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Oil Prices, Silver, Gold and Exchange Rate Relationship with Stock Market Returns in Indian Bourse with ARDL Model

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Abstract

Oil plays a very important role in the Indian economy and the stock market. In India, oil is key factor as nearly 85% of crude oil requirements are fulfilled through imports. It is believed that Indian stock market and crude oil are inversely proportional. In the past, it was seen that when crude oil fell more than 20%, then the Indian stock market offered good average returns of near about 19% Likewise silver, gold and exchange rates are also playing an important role in affecting the stock market of Indian economy. The objective of the present study is to see the relationship between Indian stock market and commodities such as oil, gold and silver as well as the exchange rates. The proxy used to represent the Indian stock market is Nifty. The models used for the analysis purposes were the ARDL and VAR models. The results showed that exchange rate and crude oil have a significant relationship with the stock market while other variables like gold and silver have an insignificant relationship, which means these did not have any impact on the stock market in the long run.

Keywords: ARDL Model, Oil Prices, Exchange Rates, Gold and Silver Rates, Stock Market
JEL Classifications: C22, C52, G12, E32

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1. Introduction

Crude oil is something that is important for all economies around the world. Oil is treated as a pillar of the global economy. Everything, starting from machinery to plastic, is related to oil or some by-product. Oil makes its presence felt in almost every human's life, and it sends undulation through the stock market. The impact of oil is not felt only in one direction, but to identify all the effects is rather a difficult job.

All companies are not adversely affected by the increase in oil prices. At a high price, oil companies lock in supply contracts for that price. It may be possible that the cost of production might be very low, resulting in high profits even after the spot price falls. As a result, it can be stated that oil companies make fantastic profits and their stock prices increase. As oil companies are a part of stock market indices, this will have a favourable impact on the overall stock market, but at the cost of other companies whose share price may be adversely affected due to the increase in oil prices.

Oil plays a very important role in the Indian economy as well. In India, oil is a key factor, as nearly 85% of the country's crude oil requirements are fulfilled through imports. It is believed that the Indian stock market and crude oil are generally inversely proportional. In the past, it was found that when crude oil fell more than 20%, Indian stock market offered good average returns of near about 19%, eight out of ten times.

It is believed that both the SENSEX and the rupee have gone from strength to strength. Both have a very strong positive correlation. The positive correlation exists, which means a rise in the stock market index will accompany appreciation of Indian rupee and vice versa. Mishra (2018) explicated the effects that gold prices and the exchange rate have on the Indian Stock Market. The rupee and market index are directly and indirectly influenced by various similar factors, like the outlook of the Indian economy, FII (Foreign Institutional Investment) inflows and outflows, surplus and trade deficit, etc.

Among many factors, one very important factor that is responsible for the positive correlation between the market index and the rupee is FII (Foreign Institutional Investment) inflows. Due to FIIs, money flows into the market, and the market rises. As FIIs require money for the purpose of investment in the Indian market, there is an increase in the demand for the rupee, which in turn boosts the currency. Furthermore, a strong market leads to a better perspective for the rupee, resulting in further inflows and rupee appreciates. The same is possible in reverse as well. For example, in any bad year, if FIIs outflows occur, the market goes down, leading to a depreciation of the rupee.

The portfolio balance approach elucidates that causality runs from exchange rate to stock prices. It is based on the notion that the market value of any firm can be strongly affected by the health of the national currency. If the currency of a country is weak, its exported goods become cheaper globally, which will lead to an increase in the profits of export-based companies, and vice versa. Lin (2012) suggested that the co-movement between exchange rates and stock prices becomes stronger during crisis periods, consistent with contagion or spillover between asset prices, when compared with tranquil periods. Furthermore, most of the spillovers during crisis periods can be attributed to the channel running from stock price shocks to the exchange rate.

A few studies found a relationship between oil, gold, silver, and exchange rates and stock market returns. While there is another group of studies that emphasize that there is absolutely no relationship between these variables and stock market returns. So, there is no strong consensus about the relationship. The present study explores it further to identify this construction. It was perceived by Salisu and Isah *(*2017*)* that there was a strong relationship between the oil price and stock prices in oil exporting and oil

importing countries. Furthermore, stock prices of oil exporting and oil importing countries react asymmetrically to changes in oil prices, although the response is stronger in the latter as compared to the former. Tursoy and Faisal (2018) explored the interaction between gold prices, crude oil prices and stock returns in the long run and short run. They found that there was a positive relationship between stock prices and crude oil. Al-hajj et al. (2020) identified the relationship between oil price fluctuations and stock market returns in nine economic sectors of the Malaysian stock exchange. The ARDL model showed that except for two sectors, trading/services and plantations, all other sectors are co-integrated. It was found that oil prices have a significant negative impact on various sectors' stock market returns.

