Nexus Between Crude Oil, Gold Prices, Commodity Prices And Stock Market In India At Times Of Covid -19

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Abstract

The present paper tries to analyze the relationship between crude oil, gold, commodity prices, and the Indian stock market at a time of the pandemic. The study includes various variables particularly Brent crude oil prices as a proxy for crude, gold price future as a proxy for the gold price while MCX is being chosen as a proxy for the commodity price. The study adopts a series of time series techniques like unit root testing, Johansen cointegration for the measurement of long-run relationship, VECM for checking the short-run equilibrium amongst the select variables, Granger causality test followed by Variance decomposition test for the measurement of the degree of exogeneity amongst the variables. The findings of the paper depicts the presence of a long-run relationship between the select variables and the stock market index. Further, there is a long-run causality on a market index derived from gold, commodity, and crude oil prices while short-run causality is being derived only from gold but not from commodity, crude oil, and the lag from the market index itself. Also, the Market index granger causes Commodity and crude oil but, the gold, crude, and commodity index do not granger cause the market index. The results of a Variance decomposition test show that market index and gold are more exogenous in comparison to commodity and crude oil prices. The study will assist the investors and policymakers in diversifying their portfolios by analyzing the impact of particular variables on the stock market.

Keywords – *Crude oil, gold price, market index, commodity prices, and Covid-19.*

Introduction

There exists a direct relationship between economic growth & development and a sound & healthy financial system as the economies cannot grow and prosper in the absence of a well-functioning financial system. In a current scenario, there occurs an integration between the financial, commodity, and real markets. However, one of the most challenging issues for an investor is to study such interrelationship between the commodity, metal and financial markets as the volatility in one market might affect the price index of the other market. Oil, metal, and commodity prices have an extensive economic effect on the various financial activities that can be apparent in consumption, industrial production, and investment. The unexpected shift or volatility in the crude oil may occur on account of changing geopolitical factors, weather conditions, etc. Understanding such volatility is very much important otherwise it may create instability in the economy in terms of high inflation and unemployment rates. Similarly, the rise in geopolitical risk, low-interest rate, and sagging U.S dollar may lead to a sudden increase in the demand for gold as an alternative investment avenue. However, increase volatility in the gold prices may lead to an unsafe investment condition and may expose investors at risk. The stock market is influenced by a number of macroeconomic variables like inflation, interest rate, gold prices, crude price,

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commodity prices, etc. Thus, the present study tries to analyze the relationship between crude oil, gold, commodity prices, and the Indian stock market at the time of the Covid-19 crisis. The study includes various variables particularly Brent crude oil prices as a proxy for crude, gold price future as a proxy for the gold price while MCX is being chosen as a proxy for the commodity price. The paper uses the monthly data of the select variables for a time period from March 2020 to December 2021 indicating the Covid time period. The entire data for the study is being retrieved from the NSE website and is being analyzed using R software. The paper adopts a series of time series techniques like unit root testing, Johansen cointegration for the measurement of long-run relationship, VECM for checking the short-run equilibrium amongst the select variables, and Granger causality test followed by Variance decomposition test for the measurement of the degree of exogeneity amongst the variables.

Literature Review

(Anon., 2009) in their empirical paper found the existence of a long-term relationship between the crude oil, exchange rate, and stock prices for the select sample period. The findings further depicted that the stock market prices are influenced by oil and exchange rate at lag 50 and 25 respectively.

(Sahu, et al., 2014) using the Johansen cointegration test investigated the dynamic relationship between oil price shocks and the Indian stock market for a time period from January 2001 to March 2013. The paper also incorporated tests like Vector Error Correction Model, Impulse Response function, Variance decomposition, and Granger causality so as to examine the long-run and short-run relationship. The findings of the study highlighted the existence of a long-run relationship between the select variables. Further, the paper demonstrated the long-run causality move from the Indian stock market to crude oil while no short-run causality existed between the select variables. As per the study, the variables were found to be strongly exogenous and also revealed that a smaller shock in the oil prices has a small but persistent and growing effect on the market.

(Ildirar & İşcan, 2015) found no relationship between the commodity prices and the stock market for the select time period from January 2012 to May 2015.

(Gokmenoglu & Fazlollahi, 2015) using the ARDL approach also founded an existence of a long-run equilibrium between crude oil, gold, and the S&P500 market index.

(Tripathy, 2016) investigated the relationship between gold prices and the Indian stock market index for a sample period from July 1990 to April 2016 using the correlation test, Granger causality test, and Johansen cointegration test. The findings revealed the existence of no causal relationship between gold prices and the stock market in the short run. However, the results exhibited the existence of a long-run relationship between the select variables.

