a new variable in the research, is an important part of the study in terms of evaluating the psychological effects of the COVID-19 Pandemic and this makes it different from the current literature. Because investors appreciate the effects of COVID-19 Pandemic on financial markets with the IDEMV, which is an index used for measuring the market volatility in pandemics. This was also supported by a study by Li et al. (2020). According to this study, IDEMV developed by Baker et al. (2020) is a powerful indicator to predict the volatility of markets (Li et al., 2020).

Whether the relationship between the COVID-19 Pandemic and financial markets is permanent or temporary is being analyzed in also this study by using time and frequency-domain causality analysis. This is a point that makes this study different. Because the studies examining the causality relationship between COVID-19 Pandemic and financial markets have been analyzed; however, no studies have been found on the existence of permanent or temporary causality in the literature. This study is a study investigating the causality between the COVID-19 Pandemic and gold, oil, conventional and Islamic stock markets in high and low frequencies. The causality is examined in this study unidirectional and separately from the number of new COVID-19 cases per day and IDEMV to gold, oil, conventional and Islamic stock markets. This is because the spread of COVID-19 Pandemic is unlikely to be affected by gold, oil and stock markets. Because the spread of COVID-19 Pandemic entirely varies depending on obeying the taken precautions and rules. It is also important and different from the literature because it is the first study to use a new volatility index IDEMV, which can be used to evaluate the response of epidemic diseases to financial markets to evaluate the effect of the COVID-19 Pandemic. Also, the fact that this study is examined separately for conventional and Islamic stock markets is a feature, which makes the study original. This study, which will be one of the leading studies analyzing the relationship between COVID-19 Pandemic and financial markets, is different from the literature due to the reasons such as used variables, analyzed different financial markets such as Islamic stock markets and used time and frequency domain causality tests and aims to fill an important gap in the literature.

Accordingly, the study consists of 5 parts. After the introduction part, literature review in the second part, data and methodology are included in the third parts, and empirical findings are discussed in the fourth part. In the fifth part, evaluations are included according to the obtained findings.

2. Literature review

Examining the relationship between the Covid 19 Pandemic and financial markets is the focus of attention of researchers. Although various studies have been conducted since December 2019, the date of the COVID-19 Pandemic, quite a few studies are analyzing the relationship between financial markets and the COVID-19 Pandemic. Sharif et al. (2020) are one of the first studies to analyze the relationship between the spread of the COVID-19 Pandemic, the oil price volatility

shock, the stock market, geopolitical risk, and economic policy uncertainty in the USA in a time-frequency framework. According to the study results, the effect of COVID-19 Pandemic on geopolitical risk is higher than the economic uncertainty of the USA and the risk of COVID-19 Pandemic is differently perceived in the short and long term. As this research shows, the risk arising from the Covid-19 Pandemic is perceived differently by investors and is reflected in portfolio investments differently. In this case, it also affects oil, stock and gold prices.

In the literature, some researchers analyzed the relationship between the COVID-19 Pandemic and the oil prices (Norouzi et al., 2020; Salisu et al., 2020; Iyke, 2020; Sharif et al., 2020; Mensi et al., 2020; Prabheesh et al., 2020; Huang and Zheng, 2020; Wang et al., 2020; Shehzad et al., 2021c). When the oil is considered in terms of financial markets, it is a significant production input as both raw material and energy resource. For this reason, the Covid-19 Pandemic has directly and indirectly caused changes in oil prices and demand. In also the COVID-19 Pandemic period significant fluctuations are observed in oil prices, which are used as an important input in the estimation of financial asset prices (Benlegha and Omari, 2021). Isolation within the scope of the COVID-19 Pandemic measures reduced the demand for oil and led to significant declines in oil prices. Crude oil prices plunged to lower than \$20 per barrel, a historic low since the start of the new century. More astonishing, on April 20, 2020, crude oil futures for the West Texas Intermediate (WTI), the US oil benchmark, closed at -\$37.63 per barrel, an unprecedented event that will have a profound impact on practitioners and policymakers (Ji et al., 2020). Moreover, COVID-19 and the accompanying lockdown have adversely impacted more oil price than stock market (Shehzad et al., 2021c).

