“Dynamic relationship between equity, bond, commodity, forex and foreign institutional investments: Evidence from India”

AUTHORS	Rajeev Matha Geetha E. Satish Kumar Raghavendra

ARTICLE INFO	Rajeev Matha, Geetha E., Satish Kumar and Raghavendra (2022). Dynamic relationship between equity, bond, commodity, forex and foreign institutional investments: Evidence from India. *Investment Management and Financial Innovations*, *19*(4), 65-82. doi:10.21511/imfi.19(4).2022.06
DOI	http://dx.doi.org/10.21511/imfi.19(4).2022.06
RELEASED ON	Thursday, 20 October 2022
RECEIVED ON	Thursday, 16 June 2022
ACCEPTED ON	Tuesday, 11 October 2022

JOURNAL	"Investment Management and Financial Innovations"
ISSN PRINT	1810-4967
ISSN ONLINE	1812-9358
PUBLISHER	LLC “Consulting Publishing Company “Business Perspectives”
FOUNDER	LLC “Consulting Publishing Company “Business Perspectives”

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
54	0	8

BUSINESS PERSPECTIVES

LLC "CPC "Business Perspectives"
Hryhorii Skovoroda lane, 10,
Sumy, 40022, Ukraine

www.businessperspectives.org

Rajeev Matha (India), **Geetha E.** (India), **Satish Kumar** (India), **Raghavendra** (India)

DYNAMIC RELATIONSHIP BETWEEN EQUITY, BOND, COMMODITY, FOREX AND FOREIGN INSTITUTIONAL INVESTMENTS: EVIDENCE FROM INDIA

Abstract

The interrelationship between equity, bond, commodity and forex movements can provide investors with abundant trading opportunities regardless of whether one market is trending upward or downward. Hence, to understand the interlinkage between markets, this study examines the long-run and causal linkage between forex, G-sec bonds, oil prices, gold rates, foreign institutional investment (FII) flows, and equity market and sectoral index returns. Daily time-series data from August 2012 to August 2021 were considered for empirical analysis. Johansen's cointegration test revealed that foreign exchanges like USD, Euro, GBP and Yen, oil and gold rates, G-bond returns and FII flows were significantly cointegrated with the stock market and sectoral indices in the long run. Further, Granger causality found a uni-directional relationship between forex rates (i.e., USD, Euro, Yen) and the market, as well as sectoral indices, except Nifty 50 and Nifty IT indices. Oil price movements were found to effectively predict future price changes of Nifty consumer durables, auto, IT indices. Gold prices are useful to predict Nifty-Auto, Bank, Financial Services, Oil & Gas and PSU. The study also found a bi-directional relationship from FII inflows to the stock market and sectoral indices. The findings suggest that forex rates, oil prices and FII flows significantly affect India's stock market and sectoral performance. The study contributes to the existing literature by comprehensively examining the interlinkage between commodities such as oil and gold, foreign exchanges like USD, Euro, GBP and Yen, G-bond, FII flows and the stock market, and fourteen sectoral indices in the Indian context.

Keywords stock, bond, commodity, forex, FII, Granger causality, financial instruments

JEL Classification C53, E37 G17, G12, G15

Received on: 16th of June, 2022
Accepted on: 11th of October, 2022
Published on: 20th of October, 2022

Rajeev Matha, Research Scholar, Department of Commerce, Manipal Academy of Higher Education, India.

Geetha E., Associate Professor, Department of Commerce, Manipal Academy of Higher Education, India. (Corresponding author)

Satish Kumar, Associate Professor, Department of Commerce, Manipal Academy of Higher Education, India.

Raghavendra, Professor and Associate Dean, VIT-AP School of Business, VIT-AP University, India.

Conflict of interest statement:
Author(s) reported no conflict of interest

INTRODUCTION

The sustained rise in the interdependence of commodity, bond, forex and equity markets accelerated the financialization process and witnessed increased volatility (Parab & Reddy, 2020). A volatile capital market has large implications for financial and economic stability. The interdependence between the market and economies plays a pivotal role in pricing securities in the market. The most traded commodities such as oil and gold, foreign exchanges like USD, euro, GBP and Yen, bond rates and foreign institutional inflows and outflows, and equity markets are intercorrelated. Therefore, price changes in one market can trigger price fluctuations in other markets. It is necessary to understand the long-run and causal relationship between the popular macro-economic indicators in the short run and long run, because economic indicators have been considered risk factors that significantly influence the financial market. The direction of causality between

commodity, bond, forex and equity markets would provide insights to the investors, portfolio managers and policymakers for portfolio diversification and strategic decision-making (Arfaoui & Rejeb, 2017; Parsva & Tang, 2017).

The existing body of literature has evidenced uni-directional or bidirectional linkages either between forex and stock prices (Farooq & Keung, 2004; Akram, 2009; Ingalhalli et al., 2016; Arvind, 2017; Parsva & Tang, 2017; Singh & Sharma, 2018) or oil and stock returns (Beckmann & Czudaj, 2013; Aydogan et al., 2017) or FII and stock returns (Chandra, 2012; Dhingra et al., 2016; Arora, 2016; Agarwal, 2016; Parab & Reddy, 2020). However, no studies comprehensively explore the interlinkage between forex, commodities, G-bonds, FIIs and equity markets. Additionally, the findings on the interlinkage between markets have been subject to intensive debate in the scientific community due to inconclusive results. For example, the study by Tudor and Dutaa (2012) found a uni-directional relationship, while studies by Akram (2009), Arvind (2017), and Parsva and Tang (2017) found bi-directional relationships and Farooq and Keung (2004) found no causal interlinkage between the variables. Furthermore, a considerable amount of literature has widely examined the interlinkage between the forex, commodities, G-bonds, FIIs and equity markets; however, limited attention has been paid to analyzing the correlation with equity markets sectoral indices such as Nifty-Auto, Nifty-Bank, Nifty – FMCG and macro-economic indicators from the Indian capital market context (Siddiqui & Azad, 2012; Parab & Reddy, 2020).

This paper attempts to address the following questions: Is there a long-run relationship between commodities such as oil and gold, foreign exchanges like USD, euro, GBP and Yen, G bond returns and foreign institutional inflows and outflows, and equity markets? Is there a casual and lead-lag relationship between commodities such as oil and gold, foreign exchanges like USD, euro, GBP and Yen, G bond returns and foreign institutional inflows and outflows, and the equity market? Considering the above questions, the prospective study is designed to investigate the long-term and causal relationship between forex, gold, oil, FII flows, Nifty 50, and other sectoral indices. In order to verify the stationarity of the data, the study employed the Augmented Dickey-Fuller Test (ADF), the Johansen cointegration test to examine the long-run relationship among variables, and the Granger causality test to examine the causal relationship between variables. This paper contributes to the body of literature by providing evidence on the causal and long-term relationship between forex, commodity, gold and equity markets in the Indian capital market, which will help investors in formulating investment strategies and policymakers in devising regulatory policies related to the market.

1. LITERATURE REVIEW

The studies on the degree of interdependency and co-movements between markets have captured the attention of researchers. The arbitrage pricing theory proposed by Ross (1976) argues that macroeconomic indicators significantly affect the performance of the stock market. Similarly, 'Portfolio balance approach' proposed by Frankel and Rodriguez (1975) established the interlinkage between the markets. The theory argues that a dynamic stock market attracts a large pool of foreign investment to the market and increases the demand for the domestic currency (Aravind, 2017, p. 2). Subsequently, market hypotheses such as Frenkel's asset market hypothesis and 'Goods and market approach' (Dornbusch & Fischer, 1980) also explain the association between forex and stock markets. Furthermore, Friedman (1988) explained the relationship between stock market performance and money supply. Stable market conditions and the economy attract foreign investments to the market. Thus, foreign institutional investment (FII) is one of the key indicators for understanding equity return movements (Chandra, 2012). The most traded commodities, such as oil and gold, and government bonds can become good portfolio diversifiers by channelising funds during market crashes (Arafoui & Rejeb, 2017).

In recent years, global markets have been vulnerable to unforeseen financial crises, including unexpected equity and foreign exchange price oscillations. The relationship between stock market return, price movements, and forex price variations

http://dx.doi.org/10.21511/imfi.19(4).2022.06

has been widely explored (Patel, 2017). Aravind (2017) analyzed the effect of volatility in Forex rates of the Indian rupee with other major global currencies like US Dollar, Euro, Japanese Yen, and GBP on the stock price and return volatility in the Indian stock market using the granger causality test. The study exhibited a weak causal relationship between the exchange rate of USD, EUR and JPY to stock returns but a positive relationship with GBP. It concluded that an increase in the exchange rate of GBP causes an increase in the stock return; in contrast, any variations in other exchange rates of currencies will not influence stock returns significantly. Tudor and Dutaa (2012) examined the causal relationship between equity returns and thirteen countries' exchange rates. They found a significant bi-directional relationship only in South Korea and the uni-directional impact of the exchange rate on returns in other countries. Parsva and Tang (2017) examined the causal association between equity prices and forex rates of middle east economies. The study established the bi-directional causality between equity prices and exchange rates in middle east economies such as Iran, Oman, Saudi Arabia, and non-causality in Kuwait. At the same time, Farooq and Keung (2004) claimed the non-stationarity and non-cointegration among the exchange rate and stock prices, as contrary to other studies. It is also argued that uni-directional causality from stock price to exchange rates are possible only in the short run; it could not exist in the long term. Akram (2009) concluded that exchange rates and interest rates are negatively correlated with commodity prices; Commodity prices tend to increase when interest rates and foreign exchange rates are low (Mitra & Bhattacharjee, 2015; Bataineh, 2022). Adjasi et al. (2008) explored the effect of exchange rates and macroeconomic variables on the stock market using EGARCH models in the Gahan stock exchange. It is evident that the movement in the exchange rate influences volatility in the stock market (Saxena & Bhaduriya, 2012).