Singhal et al. (2019) investigated the relationship among oil prices, gold prices, exchange rate and the stock market index in Mexico. The ARDL model was used to understand this relationship. They concluded that gold prices affect stock returns positively. On the other hand, the price of oil affects it negatively. As far as the exchange rate is concerned, it was seen that oil prices influence the exchange rate negatively in the long run and gold price does not have any significant impact on the exchange rate. Badeeb and Lean *(*2016*)* throw light on the asymmetric impact of the oil price on the Malaysian stock market. The NARDL model was used to understand this relationship. They found that changes in oil prices, whether positive or negative, has a significant impact on the Islamic stock returns in both the short run and long run. Güler and Nalin (2014) investigated the dynamics of stock market returns, financial variables like oil prices, gold prices, export volume, import volume, macroeconomic variables and the exchange rate in the short run and long run. The Autoregressive Distributed Lag (ARDL) model was applied to capture these dynamics between variables in the short run and long run. It was seen that a long-term relationship exists between stock return and economic factors. Furthermore, in the short run and long run, a significant relationship exists between imports and stock returns. Jain and Ghosh (2013) investigated the relationship between gold, silver, oil, dollar/euro exchange rate and Volatility Index. They concluded that gold, silver, dollar/euro exchange rate and risk perceptions influence world oil prices in the long run. It is found that if there were a shock to risk perceptions of global investors, it would result in a negative impact on oil prices, but only for a short period of time.

Kilian and Park (2009) found that the reaction of U.S. real stock returns to an oil price shock differs greatly depending on whether the change in the price of oil is driven by demand or supply shocks in the oil market. The demand and supply shocks driving the global crude oil market together account for 22% of the long-run variation in U.S. real stock returns. The responses of industry-specific U.S. stock returns to demand and supply shocks in the crude oil market are consistent with accounts of the transmission of oil price shocks that emphasize the reduction in domestic final demand. Sahu et al. (2015) investigated the dynamic relationships between the oil price, exchange rate and Indian stock market during 1993 - 2013. The estimated results of Johansen's cointegration test and vector error correction model suggest that there exist long-run cointegrating relationships between the crude oil price and Indian stock indices, but it cannot be said with sufficient confidence that the direction of the relationship in the long run is from the oil price to the Sensex. The Granger causality test also reveals that the volatility of stock prices in India can be explained by the movement of the oil price and exchange rate in the short run. The variance decomposition analysis reveals that Indian stock prices are highly exogenous, in the sense that the crude oil price or exchange rate explains only a very small portion of the forecast variance error of the market index. Finally, from the impulse response function analysis, it is noticed that a positive shock in one variable has a persistent and prolonged effect on other variables. Degiannakis et al. (2018) focused on

the relationship between oil prices and the stock market. It was found that oil prices have an impact on stock market returns, and the volatility in oil prices results in volatility in the stock market. Tchatoka et al. (2019) indicated that large negative shocks in oil prices can increase stock market returns in both oil exporting countries and moderately exporting countries. As far as negative oil shocks are concerned, the market depress further. It was concluded that the relationship between oil price shocks and stock market returns was not stable over time and kept on fluctuating. Singhal and Gosh (2016) thrived with the idea of looking into relationship between crude-oil prices and Indian stock market returns at both aggregate and sector level. They brought into notice that oil price movements do not sway stock market at aggregate level. But in different sectors like auto, power and other finance sectors, oil price shocks are affecting stock market returns.

Ono (2011) examined stock market returns and found that they are positively responding to oil price movements, except in Brazil. It was observed that oil price shocks' contribution to movements in stock market returns is huge and significant enough. Jones and Kaul (1996) found that revolutions in oil prices seem to cause higher fluctuations in stock prices than can be tolerated by succeeding changes in real cash flows or fluctuating stock returns. According to Jain and Biswal (2016), a drop in gold prices and crude oil prices resulted in a drop in the value of Indian Rupee and stock market returns. They also reinforced the advent of gold as an investment asset class among investors. Fang and You (2014) studied the relationship between how changes in oil prices affect stock market returns. They found that the impact of oil price shocks on stock prices is mixed, and there is only a partial correlation with them. Moore and Geoffrey H. (1990) studied the relationship between the gold price and the value of stocks. They investigated that there was a negative relationship between gold prices and stock prices which exhibited that a rise in gold price has a propensity to decrease in stock prices.