The fastest reflection of the change in oil prices is; stocks are one of the most important investment instruments. The loss of return due to the Covid-19 outbreak in the stock market also has a significant impact, although it is lower than oil (Shehzad et al., 2021c). This has emerged as one of the factors affecting researchers in examining the relationship between the Covid-19 Pandemic and stock markets. There are also studies analyzing the effect of COVID-19 Pandemic in stock markets that are other important investment tools (Baker et al., 2020; Phan and Narayan, 2020; Al-Awadhi et al., 2020; Topçu; Güllal, 2020; Liu et al., 2020; He et al., 2020). Although the Covid-19 pandemic has affected global financial markets to varying degrees, it has caused significant loss of returns in all of them (Shehzad et al., 2020a). The loss of return caused by the health crisis has been much greater than the effects of the Global Financial Crisis. However, although the impact of the Covid-19 Pandemic is quite extensive, it emerges as good options for portfolio optimization for the investor in stock markets such as Asian markets (Shehzad et al., 2020b).

Gold, on the other hand, is a popular investment tool that attracts investors at all times. It can be included in the portfolio by the investors, sometimes for effective diversification, sometimes for safe haven, and sometimes for hedging purposes. In the literature, the most important reason to analyze gold as a safe investment tool is the results indicating that gold is a haven in long term in crisis periods (Baur and Lucey, 2010; Baur and McDermott, 2010). During the COVID-19 pandemic, which can be considered a new financial crisis, the preferences of investors who want to be protected from risk and the question of what the safe investment tool is (such as gold, cryptocurrency) have been the focus of attention for researchers in this period (Conlon and McGee, 2020; Conlon et al., 2020; Ji et al., 2020; Cheema et al., 2020; Hu et al., 2020; Dutta et al., 2020; Kumar, 2020; Goodell and Goutte, 2020; Shehzad et al., 2021a). Additionally, gold is a significant hedging tool for investors in the sector as it has the qualifications that Islamic investment tools should have (Meghyereh et al., 2019). According to the current literature, investors include gold in their portfolios due to its safe port qualification. Because increases have been experienced in gold prices in the COVID-19 pandemic, unlike oil prices with significant price decreases (Atri et al., 2021). Benlagha and El Omari (2021) and Hung and

Vo (2021) also revealed that there is an important connection between gold, oil and stock markets during the COVID-19 pandemic. However, an important point to note here is that the relationship between gold and oil prices is not permanent. Balcilar et al. (2019) stated that the causality between gold and oil prices is invalid for the whole periods also emphasize on this aspect in the results of the study conducted using rolling and recursive rolling granger causality methods for 1983–2016 period. For that reason, investment strategies should be developed by considering that the correlation between gold and oil is not permanent, but changeable. However, Sulisu et al. (2021) state that gold is an important hedging tool against the oil price changes during the COVID-19 Pandemic. Additionally, especially crude oil and gold play an important role in the downside hedging in stock markets (Dutta et al., 2021). At that point, Dutta et al. (2021) emphasize that especially climate funds can be used as a hedging tool for gold, oil and stock markets during the COVID-19 Pandemic period. Adekoya et al. (2021) state that in COVID-19 Pandemic period gold is a safe port for both oil and stock markets and it is an ideal asset for short-term portfolio investment tools. Shehzad et al. (2021a) also states that in the long run, the return on investments in gold is higher than portfolio investments combined with stocks and bitcoin. Therefore, gold is a hedging tool within the stock investment tools during the COVID-19 Pandemic (Akhtaruzzaman et al., 2021; Salisu et al., 2021a).

In the current literature, there are quite a number of studies on the roles of different investment instruments in the portfolios created in the Covid-19 Pandemic. However, there are very few studies examining the impact of the Covid –19 Pandemic on financial markets in the long and short term. In fact, there are hardly any studies on whether this effect will be permanent or temporary. For this reason, for both practitioners and theorists of the study; It is thought that it will provide important and new information.