Further studies have extended the scope of research by exploring relative market indicators such as oil prices, gold rates and government securities to the existing causal relationship of forex and stock prices. Arfaoui and Rejeb (2017) explored the interlinkage between oil, gold, forex and stock market prices. The study found that oil and stock price are negatively correlated. Nevertheless, oil price positively influences gold prices and US exchange rates; USD is negatively correlated with oil, gold, and stock prices. Ingalhalli et al. (2016) found the uni-directional relationship between oil, gold, forex, and security prices. Results exhibited that oil price effectively predicts exchange rates and gold prices. It implies that any fluctuations in oil prices cause variations in the stock prices. Exchange rates and oil prices have a substantial influence on each other. In support of this argument, the relationship between U.S. exchange rates and oil prices in major oil-importing and exporting countries through incorporating the MS-VECM model was analyzed; Results argued that the U.S. exchange rate movement has significantly influenced the oil prices (Beckmann & Czudaj, 2013; Kumar et al., 2021).

Additionally, Singh and Sharma (2018) explored the correlation between gold rates, oil prices, USD exchange rates, and Sensex in the pre-crisis and post-crisis periods using Johansen's cointegration test to verify the long-run relationship. The study revealed a significant long-term relationship between gold, oil, USD, and Sensex. The studies by Arouri et al. (2012), Aydogan et al. (2017), Alqahtani et al. (2020), and Chien et al. (2021) found that the oil rate has a significant positive impact on the equity return. In contrast, Burian and Brcak (2012) argued that the variation in oil prices has no impact on the stock market return.

Macroeconomic performance and its indicators are essential to predict the price movement in the market. The macro-economic indicators such as global crude oil rates, forex rates and gold prices are highly correlated and influence the stock, bond yields and other market-related indices. Singhal et al. (2019) explored the interrelationship between crude oil rates, gold prices, forex rates and equity returns in Mexico. International gold prices have a significant positive effect on stock prices, whereas it has no significant influence on forex rates. Oil prices were found to be more volatile than other variables and have a considerable negative impact on both equity and forex prices. This relationship exhibits an increase in oil prices, causing a decrease in both stock prices and forex rates. Diebold et al. (2009) examined the interdependency of return on stock, bonds, and gold. The relationship of variables and volatility of returns of developed compared with developing economies. The study

found that returns on bonds, stocks, and gold are not correlated and will not significantly influence each other; but have shown the patterns. Sumner et al. (2010) extended the study of Diebold et al. (2009) by incorporating the spill over-index. The study argued that gold prices might not be the best predictor for stock and bond returns. It also exerts a low spillover relationship from Gold to stock and bond. On the contrary, studies on the linkages between return on gold, stock, and U.S. bonds found a significant correlation between gold, stock and bond returns. And no correlation with other macro-economic variables (Lawrence, 2003). Studies also opined that gold investment is considered as the best portfolio diversifier and hedge option in extreme market conditions (Baur & Lucey, 2009; Yilanci et al., 2021).

Ratanapakorn and Sharma (2007) investigated the short-run and long-run relationship between equity prices and macroeconomic indicators. The research found a positive relationship between money supply, industrial production, forex, and short-term interest rates. Granger causality revealed that all the macro-economic variables cause the fluctuation in stock prices in the long run, not in the short run. Krchniva (2016) analyzed the causal relationship between economic activity and the stock market in seven countries and found a strong correlation. The study opined that the stock index could be a prominent predictor of economic activities. Diebold et al. (2009) found that returns on bonds, stocks, and gold are not correlated and will not significantly influence each other. Similarly, Sumner et al. (2010) found a weak correlation between the gold, equity and bond returns. On the contrary, studies on the linkages between return on gold, stock, and U.S. bonds found a significant correlation between gold, stock and bond returns. And no correlation with other macro-economic variables (Lawrence, 2003). Furthermore, Kolluri et al. (2015) explored cointegration between the Indian stock and bond market and other major foreign equity markets. Stock and bond market returns were cointegrated in the Indian and the other five foreign stock markets. In the Indian context, the association between bond and equity market is less explored along with other macro-economic variables. Therefore, the current study hypothesis as follows:

External factors like foreign institutional investments (FII) play a significant role in determining the stock prices and returns in the stock market. If the market condition is stable, it attracts a massive amount of funds in the form of foreign investments. Chandra (2012) explored the relationship between FII and stock returns. Granger causality test established a bi-directional relationship between foreign institutional investments and returns and observed variations in return on stocks, and foreign investments cause changes to each other. Dhingra et al. (2016) also found a significant positive correlation between the FII flow and equity returns. Arora (2016) studied the impact of equity flows of FII and Domestic institutional investment (DII) on future stock returns. DII substantially influences future stock returns, whereas FII negatively correlates with stock returns (Goyal 2013; Vohra, 2016). Agarwal (2016) investigated the influence of FII inflow in IPOs on financial market development. The study argued that FII has a significant positive impact on the growth of the stock market. Hence, any increase in the inflow of FII to the IPOs significantly increases the stock market return. Murthy and Singh (2013) attempted to determine the impact of FII and DII on stock returns. Researchers argued that DII flows significantly influence equity market return more than FII flows (Parab & Reddy, 2020).

H_1: *Forex return does not Granger cause NIFTY 50 equity market and NIFTY Financial services, FMCG, Auto, Metal, Consumer durables, Oil and gas, IT, Media, Private Banks, PSU, Pharma, and Reality sectoral returns.*

H_2: *Oil rate does not Granger cause NIFTY 50 equity market and NIFTY Financial services, FMCG, Auto, Metal, Consumer durables, Oil and gas, IT, Media, Private Banks, PSU, Pharma, and Reality sectoral returns.*

H_3: *Gold rate does not Granger cause NIFTY 50 equity market and NIFTY – Financial services, FMCG, Auto, Metal, Consumer durables, Oil and gas, IT, Media, Private Banks, PSU, Pharma, and Reality sectoral returns.*

H_4: *Government bond rate does not Granger cause NIFTY 50 equity market and NIFTY – Financial services, FMCG, Auto, Metal,*

http://dx.doi.org/10.21511/imfi.19(4).2022.06

Consumer durables, Oil and gas, IT, Media, Private Banks, PSU, Pharma, and Reality sectoral returns.

H_5: *FII inflows and outflows do not Granger cause NIFTY 50 equity NIFTY – Financial services, FMCG, Auto, Metal, Consumer durables, Oil and gas, IT, Media, Private Banks, PSU, Pharma, and Reality sectoral returns.*

2. METHODS

This study examines the long-term and causal relationship between forex, gold, oil, FII flows, Nifty 50, and other sectoral indices. The study incorporated post positivism research philosophy and quantitative research technique. Daily time-series data from August 1, 2012 to August 31, 2021 have been considered for empirical analysis, which consists of 2,183 days. The analysis has included the four most traded foreign currencies, i.e., USD, Pound Sterling, euro, and Japanese Yen exchange rates. The data on forex rates and gold prices have been retrieved from the Reserve bank of India (RBI) repository. The data on crude oil spot prices were obtained from www.eia.org. The data on foreign institutional investment, i.e., FII inflows and outflows, have been obtained from the National Securities Depository Limited (NSDL) database.

Moreover, the Nifty 50 return is considered a market indicator as it represents about 66.8% of the free float market capitalization of stocks listed on NSE and is a widely accepted benchmark by portfolio managers and researchers. National stock exchange (NSE) sectoral indices return such as Nifty Financial services, Nifty FMCG, Nifty Auto, Nifty Metal, Nifty Consumer durables, Nifty oil and gas, Nifty IT, Nifty Media, Nifty Private Banks, Nifty PSU, Nifty Pharma, and Nifty Reality have been considered to understand the sectoral impact. The market and sectoral indices data were retrieved from the NSE database. The data sets were cleaned by removing duplicate or irrelevant observations. Additionally, Using Microsoft excel software, data sets were formatted to ensure the consistency of the dates for all the time series by considering Nifty 50 data as a base.

EViews 10.0 software was used to analyze the data. Initially, a natural logarithm is used to decrease the skewness in the data; the returns are calculated using the following formula:

$$R_t = \ln\left\{\frac{P_t}{P_{t-1}}\right\}\cdot 100\,, \tag{1}$$

where ln = Natural log; P_t is the price of the current period; and P_{t-1} is the price of the previous period.

Further, stationarity of the time series was verified using the Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979). The stationarity of the time series data implies that statistical properties will remain unchanged in the future. Unit root test is essential in econometrics forecasting and models. Granger-causality and Johansen cointegration tests assume the stationarity of time series data. The mathematical expression of ADF is as follows:

$$\Delta y_t = a + \beta t + \gamma y_{t-1} + \delta_1 \Delta y_{t-1} + \ldots + \delta_{p-1}\Delta y_{t-p+1} + \varepsilon_t\,, \tag{2}$$

where y_t denotes the time series to be tested; β = coefficient on a time trend; p = lag order of the autoregressive process; a = constant, ε_t = error term.

Further, the Johansen cointegration test (Johansen, 1988) was applied to examine the cointegrating vectors in the data series. It evaluates the cointegrated vectors in two forms, i.e., Trace test and the Max-Eigen test. In time series results, trace tests determine the number of linear combinations, i.e., K is equal to the K_0 value, and the hypothesis that K is more significant than K_0. It is expressed as H_0: $K = K_0$, H_1: $K > K_0$. In addition, the Granger causality test was used to examine the short-run causal relationship between forex, gold, oil, equity flow of FII, Nifty 50 and other sectoral indices. The Granger causality test evaluates the ability to predict the variable's potential to predict the future movements of the time series using prior actions of another time series data. The regression equation for the granger causality test is

$$X_t = \alpha_1 + \sum_{k=1}^{m}\beta_{1k}X_{t-k} + \sum_{k=1}^{m}\gamma_{1k}Y_{t-k} + e_{1t}\,, \tag{3}$$

$$Y_t = \alpha_2 + \sum_{k=1}^{m}\beta_{2k}Y_{t-k} + \sum_{k=1}^{m}\gamma_{2k}X_{t-k} + e_{2t}\,, \tag{4}$$

where Y_t and X_t are variables to be tested; e_{1t} and e_{2t} are error terms, t is time period, k is no of lags.

