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An Empirical Study of Causality Relationship between Crude Oil Prices and Thematic Indices of National Stock Exchange of India

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ABSTRACT

The objective of this study is to examine the causal relationship between crude oil prices and Thematic Indices of NSE of India. The spot price of Brent crude oil is used as a proxy for crude oil prices. The Thematic Indices have been selected for the purpose of the study are: Nifty 100 ESG, Nifty 500 Shariah Index, Nifty Housing Index, Nifty Services Sector Index and Nifty India Manufacturing Index. Data has been collected for the time period from April1, 2009 to September 30, 2025 i.e. the period of post subprime lending financial crisis. But the data of Nifty 100 ESG has been taken from January1, 2011 due to availability of data. Daily closing prices of the variables have been considered. Granger Causality Test have been applied to check the causality between the variables. The study concludes that there is no causality between crude oil prices and selected Thematic Indices of NSE of India.

Keywords: *Oil Prices, Thematic Index, Granger Causality Test.*

Introduction

In developing nation like India, the relationship of crude oil with stock market is important to study to drive the economy. Oil plays an important role for the growth of an economy as it is one of the most important raw material which is required by companies for the production of goods and services. So, if prices of oil (used as a input in industries) increases, then it makes difficult for the companies to provide the goods at the same price which was earlier before rising in oil prices. So, it makes a significant effect on the profitability of companies as well as on the performance of companies in the stock market. As of March 2025, India maintained its position as the third largest consumer of oil in the world (IBEF, 2025). As the largest consumer of oil in the world, India needs to import crude oil which makes a significant effect on exchange rate as well. In financial year, 2024-2025, the import of crude oil was 243225 thousand metric tonnes as per report of Petroleum Planning & Analysis Cell (PPAC). Prices of oil have been influenced by various factors such as geographical tensions, supply and demand, etc. The conflicts between Russian – Ukraine affected the Indian economy. China and India are the biggest purchaser of crude oil from Russia as Russia is considered as second largest exporter in the world (The Economic Times, 2025). Despite international pressure as US imposed fifty per cent tariff on Indian goods and ask to cut purchases from Russia, India was continuously heavily dependant on Russia for the import of crude oil in 2025.The import of crude oil from Russia is more than one-third imports of India for most of the year (The Economic Times, 2025). The spot price of WTI crude oil (West Texas Intermediate crude oil, a benchmark price for U.S. crude oil) on December 30, 2022 was $80 per barrel, $4 per barrel higher than the price on January 3, 2022 ($76 per barrel). The spot price of Brent crude oil (a benchmark price in Northwest Europe) on December 30, 2022 was $ 83 per barrel, $5 per barrel higher than the price on January 3, 2022 ($78 per barrel) (eia.gov). In first half of 2022, prices of crude oil increased due

to Russia's full scale invasion of Ukraine and on March 8, 2022, the spot price of Brent crude oil climbed to $133 per barrel and WTI crude oil climbed to $124 per barrel. In second half of 2022, crude oil prices reduced due to decrease in demand on account of possibility of recession in the economy (EIA, 2023). So, all these factors which bring fluctuations in prices of oil affects the stock market also as there is interlinkage in the financial markets.

So, the objective of this study is to examine the causal relationship between crude oil prices and Thematic Indices of NSE of India. Unlike the majority of existing literature that focuses on Broad Indices and Sectoral Indices of National Stock Exchange, Bombay Stock Exchange and foreign stock exchanges. The choice of Thematic Indices as a case study is important due to change in investment patterns. In India, investors are getting attracted towards thematic index based investment strategy as they have a potential for higher returns (Majumder, 2021). As compared to sectoral indices, thematic indices are more diversified as it includes the stocks of different sectors that are combined by a theme. For example; Nifty Services Sector Index includes companies that represent different sectors such as IT Education and Training, Banks, computers – Software, Telecommunication Services, Power, Media, Financial Institutions, Shipping, Courier, etc.

So, the novelty of this study is to study the causal relationship between crude oil prices and Thematic Indices of NSE.

Literature Review

Anoruo (2011) examined the linear and non - linear causality associations between stock market returns of US and crude oil price changes for the period from February 1974 to December 2009. The study employed standard VAR model to test linear causality and Mackey-Glass (M-G) model to test the non-linear causality between crude oil price changes and stock market returns of US. The study showed that bidirectional causality moves between stock market returns and crude oil price changes as per standard VAR model. M-G causality test confirmed that bidirectional causal association between stock market returns and positive values of crude oil price changes while unidirectional causality moves from negative value of crude oil price changes to stock market returns of US.