3. Data and methodology

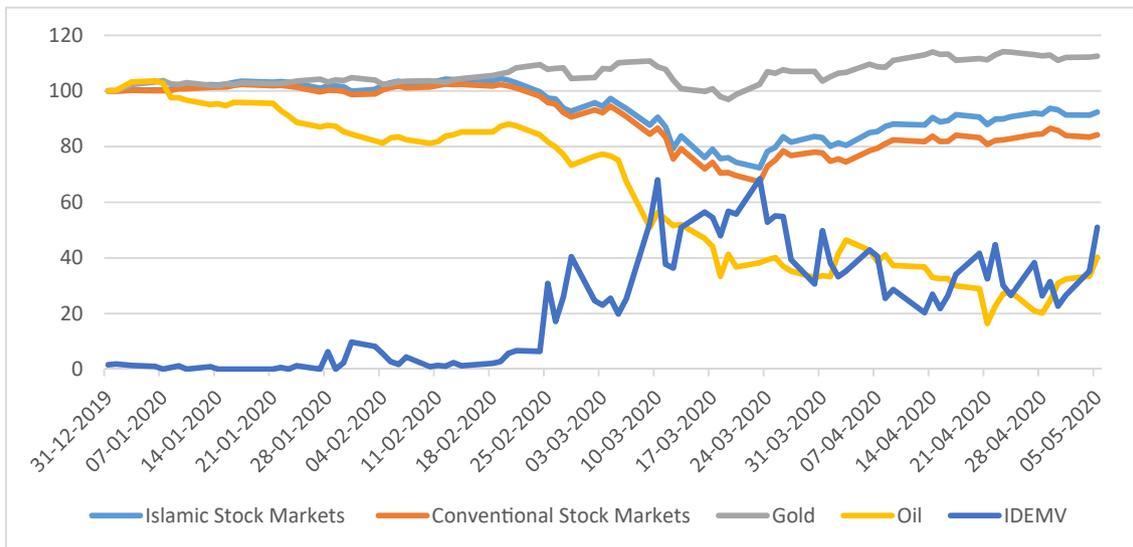
3.1. Data

The data used in the study are the number of new COVID-19 cases per day (measured as the number of new COVID-19 infected cases across the world), oil prices (measured as WTI benchmark crude oil prices), IDEMV (news-based index), gold prices (ounce price of gold) and Dow Jones index values for conventional and Islamic stock markets. Two variables as the number of new COVID-19 cases across the world and Infectious Disease Equity Market Volatility (IDEMV) Index developed by Baker et al. (2019) were used to discuss the effect of COVID-19 pandemic on financial markets Both conventional and Islamic stock markets index values are expressed in US Dollars. The analyzes in the research were made with the daily data set starting from 31.12.2019 to 05.05.2020. Islamic and Traditional Stock Index data is obtained from the data stream managed by Thomson Reuters. The Dow Jones Islamic Index was preferred in this study because it is widely used in the literature. Gold and oil prices, which are other variables used in the research, were obtained from the World Bank database. IDEMV data were collected from the website of Economic Policy Uncertainty and the number of COVID-19 cases was collected from the website of <https://ourworldindata.org/covid-cases>.

The data set used in the study began on 31st December 2019 when the first COVID-19 case was officially announced and it consists of daily values until 5th May 2021. Transactions were performed by taking the natural logarithm of the entire data set.

To see the course of the variables analyzed within the scope of the study after the official announcement of the first COVID-19 case, percentage changes were calculated according to the value on 3st December 2019. This is indicated as in Graph 1.

According to Graph 1, the changes in conventional and Islamic stock markets move very close to each other. Generally, prices tend to decrease in both stock markets. It is noteworthy that there has been an



Graph 1. Course of analyzed variables in COVID-19 pandemic.

overall recovery in all stock markets as of March 2020. Although there were some decreases in gold prices from time to time, they continued to be the investors' focus of interest and increased in general. Oil was the tool which had the most serious decline. Although increases were observed in the general level of oil prices from time to time, they continued the decline. In the COVID-19 period, the increase in gold prices also supports in general the literature on the decline in oil prices (Atri et al., 2021, Benlagha and El Omari, 2021). According to Graph 1, while the IDEMV index based on newspaper news increases, decreases occur in both stock markets and oil prices. The increase in gold prices has always been stable.