3. RESULTS

3.1. Descriptive statistics

The summary of descriptive statistics is demonstrated in Table 1. The Nifty 50, Nifty CD, Nifty Auto, Nifty Bank, Nifty FS, Nifty FMCG, Nifty IT, Nifty O&G, Nifty PH, and Nifty P Bank sectors showed positive returns with the highest mean returns for Nifty CD and Nifty IT (0.05%). While Nifty Metal, Nifty PSU, and Nifty REA sectors exhibited negative returns, with the lowest mean returns for Nifty PSU (-0.05%). Further, positive mean returns were observed for US Dollar, Euro, Japanese Yen, GBP, Gold, and Government Bonds except for oil (-0.04%). Standard deviation explained the variation from the actual mean and showed the highest deviations for FII Purchase and FII Sales with 44.26% and 42.29%, respectively. This deviation is because of high fluctuations in foreign institutional investment inflow and outflows. The skewness of the data depicts positive skewness only for USD, Euro, Yen, and gold. The kurtosis measured the flatness of the data and found that the data was too peaked. Further, the Jarque-Bera test is applied to determine the data normality, and the null hypothesis is H_0: The data are normally distributed. The results showed that the p-value of the test statistics is insignificant at a 5% significance level and thus, data is not normally distributed (H_1).

3.2. Augmented Dickey-Fuller Test (ADF)

Table 2 describes the test results of the ADF proposed by Dickey and Fuller (1979), which tests the stationarity of the time-series data. Unit root test is essential in econometrics forecasting and models. The stationarity of the time series data implies that the statistical properties such as mean and variances should be constant over time. The Granger-causality test assumes the stationarity of time series data. The unit root test has been done using the ADF test to confirm the stationarity. This test postulates null hypothesis *H_0: There is no stationarity in the data or a unit root in the data.*

Table 1. Results of descriptive statistics

Source: Authors' calculation.

	NIFTY_50	N_CD	N_AUTO	N_BANK	N_FS	N_FMCG	N_IT	N_MEDIA	N_METAL	N_O&G	N_PH	N_PSU
Mean	0.03	0.05	0.03	0.03	0.04	0.04	0.05	0.00	–0.03	0.03	0.03	–0.05
Median	0.05	0.07	0.07	0.05	0.06	0.09	0.05	0.03	–0.01	0.06	0.05	–0.05
Maximum	10.23	7.41	9.90	10.00	8.03	7.99	8.92	8.04	9.39	8.68	9.87	25.95
Minimum	–13.90	–12.04	–14.91	–18.31	–17.36	–11.20	–12.49	–17.88	–12.33	–12.44	–9.35	–14.11
Std. Dev.	1.14	1.29	1.40	1.57	1.49	1.13	1.34	1.60	1.78	1.36	1.23	2.16
Skewness	–0.91	–0.64	–0.48	–0.80	–1.00	–0.43	–0.75	–1.01	–0.25	–0.82	–0.20	0.72
Kurtosis	21.86	10.19	13.82	15.72	15.63	12.72	14.07	13.33	6.14	13.31	8.88	14.83
Jarque–bera	32669	4849	10735	14951	14859	8664	11346	10078	919	9914	3163	12912
P– value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Observations	2183	2183	2183	2183	2183	2183	2183	2183	2183	2183	2183	2183
	N_P Bank	N_REA	US_DOLLAR	EURO	J_YEN	GBP	GOLD	OIL	G _Bonds	FII_IF	FII_OF	
Mean	0.04	–0.03	0.02	0.02	0.01	0.01	0.03	–0.04	0.03	0.06	0.02	
Median	0.05	0.09	0.02	0.01	0.00	0.02	0.00	0.00	0.03	–0.23	0.00	
Maximum	10.49	8.09	4.02	4.15	4.81	3.68	12.85	49.37	2.66	238.10	219.80	
Minimum	–19.70	–12.33	–2.68	–2.65	–4.53	–6.78	–8.66	–64.37	–3.53	–242.73	–265.52	
Std. Dev.	1.58	2.11	0.47	0.59	0.74	0.63	0.90	3.15	0.31	44.26	42.29	
Skewness	–0.94	–0.49	0.36	0.34	0.26	–0.50	0.87	–1.71	–1.00	–0.17	–0.23	
Kurtosis	18.83	5.76	9.13	6.11	5.92	10.69	29.87	130.92	20.05	6.65	7.91	
Jarque–bera	23102	779	3468	920	801	5468	65954	1489571	26792	1221	2209	
P–value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Observations	2183	2183	2183	2183	2183	2183	2183	2183	2183	2183	2183	

Note: NIFTY_50 – Nifty 50 index, N_CD – Nifty consumer durable index, N_AUTO – Nifty auto index, N_BANK – Nifty bank index, N_FS – Nifty financial services index, N_FMCG – Nifty FMCG index, N_IT – Nifty I.T. index, N_MEDIA – Nifty Media index, N_METAL – Nifty metal index, N_O&G – Nifty oil & gas index, N_PH – Nifty Pharma index, N_PSU – Nifty PSU index, N_PVT Bank – Nifty Private Banks index, N_REALITY –Nifty Realty index, G _Bonds – Nifty composite G-sector bond index, FII_IF FII inflow and FII_OF FII outflow.

http://dx.doi.org/10.21511/imfi.19(4).2022.06

The null hypothesis is rejected if the ADF test values are less than the critical value at 5% (i.e., the p-value is less than 0.05). ADF-test results show that all the variables are stationary at levels. Therefore, the null hypothesis (H_0: There is no stationarity in the data) has been rejected. Hence, data is stationary for all the selected variables or does not have a unit root (H_1) by accepting the alternative hypothesis.

Table 2. Augmented Dickey-Fuller test results

Source: Authors' calculation.

Variables	t-statistic	p-value
NIFTY_50	–47.9411	0.0001*
N_CD	–43.3128	0.0000*
N_Auto	–45.2537	0.0001*
N_Bank	–44.5496	0.0000*
N_FS	–45.2947	0.0001*
N_FMCG	–46.9470	0.0001*
N_IT	–47.8779	0.0001*
N_Media	–45.2732	0.0001*
N_Metal	–46.8545	0.0001*
N_O&G	–30.8682	0.0000*
N_Pharma	–43.1399	0.0000*
N_PSU	–45.1130	0.0001*
N_PB	–44.2425	0.0001*
N_Reality	–43.0907	0.0000*
USD	–46.7669	0.0001*
Euro	–46.9642	0.0001*
YEN	–44.6104	0.0001*
GBP	–44.1241	0.0001*
Gold	–45.0562	0.0001*
Oil	–52.4445	0.0001*
G _Bonds	–47.0592	0.0001*
FII Inflow	–21.9471	0.0000*
FII Outflow	–22.0827	0.0000*

Note: * denotes statistically significant at 5% (0.05).

3.3. Johansen cointegration analysis

Johansen's cointegration test exhibits the long-run relationship between variables. This test is proposed by Johansen (1988); it examines the cointegrating vectors in the data series. Johansen cointegration test examines the cointegrated vectors in two forms, i.e., Trace test and the Max-Eigen test. In time series results, trace tests determine the number of linear combinations, i.e., K is equal to the K_0 value, and the hypothesis that K is more significant than K_0. It is expressed as H_0: $K = K_0$, H_1: $K > K_0$.

Table 3 shows the Trace and Max-Eigen values of all the dependent variables with the associated critical values. Forex rates, oil prices, gold rates, G-sec bond returns, FII purchases and sales are considered as independent variables in the test analysis. The null hypothesis (H_0: No cointegration between the variables) has been tested at the critical value of 5%. The long-run relationship among variables is proved only when the Trace and Max-Eigen values are higher than the respective critical values. The trace's critical value at 5% is 239.2354, and Max-Eigen is 64.5047. Hence, Johansen cointegration test result values of Trace and Max-Eigen are consistently higher than their respective critical values. Therefore, the alternative hypothesis is accepted (H_1: There is cointegration between the variables.). At a 5% significance level, at least ten cointegrating pairs among the variables are visible in the Johansen cointegration test results. Two or more cointegrated pairs in the time series are verified and exhibit bi-directional or uni-directional relationships in the Granger causality test.

Table 3. Results of Johansen's cointegration test

Source: Authors' own calculation.

Variables	Trace*	Max-Eigen**
NIFTY_50	2361.77	435.26
N_CD	2376.74	434.20
N_Auto	2369.57	443.92
N_Bank	2382.38	436.22
N_FS	2392.54	436.28
N_FMCG	2391.53	434.10
N_IT	2352.91	432.25
N_Media	2338.77	435.55
N_Metal	2341.01	433.91
N_O&G	2351.75	433.28
N_Pharma	2370.36	443.47
N_PSU	2359.14	429.32
N_PB	2377.81	440.36
N_Reality	2365.27	427.22

Note: * Critical value at 5% is 239.2354 (Trace); ** critical value at 5% is 64.5047 (Max-Eigen).

3.4. Granger causality test

The Granger causality test evaluates the ability to predict the variable's potential to predict the future movements of the time series using prior actions of another time series data. It is essential to understand the usefulness of the time-series data to predict another time series' movement. The null hypothesis (H_0: There is no causality between variables) was tested to study the causal relationship of forex rates (H_1), oil (H_2), gold (H_3), G-sec bonds (H_4), FII inflows and FII outflows (H_5) with market performance indica-

tor Nifty 50 index returns as well as sectoral performance indicators such as Nifty Auto, Nifty Financial Services, Nifty FMCG, Nifty IT, Nifty Media, Nifty Metal, Nifty Consumer durables, Nifty Oil and gas, Nifty Pharma, Nifty Pvt. Banks, Nifty PSU, and Nifty Reality.