Baig et al. (2013) studied the association among gold prices, oil prices and KSE 100 returns for the time period from 2000 to 2010. The study employed Johansen Co-integration Test, Granger Causality Test, Variance Decomposition and Impulse Response Function. The study concluded that no co movement exist between oil growth, gold growth and KSE 100 return. Granger Causality Test confirmed that unidirectional causality moves from gold to oil only. Impulse Response Function showed that fluctuations in gold and oil prices does not affect KSE 100 as well as KSE 100 return does not affect gold and oil markets.

Gokmenoglu and Fazlollahi (2015) investigated the linkages between oil, gold and stock market. The paper examined the effect of oil prices, gold prices and their respective volatilities such as OVX and GVZ on stock market price index. The data has been collected for the time period from starting of January 2013 to the end of November, 2014. The study used daily prices. The study employed the model ARDL co-integration approach for finding the long run relationship of GVZ (Gold Market Volatility Indices), OVX (Oil Market Volatility Indices) and S&P500 market price index. The findings of the study indicated that long run equilibrium is present among the variables under study and the study also indicated that by making a contribution of gold and oil market prices and their volatilities, S&P500 stock market price index, by 1.2 percent speed of daily adjustment, converges to its long run equilibrium. In long run, all the variables under study influence the S&P 500. In long run and short run, prices of gold have the largest effect on stock prices. S&P 500 stock market is not influenced by the volatilities of gold and oil in short run.

Ingalhalli et al. (2016) investigated the connection among forex, gold, oil and Sensex for the period from January 2005 to July 2015 by employing Granger Causality Test. The study revealed that prices of oil contribute in predicting the gold prices and exchange rates. The study also showed that stock price index (Sensex) granger causes fluctuations in oil prices as well as makes a contribution in predicting the exchange rate and gold prices.

Iheanacho (2016) studied the association between exchange rate, crude oil price and stock market performance of Nigeria for the period from January 1995 to December 2014. The study employed Johansen Co integration Test and Vector Error Correction Model. The study concluded that in long run, prices of oil and exchange rate have a significant negative effect on All Share Index. Exchange rate and

crude oil price both have a positive effect on All Share Index in short run. Granger Causality Test revealed that exchange rate and oil prices both granger cause All Share Index. Exchange rate is only granger caused by oil prices. ASI and exchange rate both does not granger cause oil price. Variance Decomposition analysis confirmed that exchange rate and Nigerian stock market performance are strongly affected by movements in prices of crude oil.

Raza et al. (2016) investigated the effect of oil, gold prices and their volatilities on stock prices of emerging markets asymmetrically by using monthly data for the period from January 2008 to June 2015 by using NARDL approach to find out short run and long run asymmetries. The findings of the study stated that in short run and long run, emerging stock markets are asymmetrically impacted by gold prices, oil prices and their volatilities. Emerging BRICS stock markets are positively impacted by gold prices but stock prices of Mexico, Thailand, Indonesia, Chile and Malaysian markets negatively impacted by gold prices. Emerging stock markets under study negatively impacted by oil prices. In short run and long run, the volatilities of gold and oil prices negatively affect the emerging stock markets.

Mishra and Debasish (2017) analysed the effect of prices of oil on exchange rate of Indian rupee against U.S. Dollar. The data has been collected for the time period from June 2003 to March 2016. The study used GARCH (Generalised Autoregressive Conditional Heteroskedasticity) and EGARCH (Exponential Generalised Autoregressive Conditional Heteroskedasticity) model. The study concluded that Indian currency in relation to U.S. Dollar depreciates due to rise in oil prices. The study also revealed that negative and positive oil price shocks have same effect on exchange rate volatility in terms of magnitude and this effect on exchange rate volatility is permanent.

Seyyedi (2017) studied the relationship among Indian rupee-dollar exchange rate, oil prices and gold prices for the time period from January 12, 2004 to April 30, 2015. The study employed Johansen's Co-integration Test, Granger Causality Test, Vector Autoregressive Model and Impulse Response Function. The study confirmed that no long run association exist among the variables under study. Granger Causality Test confirmed that there is bidirectional causality between prices of oil and exchange rate. Unidirectional causality moves from gold prices to oil prices and exchange rate.

Kirkulak- Uludag and Safarzadeh (2018) investigated the volatility spillover between OPEC oil prices and returns of Chinese sectoral stock. The data has been collected for the time period from December 31, 2004 to October 17, 2014. The study used daily closing prices of six sectoral stock indices namely Machinery, Construction, Military, Automobile, Financial and Agriculture. The study employed VAR-GARCH model. The findings of the study indicated that volatility spillover from oil to stock returns is unidirectional. The results also stated that there is significant evidence of volatility spillover between OPEC oil prices and the returns of Chinese sectoral stock. The negative and significant effect of past shock of oil on conditional volatility of Automobile, Construction, Machinery, Agriculture and Military stock indices. But effect of past stock returns on oil returns volatility is not significant except Military stock index.