3.2. Methodology

3.2.1. Time domain causality approach

In traditional Granger (1969) causality test, on future-directed predicting one factor, it is tested if the second factor provides useful information. In Granger causality analyze, firstly, VAR model is taken as the basis, as equation (1).

$$\begin{aligned}
 Y_t &= \alpha_{01} + \sum_{i=1}^p \alpha_{1i} Y_{t-i} + \sum_{i=1}^p \beta_{1i} X_{t-i} + u_{1t} \\
 X_t &= \alpha_{02} + \sum_{i=1}^p \alpha_{2i} Y_{t-i} + \sum_{i=1}^p \beta_{2i} X_{t-i} + u_{2t}
 \end{aligned}
 \tag{1}$$

The hypothesis indicating that X is not the Granger cause of Y is tested in the first model. For this, the residual sum of squares of the model is calculated. Then, the residual sum of squares is calculated as in Equation (2) by estimating with the model that the lagged values of X are not included.

$$Y_t = \alpha_{01} + \sum_{i=1}^p \alpha_{1i} Y_{t-i} + u_{1t}
 \tag{2}$$

F test statistic is calculated as in equation (3) by using the model with constraints and the model without constraints.

$$F = \frac{(\text{residual sum of squares}_{\text{Constraint}} - \text{residual sum of squares}_{\text{Unconstraint}}) / m}{\text{residual sum of squares}_{\text{Unconstraint}} / (n - k)}
 \tag{3}$$

In Equation (3), m indicates the number of constraints and k indicates the number of parameters estimated in the model without constraints. This obtained test statistics (m, (n-k)) is compared with F table value with a degree of freedom. If it is F(critic) > F(table), the main

hypothesis indicating that Y is not the Granger cause of X is rejected.

Causality tests also called as time-domain causality tests, produce a single test statistic to determine the causality relationship between the relevant variables. The fact that the existence and direction of Granger causality are analyzed in a certain t period causes the variability possibility of the causality by different frequencies to be ignored. This is considered as a lacking aspect of time-domain causality tests (Bozoklu ve Yilanci, 2013).

3.2.2. Frequency domain causality approach

Geweke (1982) and Hosoya (1991) in their study recommended a causality measurement in a certain frequency based on the separation of spectral density. The VAR model used to represent two stationary time series in the studies of Geweke (1982) and Hosoya (1991) is as in equation (4):

$$\theta(L) \begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \begin{pmatrix} \theta_{11}(L) & \theta_{12}(L) \\ \theta_{21}(L) & \theta_{22}(L) \end{pmatrix} \begin{pmatrix} X_t \\ Y_t \end{pmatrix} = \begin{pmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{pmatrix}
 \tag{4}$$

In this case, the causality between X_t and Y_t variables is determined as the fact that if the predictive component of X_t spectrum in w frequency is null, Y_t is not the Granger cause of X_t in w frequency.

Breitung and Candelon (2006) developed a simple test procedure based on a set of linear hypotheses on autoregressive parameters using a bivariate vector autoregressive (VAR) model. Breitung and Candelon (2006) proposed a single test procedure based on the VAR model creating a linear hypothesis on autoregressive parameters. The VAR model used in this study is as in Equation (5):

$$X_t = \sum_{j=1}^p \theta_{11j} X_{t-j} + \sum_{j=1}^p \theta_{12j} Y_{t-j} + \varepsilon_{1t}
 \tag{5}$$