If the p-value of the Granger Causality Test is less than 5%, the null hypothesis is rejected. Alternatively, the paired granger causality test outcomes alternated between bi-directional, uni-directional and no causality. As a pre-requisite to the granger causality test, the stationarity of the variables was verified using the Augmented Dickey-Fuller (ADF). At a 5% significance level, the Johansen cointegration test results illustrate at least ten cointegrating pairs among the variables. These cointegrated pairs verify the fact that there must be either bi-directional or uni-directional Granger causality between them if two or more time series are cointegrated.

Table 4 shows the results of hypothesis testing. The p-value for the relationship between the forex rates such as USD (H_{1a}), Euro (H_{1b}), Yen (H_{1c}) and equity market as well as sectoral indices were less than 0.05 at a 5% level of significance. Hence, the null hypothesis is rejected. Alternatively, the granger causality test establishes a uni-directional relationship between forex rates (i.e., USD, Euro, Yen) and the market as well as sectoral indices except Nifty 50 and Nifty IT. Indices. Further, GBP (H_{1d}) has shown bi-directional, uni-directional and no causality. Firstly, the test results found a uni-directional relationship between GBP and NSE sectoral indices such as Nifty- Consumer durables, Pharma, PSU, and Pvt. Bank indices. Secondly, no causality with Nifty 50, Nifty-Auto, IT and Media. Lastly, a bi-directional relationship implies that future movements of GBP can be predicted by Nifty-Bank, FMCG, Financial services, Metal, Oil & Gas and Reality sectoral indices movements.

Furthermore, the p-value for the relationship between oil prices (H_2) and the equity market and sectoral indices was less than 0.05 at a 5% significance level. On the other hand, Granger causality test results found that oil price movements were found to be efficient in predicting the future price changes of Nifty- consumer durables, auto, and IT indices. In addition, the uni-directional relationship of oil with Nifty-50, Bank, Financial services, Metal, Oil & Gas, Pvt. Bank suggests that future prices can be forecasted by each other. The test results exhibited the bi-directional relationship between gold (H_3) and equity sectoral indices like Nifty-Auto, Bank, Financial services, Oil & Gas and PSU. Hence, gold prices are useful to predict Nifty-Auto, Bank, Financial Services, Oil & Gas and PSU. On the contrary, test results found no causal relationship with the Nifty 50 and the remaining sectoral indices. Similarly, G-sec bond index returns (H_4) are significant for forecasting the price movements of Nifty 50, Nifty-Auto, Bank, Financial services, FMCG, Pvt. banks and realty indices movements.

The test results exhibited a bi-directional relationship of FII inflows (H_{5a}) with all the markets and sectoral indices except Nifty – Media & Pharma. It implies that FII inflows significantly forecast the indices' future price movements. On the other hand, Foreign institutional investment outflows (H_{5b}) are meaningful to forecast the movements of all the market and sectoral indices except Nifty- Bank, financial services and PSU.

The complete results of the Granger causality test are presented in Appendix A, Table A1.

Table 4. Summary of hypothesis testing results

Source: Authors' calculation.

Hypothesis 1a	p-value	Decision	Hypothesis 1b	p-value	Decision	Hypothesis 1c	p-value	Decision
USD → N_50	0.287	Not supported	Euro → N_50	0.346	Not supported	Yen → N_50	0.725	Not supported
USD → N_CD	0.000*	Supported	Euro → N_CD	0.000*	Supported	Yen → N_CD	0.000*	Supported
USD → N_Auto	0.000*	Supported	Euro → N_Auto	0.000*	Supported	Yen → N_Auto	0.000*	Supported
USD → N_Bank	0.000*	Supported	Euro → N_Bank	0.001*	Supported	Yen → N_Bank	0.000*	Supported
USD → N_FS	0.000*	Supported	Euro → N_FS	0.000*	Supported	Yen → N_FS	0.000*	Supported
USD → N_FMCG	0.000*	Supported	Euro → N_FMCG	0.001*	Supported	Yen → N_FMCG	0.000*	Supported
USD → N_IT	0.249	Not supported	Euro → N_IT	0.531	Not supported	Yen → N_IT	0.018*	Supported
USD → N_Media	0.000*	Supported	Euro → N_Media	0.020*	Supported	Yen → N_Media	0.000*	Supported

http://dx.doi.org/10.21511/imfi.19(4).2022.06

Table 4 (cont.). Summary of hypothesis testing results

Hypothesis 1a	p-value	Decision	Hypothesis 1b	p-value	Decision	Hypothesis 1c	p-value	Decision
USD → N_Metal	0.000*	Supported	Euro → N_Metal	0.003*	Supported	Yen → N_Metal	0.000*	Supported
USD → N_O&G	0.000*	Supported	Euro → N_O&G	0.000*	Supported	Yen → N_O&G	0.000*	Supported
USD → N_Pharma	0.001*	Supported	Euro → N_Pharma	0.007*	Supported	Yen → N_Pharma	0.000*	Supported
USD → N_PSU	0.000*	Supported	Euro → N_PSU	0.000*	Supported	Yen → N_PSU	0.000*	Supported
USD → N_Pvt. Bank	0.000*	Supported	Euro → N_Pvt. Bank	0.002*	Supported	Yen → N_Pvt. Bank	0.000*	Supported
USD → N_Reality	0.000*	Supported	Euro → N_Reality	0.003*	Supported	Yen → N_Reality	0.013*	Supported
Hypothesis 1d	**p-value**	**Decision**	**Hypothesis 2**	**p-value**	**Decision**	**Hypothesis 3**	**p-value**	**Decision**
GBP → N_50	0.098	Not supported	Oil → N_50	0.002*	Supported	Gold → N_50	0.233	Not supported
GBP → N_CD	0.037*	Supported	Oil → N_CD	0.004*	Supported	Gold → N_CD	0.499	Not supported
GBP → N_Auto	0.473	Not supported	Oil → N_Auto	0.000*	Supported	Gold → N_Auto	0.007*	Supported
GBP → N_Bank	0.126	Not supported	Oil → N_Bank	0.002*	Supported	Gold → N_Bank	0.039*	Supported
GBP → N_FS	0.074	Not supported	Oil → N_FS	0.002*	Supported	Gold → N_FS	0.018*	Supported
GBP → N_FMCG	0.146	Not supported	Oil → N_FMCG	0.365	Not supported	Gold → N_FMCG	0.273	Not supported
GBP → N_IT	0.298	Not supported	Oil → N_IT	0.000*	Supported	Gold → N_IT	0.582	Not supported
GBP → N_Media	0.424	Not supported	Oil → N_Media	0.188	Not supported	Gold → N_Media	0.085	Not supported
GBP → N_Metal	0.64	Not supported	Oil → N_Metal	0.000*	Supported	Gold → N_Metal	0.546	Not supported
GBP → N_O&G	0.105	Not supported	Oil → N_O&G	0.017*	Supported	Gold → N_O&G	0.034*	Supported
GBP → N_Pharma	0.027*	Supported	Oil → N_Pharma	0.033*	Supported	Gold → N_Pharma	0.408	Not supported
GBP → N_PSU	0.025*	Supported	Oil → N_PSU	0.691	Not supported	Gold → N_PSU	0.040*	Supported
GBP → N_Pvt. Bank	0.193	Not supported	Oil → N_Pvt. Bank	0.001*	Supported	Gold → N_Pvt. Bank	0.052	Not supported
GBP → N_Reality	0.063	Not supported	Oil → N_Reality	0.056	Not supported	Gold → N_Reality	0.432	Not supported
Hypothesis 4	**p-value**	**Decision**	**Hypothesis 5a**	**p-value**	**Decision**	**Hypothesis 5b**	**p-value**	**Decision**
Gvt. Bond → N_50	0.001*	Supported	FII IF → N_50	0.291	Not supported	FII OF → N_50	0.225	Not supported
Gvt. Bond → N_CD	0.589	Not supported	FII IF → N_CD	0.56	Not supported	FII OF → N_CD	0.374	Not supported
Gvt. Bond → N_Auto	0.633	Not supported	FII IF → N_Auto	0.23	Not supported	FII OF → N_Auto	0.627	Not supported
Gvt. Bond → N_Bank	0.192	Not supported	FII IF → N_Bank	0.387	Not supported	FII OF → N_Bank	0.782	Not supported
Gvt. Bond → N_FS	0.202	Not supported	FII IF → N_FS	0.29	Not supported	FII OF → N_FS	0.631	Not supported
Gvt. Bond → N_FMCG	0.087	Not supported	FII IF → N_FMCG	0.217	Not supported	FII OF → N_FMCG	0.047*	Supported
Gvt. Bond → N_IT	0.019*	Supported	FII IF → N_IT	0.769	Not supported	FII OF → N_IT	0.643	Not supported
Gvt. Bond → N_Media	0.667	Not supported	FII IF → N_Media	0.237	Not supported	FII OF → N_Media	0.549	Not supported
Gvt. Bond → N_Metal	0.41	Not supported	FII IF → N_Metal	0.487	Not supported	FII OF → N_Metal	0.712	Not supported
Gvt. Bond → N_O&G	0.114	Not supported	FII IF → N_O&G	0.929	Not supported	FII OF → N_O&G	0.898	Not supported
Gvt. Bond → N_Pharma	0.311	Not supported	FII IF → N_Pharma	0.596	Not supported	FII OF → N_Pharma	0.484	Not supported
Gvt. Bond → N_PSU	0.156	Not supported	FII IF → N_PSU	0.784	Not supported	FII OF → N_PSU	0.953	Not supported
Gvt. Bond → N_Pvt. Bank	0.282	Not supported	FII IF → N_Pvt. Bank	0.426	Not supported	FII OF → N_Pvt. Bank	0.842	Not supported
Gvt. Bond → N_Reality	0.702	Not supported	FII IF → N_Reality	0.289	Not supported	FII OF → N_Reality	0.615	Not supported

Note: NIFTY_50 – Nifty 50 index, N_CD – Nifty consumer durable index, N_AUTO – Nifty auto index, N_BANK – Nifty bank index, N_FS – Nifty financial services index, N_FMCG – Nifty FMCG index, N_IT – Nifty I.T. index, N_MEDIA – Nifty Media index, N_METAL – Nifty metal index, N_O&G – Nifty oil & gas index, N_PH – Nifty Pharma index, N_PSU – Nifty PSU index, N_PVT Bank – Nifty Private Banks index, N_REALITY – Nifty Realty index, G _Bonds – Nifty composite G-sector bond index, FII_IF FII inflow and FII_OF FII outflow.