On the other hand, there are some studies that believe that there was no relationship between oil prices, gold, silver, the exchange rate, and stock market returns. Apergis and Miller (2009) examined the fact that international stock markets do not respond to oil market shocks in a large way with the help of the VAR model. In the same way, Abhyankar et al. (2013) showed that the Japanese stock market responds negatively to oil price shocks, and Lin et al. (2010) show that global oil demand and oil-specific demand shocks have no significant impacts on China's stock market returns. Muhammad et al. (2012) analysed the variability of Arbitrage Price Theory (APT) in the case of the KSE. The monthly data from January 1985 to December 2008 has been considered, and two econometric methodologies, Johanson co-integration and error correction models are used to check out the validity of APT in this study. The findings of this study illustrate that quasi-money reacts negatively to KSE 100 index return whereas IIP (industrial index of production), exchange rate, petroleum price, domestic interest reacts negatively to KSE 100. Mookherjee and Yu (1997) found that there is no relationship between the exchange rate and the Singapore stock market. Singh (2010), Naik (2013) and Naik and Padhi (2012) examined the relationship between Indian stock prices and the exchange rate, and discovered that there was no relationship between the exchange rate and Indian stock returns. It was found that the gold price and the Tehran Stock Exchange (TSE) are not co-integrated, Bashiri (2011). Thus, it can be said that there is a gap, which paves the way for the present study.

2. Methodology

The objective of the present study is to see the relationship between the Indian stock market, exchange rate and commodities. For this purpose, three commodities are taken, namely crude oil, gold, and silver. The data was taken from a period of five years, from 1st January 2017 to 31st December 2021. Eviews11 software was used to analyze the data. The data was collected from moneycontrol. com, yahoofinance. com and mcxindia. com. The proxy used to represent the Indian stock market is Nifty. The models used for the analysis purpose were the ARDL and VAR models. This section discusses the data collection and techniques used in the study.

2.1 Data

The objective of the present study is to see the relationship between the Indian stock market, exchange rate and three commodities, which are crude oil, gold and silver. As far as the selection of commodities is concerned, oil is a key factor, as nearly 85% of crude oil requirements are fulfilled through imports. It is believed that Indian stock market and crude oil are inversely proportional. In the past, it was found that when crude oil fell more than 20%, Indian stock market offered good average returns of near about 19%, eight out of ten times. So, it was seen that crude oil has its significance for countries such as India, which is the largest oil-importing country and, hence, can affect the Indian stock market (Singh, 2014; Sahu et al., 2015; Gay Jr., 2016; Degiannakis et al., 2018). Gold and Silver are very important commodities in terms of Indian scenario, (Mishra, 2018; Jain & Biswal, 2016). Gold has accomplished much better as a tail hedge over the past 2 to 3 decades. There is a general insight that costly metals, such as gold, provide a reliable, effective hedge over the uncertainties of the market. On the other hand, silver inclinations seem to be much more related to the economy's situation than gold, largely due to the downside market. In the case of the exchange rate, it is seen that with the change in exchange rate, if the local currency depreciates, it results in an increase in exports, which increases the stock price of that company, and vice versa. Therefore, a strong relation between exchange rate and stock market is assumed (Güler & Nalın, 2014; Mishra, 2018; Singhal, et al., 2019). The ARDL model was used for analysis purposes, which is suitable to predict short-run and long-run relationships among the variables under study (Salisu & Isah, 2017; Kumar et al., 2021; Tursoy & Faisal, 2018; Asaad, 2021; Meo et al., 2018) applied the ARDL model earlier to see the association of similar variables. The VAR model was also used in the present study (Ono, 2011; Mensi et al., 2018).

2.2 ARDL Model

Auto Regressive Distributed Lag is a time series model where the dependent variable is a function of its own lags, other variables, and their lags. ARDL is convenient for modelling I (0) and I(1) variables together and for cointegration testing. ARDL stands for "Autoregressive-Distributed Lag". In its basic form, an ARDL regression model looks like this:

$$yt=\beta 0+\beta 1yt-1+\cdots+\beta pyt-p+\alpha 0xt+\alpha 1xt-1+\cdots+\alpha qxt-q+\varepsilon tyt=\beta 0+\beta 1yt-1+\cdots+\beta pyt-p+\alpha 0xt+\alpha 1xt-1+\cdots+\alpha qxt-q+\varepsilon t \quad (1)$$

where ε_t is a random "disturbance" term.

The model is "autoregressive", in the sense that yt is explained (in part) by its own lagged values. It also has a "distributed lag" component in the form of successive lags of the xx explanatory variable. Sometimes, the current value of xt itself is excluded from the distributed lag part of the model's structure. ARDL models have come to play an important role recently in the modelling of non-stationary time-series data. In particular, they are used to implement the so-called "Bounds Tests" (Pesaran & Shin, 1999; Pesaran et al., 2001) to see if long-run relationships are present when we have a group of time-series, some of which may be stationary while others are not.