Here θ_{11j} and θ_{12j} are the coefficients of $\theta_{11}(L)$ and θ_{12} delay polynoms. While ε_{1t} is the error term, ρ is the delay length. The necessary and sufficient constraint conditions for the basic hypothesis which indicates that there is no Granger causality in frequency w are as in equation (6):

$$\begin{aligned}
 \sum_{j=1}^p \theta_{12j} \cos(jw) &= 0 \\
 \sum_{j=1}^p \theta_{12j} \sin(jw) &= 0
 \end{aligned}
 \tag{6}$$

Under these constraints, the null hypothesis expressing the absence of Granger causality can be tested using the standard F test. This technique, called a frequency domain causality test, allows to investigate

causality dynamics at different frequencies, rather than relying on a single test statistic like traditional time-domain causality tests. While traditional time-domain causality tests create a single test statistics for the causality relationship between the variables in question, frequency domain causality tests produce different test statistics at different frequencies. This provides flexibility to analyze the direction and strength of causality at separate frequencies. It is possible to temporarily and permanently separate the causality dynamics among the variables through frequency domain causality test. While analyzing the short term (temporary) causality, test statistics in high $w = 2.5$ frequency are used. While analyzing the long term (permanent) causality, test statistics in low $w = 0.5$ frequency are used (Bozoklu ve Yilanci, 2013).

4. Empirical results

Basic statistical values belonging to the data set analyzed within the scope of the study are as in Table 1.

According to Table 1 created by using the raw data set; average Islamic stock markets values follow a higher course than average conventional stock markets. However, Islamic stock markets has a higher standard deviation. Average gold prices are \$ 1611 and oil prices are \$ 38. The average value of IDEMV is 22.55 and 685,616 new COVID-19 cases occur all over the world on average. When the skewness and kurtosis coefficients of the whole data set included in the study are analyzed, it is seen that the variables of gold, IDEMV and COVID-19 cases have positive skewness values. This indicates that the series are right-leaning. However, conventional and Islamic stock markets, oil have negative skewness values and they are left-leaning. Kurtosis values are positive in all variables and leptokurtic. According to Jargue-Bera test results, the null hypothesis of normality is rejected at the %1 significance level for oil and the number of COVID-19 cases.

Unit root analyses for the variables used in this study were conducted through ADF unit root test and Phillips Perron (PP) Unit root test. Accordingly, unit root test results of the variables are as in Table 2.

According to ADF unit root test results in Table 2, all variables contain unit root at level values. It is seen that series become stationary when their first difference is taken. It is important to apply some diagnostic tests in order to reinforce the consistency of the results of the models used in the studies. The diagnostic tests used in this study are Breusch-Godfrey test, Breusch-Godfrey LM test and ARCH test. Breusch-Godfrey test and Breusch-Godfrey LM Test is used to find out autocorrelation in the error term of regression type models. The nonexistence of autocorrelation up to lag p is the null hypothesis in both versions of the Breusch-Godfrey test (Godil et al., 2022). The diagnostic test results for the models in which the causality is examined in this study are as in Table 3.

According to Table 3, Breusch-Pagan-Godfrey and Breusch-Godfrey Serial Correlation LM Test results are not significant. Accordingly,

there is no autocorrelation in residuals in this model in which the causality is examined. ARCH effect test applied to examine ARCH effect in the model also supports the result that there is no heteroscedasticity in the model. According to the diagnostic test results, it can be said that the model is set up correctly among the variables, and there are no autocorrelation and heteroscedasticity problems related with the error terms.

Results of time-domain causality test performed for the variables analyzed within the study are as in Table 4. As the number of COVID-19 cases and the resulting IDEMV index values in the study are considered as non-determinant for gold, oil and stock prices, causality analysis is discussed as separately and unidirectional way from the new COVID-19 cases per day and IDEMV index to gold, oil, conventional and Islamic stock markets.