4. DISCUSSION

The study primarily examined the long-run relationship between forex, gold, oil, FII flows, G bond rates, Nifty 50 and other sectoral indices using the Johansen cointegration test. This test revealed that macro-economic indicators, commodities such as oil and gold, foreign exchanges like USD, euro, GBP and Yen, G bond index returns and FII inflows and outflows were significantly cointegrated with the stock market and sectoral indices in the long run. At a 5% significance level, at least ten cointegrating pairs among the variables are visible in the Johansen cointegration test results. Two or more cointegrated pairs in the time series are verified and exhibit bi-directional or uni-directional relationships in the Granger causality test. The findings contradict Alagidede et al. (2011), who argued that there is no long-run rela-

tionship between exchange rates and stock returns in Australia, Canada, Japan, Switzerland, and the UK. The results of Ratanapakorn and Sharma (2007) argued that long-term cointegration exists between macro-economic variables and stock returns in the US market; the current study supports this argument in the Indian context. Therefore, the findings suggest that macro-economic indicators like forex, gold, Oil, FII flows, and G bond returns play a pivotal role in stock market performance in the long run.

Further, the study also examined the causal relationship between forex, gold, oil, FII flows, Nifty 50, and other sectoral indices using the Granger causality test. The study found a uni-directional relationship between forex rates (i.e., USD, Euro, Yen) and the market as well as sectoral indices except Nifty 50 and Nifty IT Indices. These findings are consistent with the works of Farooq and Keung (2004), Tudor and Dutaa (2012), Saxena and Bhaduriya (2012), Lakshmanasamy (2021), who found a uni-directional relationship between exchange rates and stock returns. The study also found a bi-directional relationship between GBP and Nifty-Bank, FMCG, Financial services, Metal, Oil & Gas and Reality sectoral indices movements. These findings are partially consistent with the results of Adjasi et al. (2008) and Aravind (2017) in the bi-directional relationship between GBP and stock returns and contradict in the uni-directional relationship between USD, Euro, Yen and stock market performance in India (Aravind, 2017). In accordance with the present results of a bidirectional relationship between forex (GBP) and the equity market, previous studies have demonstrated bi-directional causality forex rates to stock price movements in South Korea (Tudor & Dutaa, 2012), Iran, Oman, and Saudi Arabia (Parsva & Tang, 2017). Therefore, the significant relationship between forex and equity markets helps policymakers and investors to predict the market and sectoral performance based on forex rate movements.

Oil price movements were found to be efficient in predicting the future price changes of Nifty – consumer durables, auto, & IT indices. In addition, the uni-directional relationship of oil with Nifty-50, Bank, Financial services, Metal, Oil & Gas, Pvt. Bank suggests that future prices can be forecasted by each other. Uni-directional relationship between Nifty 50 returns and oil supported the results of (Arouri et al., 2012; Ingalhalli et al., 2016; Aydogan et al., 2017; Singh & Sharma, 2018). The bi-directional relationship has been noticed between Gold and other sectoral indices. Gold prices are useful to predict Nifty-Auto, Bank, Financial Services, Oil & Gas and PSU. The results are not supported by Diebold et al. (2009) and Sumner et al. (2010) and argued that gold prices might not be the best predictor for stock returns. G-sec bond index returns, and Nifty-IT index can be predicted by each other. It is also significant to forecast the price movements of Nifty 50, Nifty-Auto, Bank, Financial Services, FMCG, and Pvt. Banks and realty indices movements. Results of Lawrence (2002), Diebold et al. (2009), Sumner et al. (2010), and Kolluri et al. (2015) agreed that a bi-directional causality relationship was found between bond and stock returns.

Further, the study found a bi-directional relationship from FII inflows to the stock market and sectoral indices except for Nifty – Media & Pharma. On the other hand, FII outflows are meaningful to forecast the movements of all the market and sectoral indices except Nifty – Bank, financial services and PSU. These results align with those of previous studies by Chandra (2012), Murthy and Singh (2013), Goyal (2013), Vohra (2016), Dhingra et al. (2016), Arora (2016), Agarwal (2016), and Parab and Reddy (2020). Hence, financial indicators such as foreign institutional investment inflows and outflows are significant predictors for the equity market and sectoral indices price movement. This implies that FII inflows significantly forecast the indices' future price movements.

CONCLUSION

This paper examined the long-run and causal relationship between commodities such as oil and gold, foreign exchanges like USD, euro, GBP and Yen, G bond returns and FII inflows and outflows, and the equity market sectoral indices. Johansen's cointegration test revealed that macro-economic indicators commodities such as oil and gold, foreign exchanges like USD, euro, GBP and Yen, G bond index returns and FII inflows and outflows were significantly cointegrated with the stock market and sectoral

http://dx.doi.org/10.21511/imfi.19(4).2022.06

indices in the long run. Taken together, these results suggest that economic indicators such as oil and gold rates, forex rates, and financial indicators like G bond index returns and FII flow are intercorrelated and crucial in predicting the stock market and sectoral performance in the long term. The current findings highlight the importance of the long-run relationship between the variables. Hence, this study provides insights for regulatory bodies, policymakers and investors in long-term investment decisions.

Further, the Granger causality test establishes a uni-directional relationship between forex rates (i.e., USD, Euro, Yen) and the market as well as sectoral indices. Additionally, the study found a uni-directional relationship between GBP and NSE sectoral indices such as Nifty – Consumer durables, Pharma, PSU, Pvt. Bank indices, and a bi-directional relationship from GBP to Nifty-Bank, FMCG, Financial services, Metal, Oil & Gas and Reality sectoral indices movements. Taken together, these results suggest that forex rates significantly impact the stock market performance. Currency crises may adversely impact the stock market and sectoral prices. Therefore, regulatory bodies and policymakers could timely implement the policies as a preventive measure, emphasizing transparent pricing by preventing price volatility.

The current study revealed that commodities such as oil price movements were found to be efficient in predicting future price changes of stock markets and sectors, as oil is considered a key input material in industrial production. Regulatory bodies could moderate prices through fiscal and monetary policy amendments to prevent adverse price volatility. The study also found that FII inflow is meaningful in forecasting the movements of all the market and sectoral indices. Hence, FII inflows and outflows are significant predictors for the equity market and sectoral indices price movement, which is considered a significant financial indicator by institutional and retail investors for their investment decisions. Therefore, policymakers should regulate foreign capital flows and prevent imbalances through credible investment policies.

Investors may use the findings to forecast the expected returns from a given investment avenue explored in the study. The result of the study will be helpful for retail investors and financial institutions to understand the causal relationship between various macroeconomic variables, market indicators and sectoral performance indicators. This paper has contributed to the body of literature in terms of understanding the combined effect of variables on the stock market and is beneficial to analyze the inter-relation between forex, commodity, gold and capital markets. This study also provides insights on the influence of macro-economic variables such as forex rates, gold, oil, and foreign institutional investments on the Nifty 50 market indicator and other relative sectoral indices.

The current studt analyzed the relationship between forex, oil prices, gold rates, G-sec bonds, FII purchases and FII sales on the market and sectoral indices. However, the Consumer Price Index (CPI), Wholesale price index (WPI), GDP and other macro-economic variables can be explored along with the existing independent variables. Future research can be expanded by considering the companies listed in the Nifty 50 or Sensex indices. In addition, cross-country comparative studies can be undertaken to enhance the generalizability of the results.

AUTHOR CONTRIBUTIONS

Conceptualization: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.
Data curation: Rajeev Matha, Raghavendra.
Formal analysis: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.
Funding acquisition: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.
Investigation: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.
Methodology: Rajeev Matha, Satish Kumar, Raghavendra.
Project administration: Geetha E., Satish Kumar, Raghavendra.

Resources: Rajeev Matha, Geetha E.
Software: Rajeev Matha.
Supervision: Geetha E., Satish Kumar, Raghavendra.
Validation: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.
Visualization: Geetha E.
Writing – original draft: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.
Writing – review & editing: Rajeev Matha, Geetha E., Satish Kumar, Raghavendra.