Model 1: LNifty= $\alpha 1 + \beta_2 OIL + et \ldots\ldots$ (2)
Model 2: LNifty= $\alpha 1 + \beta_2 GOLD + et \ldots\ldots$ (3)
Model 3: LNifty= $\alpha 1 + \beta_1 EXR + et \ldots\ldots$ (4)

Where, LNifty=Log of S&P CNX Nifty Closing Prices

2.3 Vector Autoregressive Model (VAR)

Vector Autoregressive Models (VARs) were given by Sims (1980) as a part of a natural overview of univariate autoregressive models. Vector Autoregressive Models (VARs) are considered as a substitute for large-scale simultaneous equations structural models. The other is a bivariate VAR, in which there are only two variables, y_{1t} and y_{2t}, their current values depend on diverse combinations of the earlier *k* values of both variables, and error terms,

$$y_{1t} = \beta_{10} + \beta_{11}\, y_{1t-1} + \cdots + \beta_{1k}\, y_{1t-k} + \alpha_{11}\, y_{2t-1} + \cdots + \alpha_1 k\, _{y2t-k} + u_{1t} \quad (5)$$
$$y_{2t} = \beta_{20} + \beta_{21}\, y_{2t-1} + \cdots + \beta_{2k}\, y_{2t-k} + \alpha_{21}\, y_{1t-1} + \cdots + \alpha_{2k}\, y_{1t-k} + u_{2t} \quad (6)$$

where u_{it} is a white noise disturbance term with E (u_{it}) = 0, (i = 1, 2), E($u_{1t}u_{2t}$) = 0.

Similarly, another valuable side of VAR models is the compactness with which a notation can be expressed. Consider the case, from the above where k = 1, hence it can be said that each variable is only dependent on the proximately previous values of y_{1t} and y_{2t}, which is also an error term. This can be expressed as-

$$y_{1t} = \beta_{10} + \beta_{11}\, y_{1t-1} + \alpha_1 k\, _{y2t-k} + u_{1t} \quad (7)$$
$$y_{2t} = \beta_{20} + \beta_{21}\, y_{2t-1} + \alpha_{2k}\, y_{1t-k} + u_{2t} \quad (8)$$

Variance Decompositions and Impulse Responses

Variance decompositions propose a slightly different method for examining VAR system dynamics**.** They give the proportion of the movements in the dependent variables that are due to their **'**own**'** shocks versus shocks to the other variables**.** Impulse responses talk about the reaction of the dependent variables in the VAR to shockwaves for each of the variables**.** Thus, for every variable in each equation separately, a unit shock is applied to the error, and its effect upon the VAR system over time is noted.

$$y_t = A_1\, y_{t-1} + u \quad (9)$$

The VAR can also be written out using the elements of the matrices and vectors as

$$\begin{bmatrix} Y_{1t} \\ Y_{2t} \end{bmatrix} = \begin{bmatrix} 0.5 & 0.3 \\ 0.0 & 0.2 \end{bmatrix} \begin{bmatrix} Y_{t-1} \\ Y_{t-2} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \end{bmatrix} \quad (10)$$

3. Results and Discussion

As there is some inconsistency of capitalizing variables 'Exchange Rate', 'Gold', 'Silver' , 'Oil' and 'Nifty', I change all variables in this unit (when discussing tables and figures) to start with capital letters. If you want to change back to small letters, please do so.

3.1 Descriptive Statistics

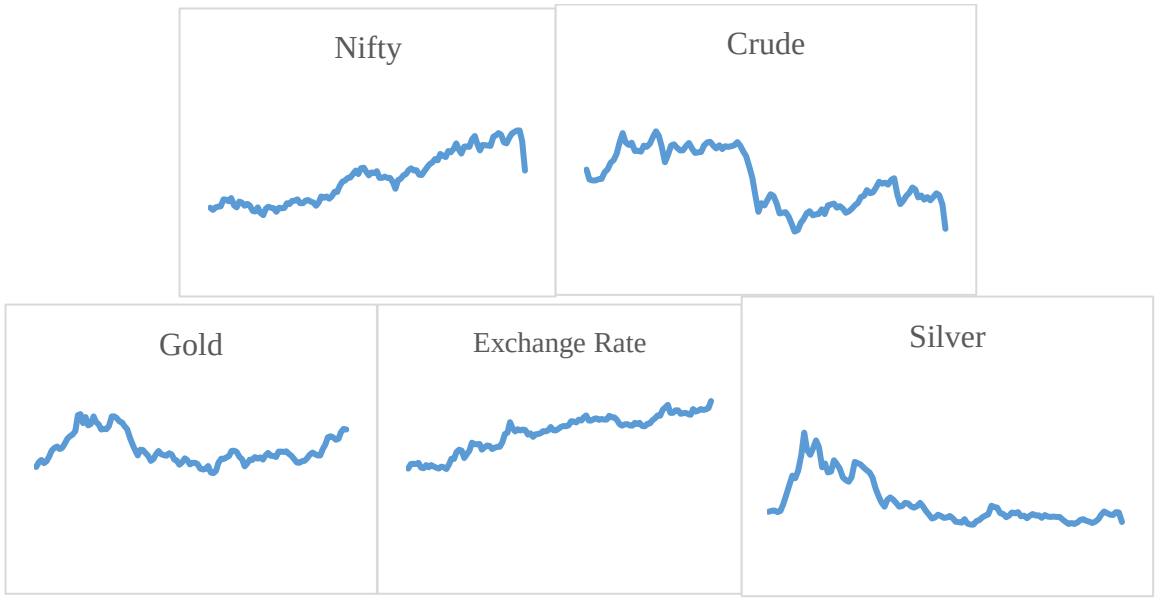
Table 1 showed the descriptive statistics of the Exchange Rate, Gold price, Nifty closing price, Silver price and Oil price. It was seen that the mean return of Gold was the highest at 11.3% which was followed by Nifty and Silver. As far as volatility is concerned, the highest standard deviation was Nifty, followed by Oil, and then Silver. It shows that volatility is highest in the Nifty, whereas Gold and the Exchange Rate are least volatile. Figure 1 explains the return series of all variables for the whole period.