Tursoy and Faisal (2018) studied the effect of crude oil prices and gold prices on stock market of Turkey for the time period from January 1986 to November 2016 by employing Autoregressive Distributed Lag Model (ARDL), FMOLS, DOLS and CCR. The study concluded that there is a negative association between gold prices and stock prices in long run and short run. Granger Causality Test confirmed that in short run, long run and joint forms, gold prices cause stock prices only. Further, the study found that stock prices are positively affected by crude oil prices in long run and short run. But as per Granger Causality Test, no causality found between stock prices and crude oil prices.

Bakhsh and Khan (2019) investigated the relationship among oil prices, gold prices, exchange rate and stock index of Pakistan for the time period from September 1997 to April 2018 by employing Johansen Co-integration Technique, Granger Test and Vector Autoregressive Model. The study revealed that no long run relationship is found among all the variables under study as confirmed by cointegration test. The study also concluded that stock index, exchange rate and crude oil prices are the most independent variable whereas gold prices are the most dependable and weakest variable through VAR model. Granger Causality Test confirmed that prices of crude oil and gold affects the exchange rate whereas exchange rate affects the stock index of Pakistan.

Aziz et al. (2020) investigated the volatility spillover among commodity markets (rice, crude oil, gold and gasoline) and equity markets of U.S. (S&P500). The data has been collected for the time period from February 2005 to December 2016. The study employed GARCH (1,1) model. The study concluded that there is no volatility spillover between commodity market and equity market of U.S. The study

suggested that to reduce the risk, investors can invest in stocks and gold simultaneously to make optimal portfolio. In case of commodity market, existance of volatility spillovers from oil to gas and rice.

Kaur and Singla (2021) investigated the association between Sectoral Indices of NSE and macroeconomic variables for the time period from 2009 to 2019 by employing ARDL Bound Test. The study found that prices of oil and exchange rate positively and significantly impact the IT sector returns but prices of gold negatively and significantly impact it in long run. In short run, prices of oil, gold and exchange rate impacts FMCG sector positively and significantly. Oil and gas sector returns and Financial services returns are impacted by exchange rates.

Samour et al. (2022) studied the relationship among gold prices, oil prices and equity market of South Africa (JSE) for the time period from January 2001 to January 2020 by employing Bootstrap (B-ARDL), The ARDL, Dynamic OLS (DOLS), Canonical Co integrating Regression (CCR) and Fully Modified OLS (FMOLS) and Granger Causality Test. The study concluded that as per DOLS, CCR, FMOLS and ARDL, gold prices have an inverse affect on equity market of South Africa whereas oil prices have positive influence on equity market of South Africa. Granger Causality Test confirmed that unidirectional causality moves from oil prices, gold prices to equity market.

Chkili (2022) investigated the relationship between prices of oil, gold and Islamic stock market (Dow Jones Islamic World Market Index). The data has been collected for the time period from January 1996 to December 2020. The study employed standard VAR and Markov Switching VAR models. The study concluded that the relationship between oil and Islamic stock market specially during turbulent period is significantly positive but there is no or negative linkage between gold and both Islamic stock market and oil.

Objectives of the Study

- The novelty of this study is to study the causal relationship between crude oil prices and Thematic Indices of NSE.

Research Methodology

The primary aim of study is to examine the causal relationship between crude oil prices and Thematic Index of NSE. The spot price of Brent crude oil is used as a proxy for crude oil prices and data has been collected from the U.S. Energy Information Administration (EIA). The Thematic Indices have been selected for the purpose of the study are: Nifty 100 ESG, Nifty 500 Shariah Index, Nifty Housing Index, Nifty Services Sector Index and Nifty India Manufacturing Index. The data has been collected from the website of NSE Indices ((https://niftyindices.com/). Data has been collected for the time period from April1, 2009 to September 30, 2025 i.e. the period of post subprime lending financial crisis. But the data of Nifty 100 ESG has been taken from January1, 2011 due to availability of data. Daily closing prices of the variables have been considered. All the variables have been converted into log form. Nifty100 ESG has 3492 observations and remaining variables have 3975 observations.