REFERENCES

1. Adjasi, C., Harvey, S., & Agyapong, D. (2008). Effect of exchange rate volatility on the ghana stock exchange. *African Journal of Accounting, Economics, Finance and Banking Research, 3*(3), 28-47. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1534178
2. Agarwal, B. (2016). FII Inflows into Indian IPOs and its Impact on the Indian Stock Market. *Emerging Economy Studies, 2*(1), 129-144. https://doi.org/10.1177/2394901515627739
3. Akram, Q. F. (2009). Commodity prices, interest rates and the dollar. *Energy Economics, 31*(6), 838-851. https://doi.org/10.1016/j.eneco.2009.05.016
4. Alagidede, P., Panagiotidis, T., & Zhang, X. (2011). Causal relationship between stock prices and exchange rates. *The Journal of International Trade & Economic Development, 20*(1), 67-86. https://doi.org/10.1080/09638199.2011.538186
5. Alqahtani, A., Lahiani, A., & Salem, A. (2020). Crude oil and GCC stock markets. *International Journal of Energy Sector Management, 14*(4), 745-756. https://doi.org/10.1108/ijesm-06-2019-0013
6. Aravind, M. (2017). FX Volatility Impact on Indian Stock Market: An Empirical Investigation. *Vision: The Journal of Business Perspective, 21*(3), 284-294. https://doi.org/10.1177/0972262917716760
7. Arfaoui, M., & Ben Rejeb, A. (2017). Oil, gold, US dollar and stock market interdependencies: a global analytical insight. *European Journal of Management and Business Economics, 26*(3), 278-293. https://doi.org/10.1108/ejmbe-10-2017-016
8. Arora, R. K. (2016). The Relation between Investment of Domestic and Foreign Institutional Investors and Stock Returns in India. *Global Business Review, 17*(3), 654-664. https://doi.org/10.1177/0972150916630830
9. Arouri, M. E. H., Jouini, J., & Nguyen, D. K. (2012). On the impacts of oil price fluctuations on European equity markets: Volatility spillover and hedging effectiveness. *Energy Economics, 34*(2), 611-617. https://doi.org/10.1016/j.eneco.2011.08.009
10. Aydogan, B., Tunc, G., & Yelkenci, T. (2017). The impact of oil price volatility on net-oil exporter and importer countries' stock markets. *Eurasian Economic Review, 7*(2), 231-253. https://doi.org/10.1007/s40822-017-0065-1
11. Bagchi, B., Dandapat, D., & Chatterjee, S. (2016). Dynamic Linkages and Volatility Spillover. In *Effects of Oil Prices on Exchange Rates, and Stock Markets of Emerging Economies*. Emerald insight. https://doi.org/10.1108/9781786355539
12. Bampinas, G., & Panagiotidis, T. (2015). On the relationship between oil and gold before and after financial crisis: linear, nonlinear and time-varying causality testing. *Studies in Nonlinear Dynamics & Econometrics, 19*(5), 657-668. https://doi.org/10.1515/snde-2014-0060
13. Basher, S. A., & Sadorsky, P. (2006). Oil price risk and emerging stock markets. *Global Finance Journal, 17*(2), 224-251. https://doi.org/10.1016/j.gfj.2006.04.001
14. Beckmann, J., Czudaj, R., & Pilbeam, K. (2015). Causality and volatility patterns between gold prices and exchange rates. *The North American Journal of Economics and Finance, 34,* 292-300. https://doi.org/10.1016/j.najef.2015.09.015
15. Burian S., & Brcak, J. (2012). Granger Causality within Monetarist Transmission in the Czech Republic. *International Advances in Economic Research, 19*(1), 69-70. https://doi.org/10.1007/s11294-012-9388-6
16. Chandra, A. (2012). Cause and effect between FII trading behaviour and stock market returns. *Journal of Indian Business Research, 4*(4), 286-300. https://doi.org/10.1108/17554191211274794
17. Chien, F., Sadiq, M., Kamran, H. W., Nawaz, M. A., Hussain, M. S., & Raza, M. (2021a). Co-movement of energy prices and stock market return: environmental wavelet nexus of COVID-19 pandemic from the USA, Europe, and China. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-021-12938-2
18. Dhingra, V. S., Gandhi, S., & Bulsara, H. P. (2016). Foreign institutional investments in India: An empirical analysis of dynamic interactions with stock market return and volatility. *IIMB Management Review, 28*(4), 212-224. https://doi.org/10.1016/j.iimb.2016.10.001
19. Dickey, D. A., & Fuller, W. A. (1979). Distribution of the

http://dx.doi.org/10.21511/imfi.19(4).2022.06

Estimators for Autoregressive Time Series with a Unit Root. *Journal of the American Statistical Association, 74*(366), 427. https://doi.org/10.2307/2286348

20. Diebold, F. X., & Yilmaz, K. (2008). Measuring Financial Asset Return and Volatility Spillovers, with Application to Global Equity Markets. *The Economic Journal, 119*(534), 158-171. https://doi.org/10.1111/j.1468-0297.2008.02208.x

21. Dornbush, R., & Fischer, S. (2000). Exchange Rates and the Current Account. *The International Economy, 70*(5), 322-344. https://doi.org/10.1017/cbo9780511818233.015

22. Farooq, M., Keung, W., & Kazmi, A. (2004). The Pakistan Development Review. *Pakistan Institute of Development Economics, Islamabad, 43*(4), 639-649.

23. Frenkel, J., & Rodriguez, C. (1975). Portfolio Equilibrium and the Balance of Payments: A Monetary Approach. *The American Economic Review, 65*(4), 674-688.

24. Friedman, M. (1988). Money and the Stock Market. *Journal of Political Economy, 96*(2), 221-245. Retrieved from https://www.jstor.org/stable/1833107

25. Gilmore, C. G., McManus, G. M., Sharma, R., & Tezel, A. (2009). The Dynamics of Gold Prices, Gold Mining Stock Prices and Stock Market Prices Comovements. *Research in Applied Economics, 1*(1). https://doi.org/10.5296/rae.v1i1.301

26. He, X., Takiguchi, T., Nakajima, T., & Hamori, S. (2020). Spillover effects between energies, gold, and stock: the United States versus China. *Energy & Environment, 31*(8), 1416-1447. https://doi.org/10.1177/0958305x20907081

27. Ingalhalli, V., G., P. B., & Reddy, Y. V. (2016). A Study on Dynamic Relationship Between Oil, Gold, Forex and Stock Markets in Indian Context. *Paradigm, 20*(1), 83-91. https://doi.org/10.1177/0971890716637706

28. Jain, A., & Biswal, P. C. (2016). Dynamic linkages among oil price, gold price, exchange rate, and stock market in India. *Resources Policy, 49,* 179-185. https://doi.org/10.1016/j.resourpol.2016.06.001

29. Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2-3), 231-254. https://doi.org/10.1016/0165-1889(88)90041-3

30. Kamran, A., Israr, S., & Ahsan Rizvi, S. (2014). Determinants of gold prices in Pakistan. *Lecture Notes in Electrical Engineering, 2,* 1219-1227. https://doi.org/10.1007/978-3-642-40081-0_103

31. Kolluri, B., Wahab, S., & Wahab, M. (2015). An examination of co-movements of India's stock and government bond markets. *Journal of Asian Economics, 41,* 39-56. https://doi.org/10.1016/j.asieco.2015.10.001

32. Krchniva, K. (2016). Do Stock Markets Have Any Impact on Real Economic Activity? *Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 64*(1), 283-290. https://doi.org/10.11118/actaun201664010283

33. Kumar, M. (2013). Returns and volatility spillover between stock prices and exchange rates. *International Journal of Emerging Markets, 8*(2), 108-128. https://doi.org/10.1108/17468801311306984

34. Lakshmanasamy, T. (2021). Relationship Between Exchange Rate and Stock Market Volatilities in India. *International Journal of Finance Research, 2*(4), 244-259. https://doi.org/10.47747/ijfr.v2i4.443

35. Lawrence, C. (2003). *Why is gold different from other assets? An empirical investigation*. The World Gold Council. Retrieved from http://www.spdrgoldshares.com/media/GLD/file/colin_lawrence_report.pdf

36. Mitra, A., & Bhattacharjee, K. (2015c). Financial Interdependence of International Stock Markets: A Literature Review. *Indian Journal of Finance, 9*(5), 20. https://doi.org/10.17010/ijf/2015/v9i5/71447

37. Murthy, K. V. B., & Singh, A. K. (2013). Do Foreign Institutional Investors Really Drive the Indian Stock Market? *Asia-Pacific Journal of Management Research and Innovation, 9*(1), 45-53. https://doi.org/10.1177/2319510x13483510

38. Panda, B., & Leepsa, N. M. (2019). Does institutional ownership engagement matter for greater financial performance? Evidence from a developing market. *International Journal of Law and Management, 61*(2), 359-383. https://doi.org/10.1108/ijlma-09-2017-0228

39. Parab, N., & Reddy, Y. V. (2020). A cause and effect relationship between FIIs, DIIs and stock market returns in India: pre- and post-demonetisation analysis. *Future Business Journal, 6*(1). https://doi.org/10.1186/s43093-020-00029-6

40. Paramati, S. R., & Gupta, R. (2013). An Empirical Analysis of Stock Market Performance and Economic Growth: Evidence from India. *International Research Journal of Finance and Economics, 73,* 144-160. https://doi.org/10.2139/ssrn.2335996

41. Parsva, P., & Tang, C. F. (2017). A note on the interaction between stock prices and exchange rates in Middle East economies. *Economic Research-Ekonomska Istraživanja, 30*(1), 836-844. https://doi.org/10.1080/1331677x.2017.1311222

42. Patel, R. J. (2017a). Co-Movement and Integration Among Stock Markets : A Study of 14 Countries. *Indian Journal of Finance, 11*(9), 53. https://doi.org/10.17010/ijf/2017/v11i9/118089

43. Ratanapakorn, O., & Sharma, S. C. (2007). Dynamic analysis between the US stock returns and the macroeconomic variables. *Applied Financial Economics, 17*(5), 369-377. https://doi.org/10.1080/09603100600638944

44. Ross, S. A. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory, 13*(3), 341-360. https://doi.org/10.1016/0022-0531(76)90046-6

45. Saxena, S. P., & Bhadauriya, S. (2012). Causal Analysis of Oil

Prices and Macroeconomic Performance: Evidence from India. *Asia-Pacific Journal of Management Research and Innovation, 8*(4), 451-459. https://doi.org/10.1177/2319510x13481904

46. Shalit, H., & Yitzhaki, S. (1984). Mean-Gini, Portfolio Theory, and the Pricing of Risky Assets. *The Journal of Finance, 39*(5), 1449-1468. https://doi.org/10.1111/j.1540-6261.1984.tb04917.x

47. Siddiqui, A. A., & Azad, N. A. (2012). Foreign Institutional Investment Flows and Indian Financial Market: Relationship and Way Forward. Vision: *The Journal of Business Perspective, 16*(3), 175-185. https://doi.org/10.1177/0972262912460154