Table 1: Descriptive Statistics

Variables	EXC	GOL	NIF	SIL	OIL
Mean	4.098	11.3021	8.9392	8.4862	8.3656
Median	4.1523	11.3184	8.9811	8.4447	8.3742
Maximum	4.3228	11.681	9.4067	8.9334	8.8432
Minimum	3.7844	10.8418	8.4391	8.0755	7.6029
Std. Dev.	0.1504	0.1503	0.2871	0.1977	0.2782
Skewness	-0.7981	-0.5132	0.0209	0.5047	-0.3274
Kurtosis	2.4221	4.0188	1.6299	2.4961	2.4446
Jarque-Bera	14.4087	10.4569	9.3943	6.3637	3.686

Source: Author's Calculation

Figure 1: Daily Stock Prices of Variables



Source: Author's Calculation

3.2 Unit Root Test Results

The results of the ADF and PP test for a unit root for selected stock markets are presented in Table 2. Table 2 showed that all the series values are insignificant at the 5% level, so the null hypothesis that the series has a unit root problem was accepted, so it can be concluded that the series were non-stationary. It shows that all series are significant at the 5% level at the first difference, suggesting that the null hypothesis that the series has a unit root problem was rejected, which means the series are now stationary.

Table 2: ADF and PP Unit Root Test Estimation

Panel A: **ADF Test**

	Level		First Difference	
	Trend	**Trend & Intercept**	**Trend**	**Trend & Intercept**
Crude oil	-1.8166	-2.3766	-6.6224*	-6.7113*
	(0.3709)	(0.3898)	(0.0000)	(0.0000)
Exchange	-1.1488	-2.6046	-11.138*	-11.077*
	(0.6946)	(0.2792)	(0.0000)	(0.0000)
Gold	-0.8045	-1.3408	-9.2378*	-9.213*
	(0.8139)	(0.8728)	(0.0000)	(0.0000)
Nifty	-1.327	-2.3783	-7.3354*	-7.3030*
	(0.6154)	(0.3889)	(0.0000)	(0.0000)
Silver	-2.1375	-3.0046	-9.1265*	-9.1644*
	0.230(	(0.1354)	(0.0000)	(0.0000)
Test critical values at 1% level	-3.48655	-4.03767	-3.48655	-4.03767
Test critical values at 5% level	-2.88607	-3.44835	-2.88607	-3.44835
Test critical values at 10% level	-2.57993	-3.14933	-2.57993	-3.14933

Panel B: **PP Test**

	Level		First Difference	
	Trend	**Trend & Intercept**	**Trend**	**Trend & Intercept**
Crude oil	-1.5065	-1.9267	-6.1861*	-6.1875*
	(0.527)	(0.6344)	(0.000)	(0.000)
Exchange	-1.0826	-2.6131	-11.1779*	-11.111*
	(0.7211)	(0.2754)	(0.000)	(0.000)
Gold	-0.9218	-1.5435	-9.201*	- 9.1724*
	(0.7783)	(0.809)	(0.000)	(0.000)
Nifty	-1.3529	-2.2292	-7.061*	-7.1183*
	(0.603)	(0.4689)	(0.000)	(0.000)
Test critical values at 1% level	-3.48655	-4.03767	-3.48655	-4.03767
Test critical values at 5% level	-2.88607	-3.44835	-2.88607	-3.44835
Test critical values at 10% level	-2.57993	-3.14933	-2.57993	-3.14933

Note: *series is stationary at 1 %.
Source: Author's Calculation

3.3 Correlation Results

Table 3 showed a correlation among all the variables under study.

Table 3: Correlation Estimation Results

	NIFTY	**GOLD**	**EXCHANGE**	**SILVER**	**CRUDE_OIL**
NIFTY	1.0000	0.5133	0.8189	-0.5221	-0.3481
GOLD	0.5133	1.0000	0.6314	0.2411	0.1032
EXCHANGE	0.8189	0.6314	1.0000	-0.4807	-0.2579
SILVER	-0.5221	0.2411	-0.4807	1.0000	0.5327
CRUDE_OIL	-0.3481	0.1032	-0.2579	0.5327	1.0000

Source: Author's Calculation

Nifty is highly and positively correlated with the Exchange Rate (.6314), followed by a negative correlation with Silver and, thereafter, Gold. It was found that Nifty had the least negative correlation with Crude Oil.