(Sharma, et al., 2018) founded the absence of a long-run relationship between international crude oil prices and stock market indices of India for a sample period from January 2010 to January 2017.

(Al-Ameer, et al., 2018) showed a moderate correlation between the stock market and gold prices in the German stock market while a long-run relationship is being reported amongst the select sample variables.

(Singhal, et al., 2019) investigated the dynamic relationship between the international oil prices, international gold prices, exchange rate and stock market index in Mexico using the ARDL Bound testing cointegration approach for the study period from January 2006 to April 2018. The findings of their paper revealed the significantly positive impact of international gold prices on the stock prices of Mexico while oil prices impact negatively.

Also, there existed a negative influence of oil price on the exchange rate in the Mexican stock market.

(Alamgir & Amin, 2021) examined the linkages between the stock market and crude oil prices of select South Asian countries for a time period from 1997 to 2018 using the ARDL approach. The researchers reported a positive relationship between oil prices and the stock market index of select countries. They found an asymmetric response of the stock market index to oil prices.

(Saji, 2021) examined the long-run and short-run relationship between the oil, dollar, gold, and stock markets in India over a time period of 1999-to 2019 using the VECM and Granger causality test. The analysis revealed a time-varying and a countercyclical movement in the asset prices in India.

(Bashir, 2022) identified the dynamics of a nexus between the oil prices and the security market using a bibliometric analysis and found that the majority of the studies in the past were focused upon the ability of the stock price movement towards the return of the security market in countries like U.S.A, U.K and other European nations.

Data and Research Methodology

The study uses the monthly data of the select variables particularly market index, gold price, crude oil, and the commodity price for a time period from March 2020 to December 2021 indicating the Covid time period. The study further adopts the Nifty 50 as a proxy for the Indian market; Brent crude oil future prices as a proxy for crude oil; gold price future as a proxy for the gold price while MCX is being chosen as a proxy for the commodity price. The entire data for the study is being retrieved from the NSE website and is being analyzed using R software. The model used are –

MI = α1 + α2Dt + β1Crude + β2Crude*Dt + β3Gold + β4Gold*Dt + β5MCX + β6MCX*Dt + μt

MI = Market Index
MCX – Multi Commodity Exchange Index

Before applying the Johansen cointegration, VECM, and other time-series tests, the entire dataset is being tested for stationarity using the Augmented Dickey-Fuller test. Because of the time series properties, all the data set is being converted into the first difference and again being tested using the ADF test. After the determination of integration properties, the paper used the Johansen cointegration test for the testing of a long-run equilibrium between the select variables. The test will help us to identify the long-run equilibrium between the market index, crude oil, gold prices, and commodity prices. Determination of a long-run relationship between the select variables comes out to be very much important especially when the series being analyzed is non-stationary. Johansen cointegration test will help to know that whether the market index, crude oil, gold, and commodity prices are tied together in a long run or not.

Moreover, the existence of a long-run equilibrium between the variables does not guarantee a short-run equilibrium. There may be a long-run equilibrium amongst the select variables but in the short run, there may be disequilibrium. Vector Error Correction Model helps in solving this problem by checking the short-run equilibrium amongst the variables. The test indicates the speed of adjustment or rate of correction towards restoring long-run equilibrium. The test shows that a change in the dependent variable is a function of a series of independent variables and an error correction term (which indicates a level of disequilibrium in a cointegrating equation). Thus a proportion of disequilibrium in one period gets corrected in the next period with the help of an error correction mechanism. Thus, through a series of partial short-run adjustments, error correction reconciles the short-

run and long-run behavior. The VECM model adopts an Engle-Granger model which can be written as the following equation:

$$\Delta MI_{it} = \alpha 1 D_t + \alpha 2 \Delta D_t + \beta 1 \Delta Crude_t + \beta 2\ \Delta Gold_t + \beta 3 (MCX_t) + \beta 4 EC_{t-1}$$

Where Δ is the difference; α is the intercept; β is the slope of the independent variable, ECT is the correction of the error.

In order to measure the causal relationship, the study adopts a Granger causality test followed by a Variance decomposition test for the measurement of the degree of exogeneity amongst the variables.

Research Hypothesis
1. There is no long-term effect of a gold price, crude oil price, and commodity prices on the stock market index of India before and during the Covid-19 crisis
2. There is no short-term effect of a select variable on the stock market index of India before and during the Covid-19 crisis.
3. There is no causal relationship among the select variables.

Discussion and Analysis

Before applying the econometric model, the statistical properties of the select sample variables are being analyzed using descriptive statistics and unit root testing.