As the results of the time-domain frequency test indicate in Table 4, there is a causality between the number of COVID-19 cases and Islamic and conventional stock markets and oil prices. However, there is no causality between the number of COVID-19 cases and gold prices. Similarly, there is causality from IDEMV index to Islamic and conventional stock markets and oil prices. However, there is no causality from IDEMV index to gold prices. The quarantine and various restrictions taken within the scope of COVID-19 measures can be indicated as an important reason for this case. Because these practices may have caused fear and anxiety on investors and may have caused them to direct their savings to gold, which is a safe investment tool in the long run. In addition, with the decreasing oil demand, the cash flows of the companies may have slowed down and their returns may have decreased. Therefore, this indicates that numbers of daily COVID-19 case and IDEMV index have an effect on oil and stock prices.

According to the obtained results, it can be said that the number of COVID-19 cases and IDEMV index values make predictions for Islamic and conventional stock markets and oil prices and provide useful information. . These obtained results support the results of Benlagha and El Omari (2021), Hung and Vo (2021), Salisu et al. (2021b), Dutta et al. (2021), Adekoya et al. (2021), Akhtaruzzaman et al. (2021). However, another important issue here is whether the effect of causality is permanent or temporary.

Frequency domain causality test was performed based on Ciner's (2011) study to find out whether the causality is permanent or temporary. Therefore, frequency domain causality test statistics were calculated based on $w = 0.5$ long term permanent effect calculation and $w = 2.5$ long term effect calculation. The optimal lag length was determined by Bayesian information criteria. The obtained results after analyzing the frequency domain causality test are as in Table 5.

According to Table 5, the number of COVID-19 cases has a temporary effect on short term gold prices. Number of new COVID-19 cases has a long term permanent effect on Islamic stock markets, gold prices and oil price except for conventional stock markets. Oil prices have an effect on

Table 1
Descriptive statistic for variables.

	DJI	DJC	GOLD	OIL	IDEMV	CCASES
Mean	4024,047	390,549	1611,213	38,734	22,551	685616
Median	4030,900	400,020	1595,050	45,900	24,530	93077
Maximum	4491,070	444,780	1731,580	63,270	68,410	3544168
Minimum	3111,390	292,310	1471	10,010	-0,001	27
Std. Dev.	388,265	47,283	64,887	16,557	20,267	1043629
Skewness	-0,552	-0,306	0,219	-0,117	0,399	1,441
Kurtosis	2,148	1,646	2,107	1,412	1,937	3,642
Jarque-Bera	7,050	8,009	3,585	9,329	6,408	31,633
Probability	0,029**	0,018**	0,166	0,009***	0,040**	0,000***

*** ** and * denote rejection of the null hypothesis at the 1%, 5%, and 10% levels, respectively.

DJI: Dow Jones Islamic Stock indices.

DJC: Dow Jones Conventional Stock indices.

CCASE: The number of new COVID-19 cases.

IDEMV: Infectious Disease Equity Market Volatility Index.

Table 2
Results of unit root tests.

Variable	ADF				PP			
	At Level		At First Difference		At Level		At First Difference	
	t-stat	Prob	t-stat	Prob	t-stat	Prob	t-stat	Prob
DJI	-1.224	0.660	-11.837	0.000***	-1.249	0.649	-11.473	0.000***
DJC	-1.051	0.731	-5.212	0.000***	-1.106	0.710	-10.706	0.001***
GOLD	-1.611	0.472	-7.588	0.000***	-1.893	0.334	-7.588	0.000***
OIL	-1.073	0.720	-8.904	0.000***	-1.067	0.725	-8.890	0.000***
IDEMV	-1.221	0.661	-9.492	0.000***	-1.553	0.509	-12.704	0.000***
CCASES	-0.894	0.785	-3.081	0.0319**	7.457	0.999	-5.627	0.000***

***, ** and * denote rejection of the null hypothesis at the 1%, 5%, and 10% levels, respectively.

Table 3
Results of diagnostic tests.

	P-Value of Chi-Square		
	Breusch-Pagan-Godfrey	Breusch-Godfrey Serial Correlation LM Test	ARCH
CCASE-DJC	0.997	0.550	0.893
CCASE-DJI	0.995	0.540	0.892
CCASE-GOLD	0.996	0.537	0.889
CCASE-OIL	0.996	0.529	0.888
IDEMV-DJC	0.560	0.725	0.461
IDEMV-DJI	0.551	0.731	0.461
IDEMV-GOLD	0.586	0.714	0.481
IDEMV-OIL	0.552	0.734	0.462

Table 4
Time domain causality test results.