3.4 Correlation Results

Table 4 demonstrates the long-run relationship between variables. The results indicated that there was a significant negative relationship between the Exchange Rate and the Stock Market at a 1% significance level, so the null hypothesis of no relationship was rejected. In the case of Gold (Model 1), there was an insignificant negative relationship between Gold and the Stock Market at the 5% significance level. The results of Silver, as shown by Model 2, were in line with those of Gold, which means there was an insignificant negative relationship between Silver and the Indian Stock Market. Model 3 represents the results of Crude Oil. The relationship between Crude Oil and the Stock Market was positive but not significant, so the null hypothesis is accepted.

Table 4: Long Run Relationship Estimation of ARDL (1,1) selected as per AIC

Panel A: Model I (Long Run Coefficients)				
Case 3: Unrestricted Constant and No Trend		**Dependent Variable: NIFTY**		
Variable	**Coefficient**	**Std.Error**	**t-Statistic**	**P-value**
LEXR	-1.2110	0.1586	-7.6348	0.0000
LGOLD	-0.0395	0.0331	-1.1894	0.2368
C	0.5636	0.3177	1.7741	0.0787
R-squared	0.9811		1.6249	
Log likelihood	216.54	F stat p-value	0.0000	
Panel B: Model II (Long Run Coefficients)				
Case 3: Unrestricted Constant and No Trend		**Dependent Variable: NIFTY**		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**p-value**
LEXR	-1.2402	0.1566	-7.9182	0.000
LSILVER	-0.0212	0.0228	-0.9338	0.3524
C	0.4629	0.2930	1.5799	0.1169
R-squared	0.9810	D W stat	1.6163	
Log likelihood	216.26	F stat p-Value	0.0000	
Panel C: Model III (Long- Run Coefficients)				
Case 3: Unrestricted Constant and No Trend		**Dependent Variable: NIFTY**		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**p-value**
LEXR	-1.2601	0.1547	-8.1432	0.0000
LCOIL	0.0283	0.0142	1.9943	0.0485
C	-0.1163	0.2000	-0.5813	0.5622
R-squared	0.9815	DW Stat	1.6588	1.6588
Log likelihood	217.85	F stat p-Value	0.0000	

Source: Author's Calculation

So, long run coefficients showed that only the Exchange Rate has a significant negative relationship with the Stock Market, while other variables like Gold, Silver and Crude Oil had an insignificant relationship implying that they had no long-run impact on the Stock Market.

All three models were a good fit, as the value of R-Square is (0.98) approximately, which means about 98 percent of the variations of the dependent variable (Nifty) were explained by the model and the rest was error. F-Statistics P value was 0.000, which showed that the model was significant. As a result, the whole model was a good fit. As far as the Durbin Watson test is concerned, all models had a value of (1.6) approximately, which means they were not spurious. The values of DW statistics range from 1.5 to 2.5, so the value of 1.6 depicts that there is no auto-correlation.

Table 5 demonstrates the short-run relationship between variables. Results indicated that there was a significant negative relationship between Exchange Rate and Stock Market at a 1% significance level, so the null hypothesis of no relationship was

rejected. In the case of Gold (Model 1), there was a insignificant negative relationship between Gold and Stock Market at a 5% significance level. The results of Silver, as shown by Model 2, were in line with those of Gold which means there was an insignificant negative relationship between Silver and the Indian Stock Market. Model 3 represents the results of Crude Oil. Crude Oil had a significant positive relationship with the Stock Market.

Table 5: Short Run Relationship Estimation of ARDL (1,1) selected as per AIC

Panel A: Short Run Error Correction-Model I				
Case 3: Unrestricted Constant and No Trend		**Dependent Variable: NIFTY**		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-value**
C	0.5636	0.2982	1.8904	0.0612
□LEXR	-1.2110	0.1547	-7.8272	0.0000
□LGOLD	-0.0395	0.0256	-1.5460	0.1249
ECT(e_{t-1})	-0.1240	0.0230	-2.3495	0.0205
R-squared	0.4035	DW Stat	1.6249	
Log likelihood	216.54	F stat P-value	0.0000	
Panel B: Short Run Error Correction-Model II				
Case 3: Unrestricted Constant and No Trend		**Dependent Variable: NIFTY**		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-value**
C	0.4629	0.2510	1.8444	0.0677
□LEXR	-1.2402	0.1537	-8.0706	0.0000
□LSILVER	-0.0212	0.0214	-0.9909	0.3238
ECT(e_{t-1})	-0.1288	0.0231	-2.5480	0.0122
R-squared	0.4007	DW Stat	1.6163	
Log likelihood	216.26	F stat P-value	0.0000	
Panel C: Short Run Error Correction-Model III				
Case 3: Unrestricted Constant and No Trend		**Dependent** Variable: NIFTY		
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**P-value**
C	-0.1163	0.1504	-0.7730	0.4411
□LEXC	-1.2601	0.1527	-8.2514	0.0000
□LCOIL	0.0283	0.0137	2.0679	0.0409
ECT(e_{t-1})	-0.1180	0.0236	-1.6121	0.0197
R-squared	0.4164	DW stat	1.6588	
Log likelihood	217.85	F stat P-value	0.0000	