Table1 – Descriptive Statistics of constituent variables

Statistics	dMI	dGold	dCI	dCrude
Mean	150.3341	9.306818	18.26705	0.05931818
Minimum	-2604	-133.3	-153.5	-27.78
Maximum	1369.15	190.4	402.5	10.25
Standard Deviation	683.695	67.09415	111.644	7.390041
Skewness	-1.195408	0.2204892	1.0393	-1.472589
Kurtosis	4.043046	0.08814451	1.497503	2.944557
Jarque Bera Test	8.79e-11	0.7859	0.0009868	1.451e-01

Source – Author's computation

Table 1 represents the descriptive statistics of dMI, dGold, dCI and dCrude. The results indicate the highest mean for differenced market index while the lowest mean of 0.05931818 is being reported for dCrude variable. Volatility, as measured by standard deviation, is found to be on a higher end in the case of a market index for the select sample period (Covid-19 period) indicating a very high variation in the sample period. The positive skewness of all the select sample variables indicates the chances of positive earnings. Except for dGold, all the variables are found to be not normally distributed at a 5% level of significance using a Jarque Bera test whose null hypothesis assumes the normality of a series.

Table 2 - ADF Test

Variable	At Level	First Difference
MI	0.8458	0.0443
Gold	0.6845	0.0424
CI	0.4512	0.0451
Crude	0.9058	0.01

Source – Author's computation

In order to check the stationarity of a series, the study applies the Augmented Dickey-Fuller Test whose null hypothesis assumes a unit root in the time series. Table 2 depicts the results of the unit root. In the case of each of the variables, the p-value is found to be greater than

the 5% level of significance indicating unit root at levels. Further, all the variables are converted into the first difference and then again are tested using the ADF test. The p-value of all the select sample variables after converting into the first difference is found to be less than the 5% level of significance thereby indicating the series to be integrated at order 1.

Table 3 - Cointegration Variable Test

	Trace Value Test Statistic	**10%**	**5%**	**1%**
None	71.09	49.65	53.12	60.16
At most 1*	33.02	32	34.91	41.07
At most 2	9.12	17.85	19.96	24.60
At most 3	2.78	7.52	9.24	12.97

	Eigen Value Test Statistic	**10%**	**5%**	**1%**
None	39.12	25.56	58.14	33.24
At most 1*	22.84	19.77	22	26.81
At most 2	6.34	13.75	15.67	20.20
At most 3	2.78	7.52	9.24	12.97

Source – Author's computation

Table 3 shows the results of the Johansen cointegration test based upon the trace statistics and eigenvalues. The null hypothesis of the test assumes no cointegration amongst the series. The results of both the statistics at r=0 depict the trace statistics ad eigenvalues to be higher than the critical value at 10%, 5%, and 1% which strongly rejects the null hypothesis of no cointegration amongst the select variables. As per the results, series are found to be cointegrated at r=1 indicating the presence of at most one cointegrating equation amongst the constituent variables at a 10% 5% level of significance.

Table 3 – Results of Vector Error Correction Model (VECM)
AIC 1405.952
BIC 1507.053
SSR 10595040

Cointegrating vector (estimated by ML):

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    MI    Gold       CI        Crude
r1  1   76.98086   -49.59049   -22.78031
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	ECT	Intercept	MI -1	Gold -1	CI -1	Crude -1
MI	0.2136***	-15841***	-0.3919	-14.274***	6.0165	-12.0018
Gold	-0.000	64.3350	-0.0294	0.0210	-0.1531	2.4549
CI	0.0123	-897.2066	0.0347	-0.5655	-0.1372	1.5724
Crude	0.0018**	-137.891**	0.0019	-0.0969	0.0335	-0.3350
			MI -2	**Gold -2**	**CI -2**	**Crude -2**
MI			-0.0293	-11.8428***	2.2029	15.9826
Gold			-0.0255	-0.1620	0.1139	0.8151
CI			-0.0611	-0.0810	0.1674	3.9617
Crude			0.0057*	-0.0800*	0.0034	-0.3226
			MI -3	**Gold -3**	**CI -3**	**Crude -3**
MI			0.0683	-7.7115**	0.7907	-9.1279

Gold		-0.0417	-0.0242	0.0943	0.6473
CI		-0.0324	-0.1213	0.1330	-0.0022
Crude		0.0015	-0.0732*	0.0082	-0.2115

Source – Author's computation

Table 3 highlights the results of VECM showing that the market index is positively associated with gold and negatively associated with commodity index and crude oil prices. VECM model shows the long-term causality of 21.36% as depicted by the Error correction term. Thus, there is a long-run causality on a market index derived from gold, commodity, and crude oil prices. Moreover, lags 1,2, and 3 of a market index are found to be insignificant thereby indicating no short-run causality of its own lag on a market index. On the contrary, for the 'gold' variable, all the three lags are found to have a significant value and thus there is a short-run causality on the market index derived from gold. Similarly, there is no significant value at lags 1,2, and 3 for the 'CI' and 'Crude' variables, and hence no short-run causality on the market index is being derived from commodity and crude oil prices. Thus, short-run causality is derived only from gold but not from commodity, crude oil, and the lag from the market index itself.