	Wald Stat.	p value
$H_0 = \text{CCASES} \nrightarrow \text{DJI}$	11,186	0,003***
$H_0 = \text{CCASES} \nrightarrow \text{DJC}$	12,179	0,002***
$H_0 = \text{CCASES} \nrightarrow \text{Oil Prices}$	9,296	0,009***
$H_0 = \text{CCASES} \nrightarrow \text{Gold Prices}$	0,480	0,786
$H_0 = \text{IDEMV} \nrightarrow \text{DJI}$	22,281	0,000***
$H_0 = \text{IDEMV} \nrightarrow \text{DJC}$	27,447	0,000***
$H_0 = \text{IDEMV} \nrightarrow \text{Oil Prices}$	14,437	0,001***
$H_0 = \text{IDEMV} \nrightarrow \text{Gold Prices}$	1,373	0,503

***, ** and * denote rejection of the null hypothesis at the 1%, 5%, and 10% levels, respectively.

Table 5
Frequency domain causality test results.

ω_i	Long Term		Short Term	
	0,5 (Permanent)		2,5 (Temporary)	
$H_0 = \text{CCASES} \nrightarrow \text{DJI}$	6,269	0,002***	1,596	0,208
$H_0 = \text{CCASES} \nrightarrow \text{DJC}$	0,678	0,510	1,055	0,352
$H_0 = \text{CCASES} \nrightarrow \text{Oil Prices}$	2,780	0,067*	0,057	0,944
$H_0 = \text{CCASES} \nrightarrow \text{Gold Prices}$	10,473	0,000***	12,627	0,000***
$H_0 = \text{IDEMV} \nrightarrow \text{DJI}$	0,811	0,447	0,045	0,955
$H_0 = \text{IDEMV} \nrightarrow \text{DJC}$	0,570	0,567	0,216	0,805
$H_0 = \text{IDEMV} \nrightarrow \text{Oil Prices}$	2,951	0,057*	1,750	0,180
$H_0 = \text{IDEMV} \nrightarrow \text{Gold Prices}$	2,578	0,081*	2,251	0,111

***, ** and * denote rejection of the null hypothesis at the 1%, 5%, and 10% levels, respectively.

stock prices, albeit not constantly (Balcilar et al., 2019). Therefore, oil and stock market prices are the factors that affect each other in most periods. It is likely that the Islamic stock market investor will be more affected if they prefer financial tools that comply with religious rules and want to continue their investments in this market. However, since the traditional stock investors have no restrictions on the transition to

different markets, such as compliance with religious rules, businesses may be less likely to be affected by oil price fluctuations affecting their returns. However, gold is an investment tool that can react more quickly and more clearly to the events and variables that are likely to affect the financial markets, as it is used by investors both as an effective hedging tool and as a diversification tool in all periods. At the same time, the number of new COVID-19 cases in the long term has a permanent effect on Islamic stock markets, gold prices and oil prices except for conventional stock markets. It can be appreciated that these obtained results may provide useful information for the estimation of the number of new COVID-19 cases in the long term, Islamic stock market, gold and oil prices. However, the number of new COVID-19 cases does not provide useful information to make long term predictions in the conventional stock market. IDEMV index has no long term permanent effect on both conventional and Islamic stock markets. IDEMV has a long term permanent effect on gold and oil prices. This can be appreciated as a result that increasing interest in gold, which is used as an important hedging tool of financial markets, by the investors away from the fear and panic occurred with the pandemic in financial markets. In addition, significant decreases have been experienced in oil prices during the COVID-19 pandemic and gold has increased its popularity as a safe investment tool against these decreases (Salisu et al., 2021a). These obtained results can be appreciated that IDEMV index may provide useful information in long term for gold and oil prices but it may not provide for Islamic and conventional stock markets.