Source: Author's Calculation

So, short run coefficients represented that Exchange Rate and Crude Oil had a significant negative impact on the Stock Market, and other variables like Gold and Silver had an insignificant relationship, which means these did not have any impact on the Stock Market in the short run. The error correction term ECT (e_{t-1}), at one month lag time period, had a significant negative relationship with stock prices. All three models were a good fit, as the value of R-Square is (0.98) approximately, which means about 98 percent of the variations of the dependent variable (Nifty) were explained by the model and the rest was error. F- Statistics P value was 0.000, which showed that the model was significant. As a result, the whole model was good fit. As far as the Durbin Watson test is concerned, all models had a value (1.6) approximately, which means they were not spurious. The values of DW statistics range from 1.5 to 2.5, so the value of 1.6 depicts that there is no auto-correlation.

3.5 Variance Decomposition Estimates

The results of the variance decomposition estimates are shown in Table 6. It displays that the variance decomposition of Nifty in period 2 shows that about 58.58%

of the variation of Nifty is on its own, after which the exchange rate has an influence on Nifty with 27.94%, Crude Oil affects Nifty up to 12.71%, then Nifty fluctuations are due to Gold at a very less 0.75% and lastly Silver has an impact of 0.152% on Nifty variations. The variance decomposition of Nifty in period 4 has small variations, about 57.25% of the variation of Nifty ison its own; after that Crude Oil has an influence on Nifty with 20.94%, exchange rate affects Nifty up to 20%; then Nifty fluctuations due to Gold are very small at 1.66%, and lastly, Silver has an impact of 0.145% on Nifty variations. So, it was observed that, as compared to day two, on day four, the foremost influence on the Nifty was Crude Oil, which was followed by the Exchange Rate, whereas on day 2, the Exchange Rate was affecting the stock returns dominantly. Impulse response analysis is shown in Figure 2. The Exchange Rate and Crude Oil have a positive influence on Nikkei shocks, whereas Gold has a negative influence on the Nikkei. There is an insignificant influence of Silver on Nifty.