Descriptive Statistics

Table 1: Descriptive Statistics

	Nifty100ESG	Crude Oil	Nifty Housing	Nifty India Manufacturing	Nifty500 Shariah	Nifty Services Sector
Mean	2304.601	77.20077	5000.945	5622.634	3138.478	14771.97
Median	1963.845	74.89000	3997.530	4655.220	2659.100	12347.10
Maximum	5243.450	133.1800	12386.31	15752.75	8238.860	33875.05
Minimum	755.2400	9.120000	1431.880	1179.700	701.9000	3531.300
Std. Dev.	1227.525	23.81152	2791.609	3420.027	1928.979	8208.353
Skewness	0.754482	0.118301	1.100798	1.341276	0.908290	0.724661
Kurtosis	2.402193	2.222070	3.016799	4.002841	2.693104	2.308713
Jarque-Bera	383.2972	109.5040	802.8358	1358.419	562.1552	427.0500
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	8047667.	306873.1	19878757	22349972	12475452	58718595
Sum Sq. Dev.	5.26E+09	2253212.	3.10E+10	4.65E+10	1.48E+10	2.68E+11

Source: Author's Computation

The mean value of crude oil price is 77.20077 and its standard deviation is 23.81152. Among the selected indices, Nifty Services Sector Index has the highest mean value that is 14771.97 and Nifty 100ESG has lowest standard deviation value that is 1227.525. All the selected variables under study are positively skewed as the value of skewness of all the variables is greater than zero. All the variables selected under study are platykurtic curve as their kurtosis value is less than 3 except two variables that is Nifty Housing Index and Nifty India Manufacturing Index as their value is greater than 3 it means they are leptokurtic curve. The null hypothesis of Jarque-Bera Test is Distribution is normal and alternate hypothesis is Distribution is not normal. So, table no.1 shows that probability values of Jarque-Bera Test is less than 1 per cent implies rejection of null hypothesis. It means distribution of selected series is not normal.

Unit Root Test

The study employed ADF test to check the stationarity of the variables. This test is important to apply as before applying any model, data must be stationary.

H_o: Data has unit root (non-stationary)

H_1: Data has no unit root (stationary)

Table 2: Results of Unit Root Test

Variable Name	ADF Test	Integration Order
	t-stat	
ln NIFTY100ESG	-58.11449 (0.0001)*	I(1)
ln CRUDE OIL	-18.17569 (0.0000)*	I(1)
ln NIFTY HOUSING	-59.59517 (0.0001)*	I(1)
ln NIFTY INDIA MANUFACTURING	-59.67952 (0.0001)*	I(1)
ln NIFTY500 SHARIAH	-60.77269 (0.0001)*	I(1)
ln NIFTY SERVICES SECTOR	-62.21960 (0.0001)*	I(1)

Notes: *Indicates significant P-values at 1 % level.

Source: Author's Computation

The results of Table No.2 shows that all the variables selected under study are not stationary at level but they are stationary at first difference at 1 per cent level of significance.

Granger Causality Test

The Granger causality test is applied to determine causality between selected variables. In this test, both the variables are dependant and independent.

H_o: X does not granger cause Y

H_1: X granger cause Y

If prob. values is more than five per cent implies acceptance of null hypothesis that means no causality. But if prob. values is less than five per cent implies rejection of null hypothesis.

Table 3: Results of Granger Causality Test

Null Hypothesis	F- statistic	Prob. Values	Causality
Nifty 500Shariah does not granger cause crude oil	0.87511	0.3496	No Causality
Crude oil does not granger cause Nifty 500Shariah	3.12252	0.0773	No Causality
Nifty Housing does not granger cause crude oil	0.31136	0.5769	No Causality
Crude oil does not granger cause Nifty Housing	2.23275	0.1352	No Causality
Nifty India Manufacturing does not granger cause crude oil	0.97692	0.3230	No Causality
Crude oil does not granger cause Nifty India Manufacturing	2.18012	0.1399	No Causality
Nifty Services Sector does not granger cause crude oil	1.29671	0.2549	No Causality

Crude oil does not granger cause Nifty Services Sector	0.82532	0.3637	No Causality
Nifty 100 ESG does not granger cause crude oil	0.00195	0.9648	No Causality
Crude oil does not granger cause Nifty 100 ESG	0.47539	0.4906	No Causality

Table No.3 shows the result of Granger Causality test. Results show that there is no causality between crude oil and selected Thematic Indices of NSE of India. As prob values are more than 5 per cent which implies acceptance of null hypothesis that means no causality.

Conclusion

The objective of this study is to examine the causal relationship between crude oil prices and Thematic Indices of NSE of India. The spot price of Brent crude oil is used as a proxy for crude oil prices. The Thematic Indices have been selected for the purpose of the study are: Nifty 100 ESG, Nifty 500 Shariah Index, Nifty Housing Index, Nifty Services Sector Index and Nifty India Manufacturing Index. Data has been collected for the time period from April1, 2009 to September 30, 2025 i.e. the period of post subprime lending financial crisis. But the data of Nifty 100 ESG has been taken from January1, 2011 due to availability of data. Daily closing prices of the variables have been considered. Granger Causality Test have been applied to check the causality between the variables. The study concludes that there is no causality between crude oil prices and selected Thematic Indices of NSE of India.

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