48. Singh, N. P., & Sharma, S. (2018). Cointegration and Causality among Dollar, Oil, Gold and Sensex across Global Financial Crisis. *Vision: The Journal of Business Perspective, 22*(4), 365-376. https://doi.org/10.1177/0972262918804336

49. Singhal, S., Choudhary, S., & Biswal, P. C. (2019). Return and volatility linkages among international crude oil price, gold price, exchange rate and stock markets: Evidence from Mexico. *Resources Policy, 60,* 255-261. https://doi.org/10.1016/j.resourpol.2019.01.004

50. Sumner, S. W., Johnson, R., & Soenen, L. (2010). Spillover Effects Among Gold, Stocks, and Bonds. *Journal of CENTRUM Cathedra: The Business and Economics Research Journal, 3*(2), 106-120. https://doi.org/10.7835/jcc-berj-2010-0041

51. Tudor, C., & Popescu-Dutaa, C. (2012). On the Causal Relationship between Stock Returns and Exchange Rates Changes for 13 Developed and Emerging Markets. *Procedia – Social and Behavioral Sciences, 57,* 275-282. https://doi.org/10.1016/j.sbspro.2012.09.1186

52. Vohra, P. S. (2016). A Study of Co-Movement Among Indices of Bombay Stock Exchange. *Indian Journal of Finance, 10*(9), 11. https://doi.org/10.17010/ijf/2016/v10i9/101476

53. Yilanci, V., Ozgur, O., & Gorus, M. S. (2021). Stock prices and economic activity nexus in OECD countries: new evidence from an asymmetric panel Granger causality test in the frequency domain. *Financial Innovation, 7*(1). https://doi.org/10.1186/s40854-020-00221-1

54. You-How, G., Lai-Kwan, C., Yoke-Chin, K., & Chooi-Yi, W. (2017). Information Spillover Between Crude Oil and Stock Markets: Evidence from Subsidy Cut for RON95 Fuel Price in Malaysia. *Global Business Review, 19*(4), 889-901. https://doi.org/10.1177/0972150917731409

http://dx.doi.org/10.21511/imfi.19(4).2022.06

APPENDIX A

Table A1. Granger causality test results of NIFTY-50, NIFTY – Consumer Durables, IT, Media indices

NIFTY-50			NIFTY – Consumer Durables			NIFTY – IT			NIFTY – Media		
Null Hypothesis	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**
USD(X); N_50(Y)	1.242	0.287	USD(X); N_CD(Y)	20.109	0.000*	USD(X); N_IT(Y)	1.39	0.249	USD(X); N_Media(Y)	10.645	0.000*
N_50(X); USD(Y)	10.644	0.000*	N_CD(X); USD(Y)	8.24	0.000*	N_IT(X); USD(Y)	7.171	0.001*	N_ Media (X); USD(Y)	13.206	0.000*
EURO(X); N_50(Y)	1.122	0.346	EURO(X); N_CD(Y)	10.591	0.000*	EURO(X); N_IT(Y)	0.633	0.531	EURO(X); N_ Media(Y)	3.904	0.020*
N_50(X); EURO(Y)	8.349	0.000*	N_CD(X); EURO(Y)	10.1	0.000*	N_IT(X); EURO(Y)	4.813	0.008*	N_ Media(X); EURO(Y)	13.462	0.000*
Yen(X); N_50(Y)	0.568	0.725	GBP(X); N_CD(Y)	3.296	0.037*	GBP(X); N_IT(Y)	1.21	0.298	GBP(X); N_ Media(Y)	0.859	0.424
N_50(X); Yen(Y)	9.215	0.000*	N_CD(X); GBP(Y)	5.189	0.006	N_IT(X); GBP(Y)	2.228	0.108	N_ Medi (X); GBP(Y)	2.51	0.082
GBP(X); N_50(Y)	1.862	0.098	Yen(X); N_CD(Y)	12.634	0.000*	Yen(X); N_IT(Y)	4.039	0.018*	Yen(X); N_ Media(Y)	12.626	0.000*
N_50(X); GBP(Y)	0.899	0.481	N_CD(X); Yen(Y)	12.55	0.000*	N_IT(X); Yen(Y)	13.033	0.000*	N_ Media(X); Yen(Y)	16.655	0.000*
GOLD(X); N_50(Y)	1.369	0.233	GOLD(X); N_CD(Y)	0.696	0.499	GOLD(X); N_IT(Y)	0.541	0.582	GOLD(X); N_ Media(Y)	2.465	0.085
N_50(X); GOLD(Y)	1.584	0.161	N_CD(X); GOLD(Y)	0.858	0.424	N_IT(X); GOLD(Y)	2.933	0.054	N_ Media (X); GOLD(Y)	0.104	0.901
OIL(X); N_50(Y)	3.944	0.002*	OIL(X); N_CD(Y)	5.573	0.004*	OIL(X); N_IT(Y)	20.07	0.000*	OIL(X); N_ Media(Y)	1.673	0.188
N_50(X); OIL(Y)	9.368	0.000*	N_CD(X); OIL(Y)	0.024	0.976	N_IT(X); OIL(Y)	1.708	0.181	N_ Media(X); OIL(Y)	1.03	0.357
G_Bonds(X); N_50(Y)	4.259	0.001*	G_Bonds (X); N_CD(Y)	0.53	0.589	G_Bonds (X); N_IT(Y)	3.974	0.019*	G_Bonds(X); N_ Media(Y)	0.405	0.667
N_50(X); G_Bonds(Y)	1.53	0.177	N_CD(X); G_Bonds(Y)	2.987	0.051	N_IT(X); G_Bonds(Y)	3.075	0.046*	N_ Media(X); G_Bonds(Y)	1.178	0.308
FII_PU(X); N_50(Y)	1.232	0.291	FII_PU(X); N_CD(Y)	0.579	0.56	FII_PU(X); N_IT(Y)	0.263	0.769	FII_PU(X); N_ Media(Y)	1.441	0.237
N_50(X); FII_PU(Y)	11.902	0.000*	N_CD(X); FII_PU(Y)	3.426	0.033*	N_IT(X); FII_PU(Y)	3.803	0.023*	N_ Media(X); FII_PU(Y)	2.152	0.117
FII_Sales(X); N_50(Y)	1.391	0.225	FII_Sales(X); N_CD(Y)	0.984	0.374	FII_Sales(X); N_IT(Y)	0.442	0.643	FII_Sales(X); N_ Media(Y)	0.599	0.549
N_50(X); FII_Sales(Y)	2.318	0.041*	N_CD(X); FII_Sales(Y)	7.35	0.001*	N_IT(X); FII_Sales(Y)	3.53	0.030*	N_ Media (X); FII_Sales(Y)	6.259	0.002*

Table A2. Granger causality test results of NIFTY – Auto, Bank, Metal, Oil and Gas indices

NIFTY – Auto			NIFTY – Bank			NIFTY – Metal			NIFTY – Oil and Gas		
Null Hypothesiss	**F-Statistic**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**	**Null Hypothesis:**	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**
USD(X); N_Auto(Y)	16.674	0.000*	USD(X); N_Bank(Y)	17.582	0.000*	USD(X); N_Metal(Y)	17.939	0.000*	USD(X); N_O&G(Y)	20.419	0.000*
N_Auto(X); USD(Y)	16.741	0.000*	N_Bank(X); USD(Y)	23.236	0.000*	N_Metal(X); USD(Y)	12.025	0.000*	N_O&G(X); USD(Y)	21.924	0.000*
EURO(X); N_Auto(Y)	5.954	0.003*	EURO(X); N_Bank(Y)	7.443	0.001*	EURO(X); N_Metal(Y)	6.025	0.003*	EURO(X); N_O&G(Y)	12.304	0.000*
N_Auto(X); EURO(Y)	10.139	0.000*	N_Bank(X); EURO(Y)	14.064	0.000*	N_Metal(X); EURO(Y)	12.693	0.000*	N_O&G(X); EURO(Y)	11.883	0.000*
GBP(X); N_Auto(Y)	0.749	0.473	GBP(X); N_Bank(Y)	2.075	0.126	GBP(X); N_Metal(Y)	0.64	0.527	GBP(X); N_O&G(Y)	2.257	0.105
N_Auto(X); GBP(Y)	5.293	0.005	N_Bank(X); GBP(Y)	7.739	0.000*	N_Metal(X); GBP(Y)	5.682	0.004*	N_O&G(X); GBP(Y)	10.854	0.000*
Yen(X); N_Auto(Y)	17.015	0.000*	Yen(X); N_Bank(Y)	14.068	0.000*	Yen(X); N_Metal(Y)	13.914	0.000*	Yen(X); N_O&G(Y)	16.963	0.000*
N_Auto(X); Yen(Y)	19.796	0.000*	N_Bank(X); Yen(Y)	26.42	0.000*	N_Metal(X); Yen(Y)	21.402	0.000*	N_O&G(X); Yen(Y)	24.286	0.000*
GOLD(X); N_Auto(Y)	5.028	0.007*	GOLD(X); N_Bank(Y)	3.253	0.039*	GOLD(X); N_Metal(Y)	0.606	0.546	GOLD(X); N_O&G(Y)	3.401	0.034*
N_Auto(X); GOLD(Y)	1.984	0.138	N_Bank(X); GOLD(Y)	0.097	0.908	N_Metal(X); GOLD(Y)	0.31	0.733	N_O&G(X); GOLD(Y)	2.588	0.075
OIL(X); N_Auto(Y)	12.693	0.000*	OIL(X); N_Bank(Y)	6.525	0.002*	OIL(X); N_Metal(Y)	12.682	0.000*	OIL(X); N_O&G(Y)	4.077	0.017*
N_Auto(X); OIL(Y)	1.574	0.208	N_Bank(X); OIL(Y)	4.632	0.010*	N_Metal(X); OIL(Y)	4.201	0.015*	N_O&G(X); OIL(Y)	3.445	0.032*
G_Bonds (X); N_Auto(Y)	0.457	0.633	G_Bonds (X); N_Bank(Y)	1.652	0.192	G_Bonds (X); N_Metal(Y)	0.893	0.41	G_Bonds (X); N_O&G(Y)	2.171	0.114
N_Auto(X); G_Bonds(Y)	6.68	0.001*	N_Bank(X); G_Bonds(Y)	7.04	0.001*	N_Metal(X); G_Bonds(Y)	1.323	0.267	N_O&G(X); G_Bonds(Y)	4.777	0.009*
FII_PU(X); N_Auto(Y)	1.47	0.23	FII_PU(X); N_Bank(Y)	0.949	0.387	FII_PU(X); N_Metal(Y)	0.721	0.487	FII_PU(X); N_O&G(Y)	0.074	0.929
N_Auto(X); FII_PU(Y)	11.485	0.000*	N_Bank(X); FII_PU(Y)	22.943	0.000*	N_Metal(X); FII_PU(Y)	6.097	0.002*	N_O&G(X); FII_PU(Y)	8.739	0.000*
FII_Sales(X); N_Auto(Y)	0.466	0.627	FII_Sales(X); N_Bank(Y)	0.245	0.782	FII_Sales(X); N_Metal(Y)	0.34	0.712	FII_Sales(X); N_O&G(Y)	0.108	0.898
N_Auto(X); FII_Sales(Y)	4.388	0.013*	N_Bank(X); FII_Sales(Y)	1.289	0.276	N_Metal(X); FII_Sales(Y)	4.326	0.013*	N_O&G(X); FII_Sales(Y)	4.29	0.014*