Table 6: Variance Decomposition Results

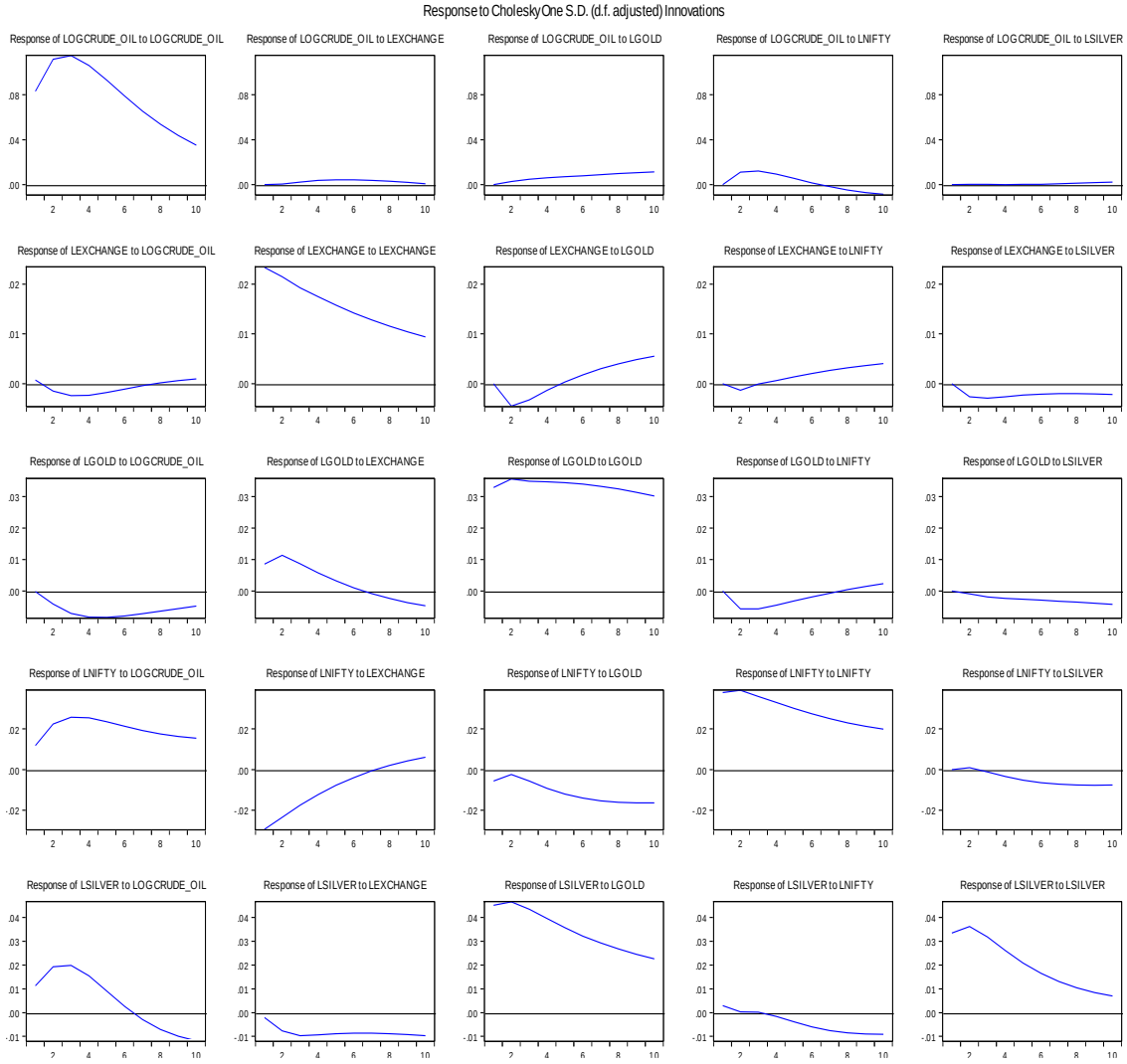
Variance Decomposition of CRUDEOIL						
Crude Oil	Period	CRUDE_OIL	LEXCHANGE	LGOLD	LNIFTY	LSILVER
	2	99.3113	0.0013	0.0427	0.6445	0.0003
	4	98.9871	0.0439	0.1557	0.8130	0.0002
	6	98.9366	0.0949	0.3053	0.6627	0.0004
	8	98.7132	0.1205	0.5356	0.6273	0.0034
	10	98.2303	0.1212	0.8602	0.7737	0.0146
Variance Decomposition of Exchange Rate						
Exchange Rate	2	0.2626	96.9727	1.9343	0.1716	0.6590
	4	0.7985	95.9624	1.8522	0.1254	1.2616
	6	0.8256	95.7731	1.6055	0.3644	1.4314
	8	0.7220	94.3824	2.3585	0.9846	1.5525
	10	0.6945	91.6873	3.9874	1.9185	1.7123
Variance Decomposition of GOLD						
Gold	2	0.66842	7.77549	90.26506	1.25642	0.03462
	4	2.61118	5.83876	89.75576	1.60043	0.19387
	6	3.49951	4.10553	90.79472	1.26683	0.33341
	8	3.63896	3.24317	91.64137	0.98740	0.48911
	10	3.48025	2.99675	91.96220	0.88139	0.67942
Variance Decomposition of NIFTY						
Nifty	2	12.7093	27.9451	0.7502	58.5802	0.0152
	4	20.9350	20.0081	1.6616	57.2499	0.1453
	6	23.7037	15.5660	3.9731	56.1032	0.6539
	8	24.3690	13.0481	6.6427	54.6668	1.2734
	10	24.3748	11.7895	9.0042	53.0233	1.8082
Variance Decomposition of SILVER						
Silver	2	6.8988	0.8805	58.3969	0.1207	33.7031
	4	8.5748	1.8643	58.2131	0.0856	31.2622
	6	7.3879	2.4178	60.5493	0.3790	29.2661
	8	6.8359	2.9572	61.8440	1.0284	27.3345
	10	7.3945	3.5782	61.7932	1.7463	25.4878

Source: Author' Calculations

4. Conclusion and Implications

The objective of the present study is to see the relationship between the Indian stock market, exchange rates and commodities such as crude oil, gold and silver. The data was collected over a period of five years from 1st January 2017 to 31st December 2021. The proxy used to represent the Indian stock market is Nifty. The models used for the analysis purpose were the ARDL and VAR models. It was seen that the mean return of gold was the highest, which was followed by nifty and silver. As far as volatility is concerned, the highest standard deviation was nifty, followed by oil and then silver. It shows that volatility is highest in the nifty whereas gold and the exchange rate are least volatile. Nifty is highly correlated with the exchange rate, followed by a negative correlation with silver and, finally, gold. It was found that nifty had the least negative correlation with crude oil. Both long- run coefficients and short- run coefficients represented that the exchange rate and crude oil have a significant negative relationship with the stock market while other variables like gold and silver had an insignificant relationship, which means these did not have any impact on the stock market in the long run (Salisu & Isah ,2017*)*.

Figure 2: Impulse Response Analysis



Source: Author' Calculations

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