Table 4 Granger Causality Test

Particulars	P-value
Gold granger cause market index	0.1857
Market index granger cause Gold	0.5469
Commodity Index granger cause market index	0.3094
Market index granger cause Commodity	0.0070
Crude granger cause market index	0.4247
Market index granger cause Crude	0.088

Source – Author's computation

Table 4 highlights that the Market index granger causes Commodity and crude oil as the p-value is found to be less than the 5% level of significance. But, the gold, crude, and commodity index do not granger cause the market index as the p-value is found to be more than the 5% level of significance thereby leading to the non-rejection of a null hypothesis. Similarly, the market index does not granger causes gold for the same above-stated reason.

Table 5 Variance decomposition test

MI				
Periods	**MI**	**Gold**	**CI**	**Crude**
1	1.0000000	0.0000000000	0.000000000	0.0000000000
2	0.9912109	0.0007766031	0.006372109	0.0016403451
3	0.9761048	0.0111303661	0.011570721	0.0011941211
4	0.9576463	0.0248153709	0.016572148	0.0009661593
5	0.9399180	0.0387341065	0.018668933	0.0026789628
Gold				
1	0.009867867	0.9901321	0.0000000000	0.00000000
2	0.009337480	0.9776996	0.0009344149	0.01202847
3	0.022003058	0.8983165	0.0042272267	0.07545325
4	0.042233615	0.8048575	0.0109731273	0.14193574
5	0.061374623	0.7414260	0.0196006571	0.17759869
CI				
1	0.01493875	0.4668262	0.5182351	0.000000000
2	0.22521129	0.4406337	0.3282988	0.005856211
3	0.14900470	0.6290592	0.2128539	0.009082215
4	0.10938496	0.7129563	0.1553375	0.022321208
5	0.08684839	0.7308578	0.1224110	0.059882757

Crude				
1	0.3516007	0.05686677	0.03066932	0.5608632
2	0.5274447	0.06441457	0.03961060	0.3685301
3	0.5837642	0.06577447	0.05195216	0.2985092
4	0.6111489	0.06310279	0.05928466	0.2664636
5	0.6320020	0.06163970	0.06206535	0.2442930

Source – Author's computation

Table 5 represents the results of the variance decomposition test which is also known as forecast error variance decomposition as it helps to how much of the forecast error variance of each variable is explained by exogenous shocks to other variables. The results depict market index and gold as strongly exogenous variables as almost 93% and 74% of the variations remain explained by their own shock even after 5 periods. This indicates that the market index and gold are dependent upon themselves rather than other variables. However, in the case of the commodity index, 73% of the variation is being explained by the gold and only 12.2% is being explained by the commodity index itself. It indicates that the commodity index is dependent upon gold also. Similar results are being highlighted by the crude wherein almost 63% of the variation is being explained by the other variable i.e., the market index. Thus, the results show that the market index and gold are more exogenous in comparison to commodity and crude oil prices.

Conclusion

The findings of the paper depict the presence of a long-run relationship between the select variables and the stock market index. As per the results, series are found to be cointegrated at r=1 indicating the presence of at most one cointegrating equation amongst the constituent variables at a 10% 5% level of significance. Further, there is a long-run causality on a market index derived from gold, commodity, and crude oil prices while short-run causality is being derived only from gold but not from commodity, crude oil, and the lag from the market index itself. Also, the Market index granger causes Commodity and crude oil but, the gold, crude, and commodity index do not granger cause the market index. The results of a Variance decomposition test show that market index and gold are dependent upon themselves rather than other variables. However, in the case of the commodity index, 73% of the variation is being explained by the gold and only 12.2% is being explained by the commodity index itself. It indicates that the commodity index is dependent upon gold also. Similar results are being highlighted by the crude wherein almost 63% of the variation is being explained by the other variable i.e., the market index. Hence, the market index and gold are more exogenous in comparison to commodity and crude oil prices. The study will assist the investors and policymakers in diversifying their portfolios by analyzing the impact of particular variables on the stock market.

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