5. Conclusions and policy implications

This study analyzes the long and short term effects of COVID-19 pandemic on financial markets. For this purpose, the number new COVID-19 cases, IDEMV index, Islamic and conventional stock market index and daily data of gold and oil prices between 3rd December 2019 and 5th May 2020 period were used. Time and frequency domain causality test was used to analyze the causality relationship among the variables. Thus, it was tried to be analyzed whether the effect of COVID-19 pandemic on different financial markets was temporary or permanent. For this, the number new COVID-19 cases across the world, Infectious Disease Equity Market Volatility (IDEMV) Index, oil prices, gold prices and index values created for conventional and Islamic stock markets were used as data set.

According to the study results, both IDEMV index and the number of new COVID-19 cases per day have a permanent effect on oil and gold prices. Besides, the number of COVID-19 cases has a long term permanent effect also in Islamic stock market. However, the number of COVID-19 cases and IDEMV index have neither temporary nor permanent effect on conventional stock markets. This result can be appreciated as an indicator that the number of COVID-19 cases and IDEMV index will not effective results for long term predictions for conventional stock markets; however, the number of COVID-19 cases can be used effectively in Islamic stock market for long term predictions.

Gold and oil which are safe haven for many investors have a permanent causality with both IDEMV and the number of COVID-19 cases.

The obtained result also can be appreciated that IDEMV and the number of COVID-19 cases can be used in the estimation of gold and oil prices. While IDEMV, developed by Baker et al. (2020), can be used effectively in predictions for gold and oil prices during the COVID-19 pandemic, it is not an effective prediction tool is neither traditional nor Islamic stock markets.

These obtained results provide important information for policy performers and researchers and also make contributions them to develop new strategies and research subjects. This study was conducted by using time and frequency causality tests for a certain period in order for investors who want to be protected from the increasing uncertainty in financial markets with the COVID-19 pandemic to make well-grounded decisions based on information while developing a new strategy. Accordingly.

- COVID-19 pandemic strongly affects all markets. For that reason, policy performers should consider the potential effects of COVID-19 pandemic while developing strategies for new investment decisions. They can utilize the number of COVID-19 cases per day and the indices such as IDEMV for it.
- When stock markets are divided into two groups as conventional and Islamic, Islamic stock markets are affected by COVID-19 pandemic permanently in long term. This effect could not be determined in conventional stock markets as either permanent or temporary. For that reason, according to the obtained results, the investors especially in Islamic stock markets can use the information about COVID-19 pandemic more actively. However, the investors in conventional stock markets should behave more carefully while making predictions with only the information about COVID-19 pandemic.
- Gold, which is a safe haven for investors, is also an important financial tool which is affected by COVID-19 pandemic. COVID-19 pandemic whose permanent effects are observed on gold prices in long term and the variables for this pandemic can be used in the estimations for gold prices.
- Oil prices indicated significant fluctuations during COVID-19 pandemic. Not only oil-producing companies but also transportation, travelling and manufacturing companies have also been affected by those fluctuations in oil prices due to the prohibitions and restrictions all over the world. Because the restrictions and prohibitions have caused the profitability of the enterprises to change by leading the expenses, costs and income figures to be directly affected. Therefore, this affects stock prices. For that reason, COVID-19 pandemic is a factor which causes either direct or indirect changes in oil prices. Thus, the stock investors should take their decisions very carefully during COVID-19 pandemic.

This research was carried out using time and frequency causality tests for a certain period of time. This study can be conducted in the future with Wavelet analysis, which gives stronger results for different investment tools such as climate funds and bitcoin, especially for small samples. In addition, different variables such as death numbers, daily patient numbers or financial fear index can be used to evaluate the effect of COVID-19. Studies on the effect of positive and negative shocks on investment tools can also be conducted for the values of the variables in this study.

Availability of data statement

Data available on request from the authors.

Credit authorship contribution statement

Gülfeş TUN: Supervision, Conceptualization, Methodology, Writing-Original draft preparation. Vedat Ender TUNA: Visualization, Investigation, Writing- Reviewing and Editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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