http://dx.doi.org/10.21511/imfi.19(4).2022.06

Table A3. Granger causality test results of NIFTY – Financial services, FMCG, Pharma, PSU indices

NIFTY – Financial Services			NIFTY – FMCG			NIFTY – Pharma			NIFTY – PSU		
Null Hypothesis	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**
USD (X) ;N_FS(Y)	23.892	0.000*	USD(X); N_FMCG(Y)	10.497	0.000*	USD(X); N_Pharma(Y)	7.141	0.001*	USD(X); N_PSU(Y)	12.205	0.000*
N_FS(X); USD(Y)	23.864	0.000*	N_FMCG(X); USD(Y)	8.023	0.000*	N_ Pharma(X); USD(Y)	6.867	0.001*	N_PSU(X); USD(Y)	11.043	0.000*
EURO (X) ;N_FS(Y)	10.289	0.000*	EURO(X); N_FMCG(Y)	6.626	0.001*	EURO(X); N_ Pharma(Y)	4.995	0.007*	EURO(X); N_PSU(Y)	9.163	0.000*
N_FS(X); EURO(Y)	13.899	0.000*	N_FMCG (Y ; EURO(Y)	7.413	0.001*	N_ Pharma(X); EURO(Y)	7.038	0.001*	N_PSU(X); EURO(Y)	14.901	0.000*
GBP (X) ;N_FS(Y)	2.606	0.074	GBP(X); N_FMCG(Y)	1.926	0.146	GBP(X); N_ Pharma(Y)	3.633	0.027*	GBP(X); N_PSU(Y)	3.707	0.025*
N_FS(X); GBP(Y)	7.816	0.000*	N_FMCG(X); GBP(Y)	4.449	0.012*	N_ Pharma(X); GBP(Y)	3.258	0.039*	N_PSU(X); GBP(Y)	5.957	0.003*
Yen (X) ;N_FS(Y)	18.241	0.000*	Yen(X); N_FMCG(Y)	7.917	0.000*	Yen(X); N_ Pharma(Y)	9.608	0.000*	Yen(X); N_PSU(Y)	12.823	0.000*
N_FS(X); Yen(Y)	25.952	0.000*	N_FMCG(X); Yen(Y)	9.627	0.000*	N_ Pharma(X); Yen(Y)	8.112	0.000*	N_PSU(X); Yen(Y)	15.975	0.000*
GOLD (X) ;N_FS(Y)	4.008	0.018*	GOLD(X); N_FMCG(Y)	1.298	0.273	GOLD(X); N_ Pharma(Y)	0.896	0.408	GOLD(X); N_PSU(Y)	3.224	0.040*
N_FS(X); GOLD(Y)	0.017	0.983	N_FMCG(X); GOLD(Y)	2.373	0.093	N_ Pharma(X); GOLD(Y)	5.468	0.004*	N_PSU(X); GOLD(Y)	1.258	0.285
OIL (X) ;N_FS(Y)	6.177	0.002*	OIL(X); N_FMCG(Y)	1.008	0.365	OIL(X); N_ Pharma(Y)	3.415	0.033*	OIL(X); N_PSU(Y)	0.37	0.691
N_FS(X); OIL(Y)	4.351	0.013*	N_FMCG(X); OIL(Y)	2.004	0.135	N_ Pharma(X); OIL(Y)	1.227	0.293	N_PSU(X); OIL(Y)	1.239	0.29
G_Bonds (X) ;N_FS(Y)	1.601	0.202	G_Bonds (X); N_FMCG(Y)	2.448	0.087	G_Bonds (X); N_ Pharma(Y)	1.167	0.311	G_Bonds (X); N_PSU(Y)	1.861	0.156
N_FS(X); G_Bonds(Y)	6.652	0.001*	N_FMCG(X); G_Bonds(Y)	4.47	0.012*	N_ Pharma (X); G_Bonds(Y)	2.288	0.102	N_PSU(X); G_Bonds(Y)	0.758	0.469
FII_PU (X) ;N_FS(Y)	1.24	0.29	FII_PU(X); N_FMCG(Y)	1.53	0.217	FII_PU(X); N_ Pharma (Y)	0.518	0.596	FII_PU(X); N_PSU(Y)	0.243	0.784
N_FS(X); FII_PU(Y)	23.579	0.000*	N_FMCG(X); FII_PU(Y)	7.847	0.000*	N_ Pharma (X); FII_PU(Y)	0.757	0.469	N_PSU(X); FII_PU(Y)	8.486	0.000*
FII_Sales (X) ;N_FS(Y)	0.46	0.631	FII_Sales(X); N_FMCG(Y)	3.073	0.047*	FII_Sales(X); N_ Pharma (Y)	0.726	0.484	FII_Sales(X); N_PSU(Y)	0.048	0.953
N_FS(X); FII_Sales(Y)	1.728	0.178	N_FMCG(X); FII_Sales(Y)	0.8	0.45	N_ Pharma (X); FII_Sales(Y)	4.418	0.012*	N_PSU(X); FII_Sales(Y)	1.11	0.33

Table A4. Granger causality test results of NIFTY – Private banks and Reality indices

NIFTY – Private Bank			NIFTY – Reality		
Null Hypothesis	**F-Statistics**	**p-value**	**Null Hypothesis**	**F-Statistics**	**p-value**
USD(X); N_PB(Y)	16.524	0.000*	USD(X); N_ Reality(Y)	15.921	0.000*
N_PB(X); USD(Y)	22.7	0.000*	N_ Reality(X); USD(Y)	21.068	0.000*
EURO(X); N_PB(Y)	6.319	0.002*	EURO(X); N_ Reality(Y)	5.997	0.003*
N_PB(X); EURO(Y)	12.518	0.000*	N_ Reality(X); EURO(Y)	19.661	0.000*
GBP(X); N_PB(Y)	1.645	0.193	GBP(X); N_ Reality(Y)	2.773	0.063
N_PB(X); GBP(Y)	7.44	0.001*	N_ Reality(X); GBP(Y)	10.772	0.000*
Yen(X); N_PB(Y)	12.793	0.000*	Yen(X); N_ Reality(Y)	4.335	0.013*
N_PB(X); Yen(Y)	23.691	0.000*	N_ Reality(X); Yen(Y)	37.573	0.000*
GOLD(X); N_PB(Y)	2.952	0.052	GOLD(X); N_ Reality(Y)	0.84	0.432
N_PB(X); GOLD(Y)	0.211	0.81	N_ Reality(X); GOLD(Y)	3.152	0.043*
OIL(X); N_PB(Y)	7.559	0.001*	OIL(X); N_ Reality(Y)	2.894	0.056
N_PB(X); OIL(Y)	5.746	0.003*	N_ Reality(X); OIL(Y)	0.899	0.407
G_Bonds (X); N_PB(Y)	1.268	0.282	G_Bonds (X); N_ Reality(Y)	0.355	0.702
N_PB(X); G_Bonds(Y)	8.079	0.000*	N_ Reality(X); G_Bonds(Y)	3.612	0.027*
FII_PU(X); N_PB(Y)	0.854	0.426	FII_PU(X); N_ Reality(Y)	0.289	0.749
N_PB(X); FII_PU(Y)	22.573	0.000*	N_ Reality(X); FII_PU(Y)	5.581	0.004*
FII_Sales(X); N_PB(Y)	0.172	0.842	FII_Sales(X); N_ Reality(Y)	0.487	0.615
N_PB(X); FII_Sales(Y)	1.614	0.199	N_ Reality(X); FII_Sales(Y)	4.462	0.012*

Note: Null hypothesis X ≠ Y (X does not Granger cause Y); * denotes statistically significant at 5% (0.05). NIFTY_50 – Nifty 50 index, N_CD – Nifty consumer durable index, N_AUTO – Nifty auto index, N_BANK – Nifty bank index, N_FS – Nifty financial services index, N_FMCG – Nifty FMCG index, N_IT – Nifty I.T. index, N_MEDIA – Nifty Media index, N_METAL – Nifty metal index, N_O&G – Nifty oil & gas index, N_PH – Nifty Pharma index, N_PSU – Nifty PSU index, N_PVT Bank – Nifty Private Banks index, Reality – Nifty Realty index, G _Bonds – Nifty composite G-sector bond index, FII_PU FII inflow and FII_SA FII outflow.

http://dx.doi.org/10.21511/imfi.19(4).2022.06