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EXPLORING RELATIONSHIP BETWEEN NIFTY, DJIA, AND SSE INDICES WITH CO-INTEGRATION AND GRANGER CAUSALITY

Dr. Pankaj Sharma

Assistant Professor (GES-II)
Shri K. K. Shastri Government Commerce College, Khokhra Road, Ahmedabad, Gujarat - 380008.
Email: pankajsharma@gujaratuniversity.ac.in
ORCID ID: https://orcid.org/0000-0002-0848-8704

Mr. Saurabh Jain

Assistant Professor
Khyati School of Business Administration, Ahmedabad, Gujarat - 382115.
Email: jprashant1108@gmail.com
ORCID ID: https://orcid.org/0009-0009-1311-1205

Abstract

The global financial share market indices play a crucial role in the interconnected and dynamic landscape of international finance and considered as barometers of overall market health. The investors rely on these markets to gauge market sentiment, make informed investment decisions, and diversify portfolios. This study uses to explore the relationship between Nifty, DJIA, and SSE through econometric analysis. The data has been collected for a period of sixteen years for comprehensive investigation. The Yahoo Finance database served as the source of the collected data. The study uses EViews Software for application the Johansen Co-integration test, to evaluate if a long-term equilibrium connection exists between the indexes. To further examine the direction and intensity of the causal association between Nifty, DJIA, and SSE, the Granger Causality test is used. The results indicate that past values of Nifty contain valuable information for predicting future values of DJIA and SSE.

Keywords: *Relationship, Causality, Co-integration, Nifty, Dow Jones Industrial Average, SSE Composite*

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INTRODUCTION

Global share market indices play a pivotal role in the interconnected and dynamic landscape of international finance. Serving as barometers of overall market health, these indices provide crucial insights into the performance and trends of diverse sectors, economies, and regions worldwide. Investors rely on them to gauge market sentiment, make informed investment decisions, and diversify portfolios. Analysts use indices as benchmarks for assessing market efficiency, identifying potential opportunities, and predicting broader economic trends. Policymakers monitor these indices to assess the impact of economic policies and external factors on financial stability. In essence, global share market indices serve as key indicators that facilitate understanding, decision-making, and strategic planning across the intricate and interdependent network of the global financial ecosystem. In the complex tapestry of global financial markets understanding the intricate relationships between key global indices is essential for investors, analysts, researchers, and policymakers. This study focuses on the interconnected dynamic relationship between the Nifty of India, DJIA of America, and SSE of China. This study is an attempt to shed lights on the underlying dynamics that govern the interactions between these influential markets.

LITERATURE REVIEW

Milena et al. (2021) explored the interconnectedness of major stock exchange indices from leading global financial markets, such as those in the USA, Germany, and Japan. Their research focused on identifying the direction of causality between these markets and assessing how economic shocks in one market could influence others. They concluded that there is no long-term equilibrium relationship among the observed markets. However, they did identify a mutual causal relationship between the German and US capital markets, indicating a strong level of interdependence between these two.

Blahun and Blahun (2020) conducted a study to determine the influence of global stock market indices on local exchanges, specifically focusing on the Ukrainian market. They found that international stock exchanges exert a significant impact on the performance of the Ukrainian stock exchange, demonstrating the extent to which local markets are affected by global financial trends.

Dania (2022) investigated the relationship between the Amman Stock Exchange Index (ASEI) and several international indices, including the S&P 500, NASDAQ, Nikkei, DAX, CAC, and HSI. Using a combination of statistical methods such as correlation analysis, stepwise regression, and artificial neural networks, the study aimed to validate the connections between these indices. The findings indicated that there is a notable relationship between ASEI and the international indices, particularly with the S&P 500, suggesting that global market movements, especially in the US, can affect the Jordanian market.

Mayur (2017) examined the correlation between global stock markets and the Indian stock market. The study revealed that the Indian stock market tends to follow global trends, particularly when determining the market's direction for daily trading. This implies a strong influence of international market sentiment on India's stock market movements.

Fučík (2018) analyzed the relationships among various global stock market indices and observed that these indices tend to form clusters based on their geographical locations. Notably, the Hang Seng Index (Hong Kong) and CAC 40 (France) were found to be particularly influential within their respective regions, suggesting that these indices play a key role in driving market trends across neighboring countries.

Ali et al. (2023) explored the co-integration and causality between the Indian stock market and selected global markets. Their findings revealed that the Indian stock market, particularly the National Stock Exchange (NSE), is highly integrated with the US market, specifically the NASDAQ. Furthermore, increased volatility in the NSE was attributed to global contagion, highlighting the vulnerability of the Indian market to external economic events.

Lalwani and Dhaddha (2021) conducted a study examining the correlation between the Indian stock market and global stock exchanges such as the New York Stock Exchange (NYSE), NASDAQ, Shanghai Stock Exchange (SSE), and the London Stock Exchange (LSE). They found that the Indian markets have become increasingly connected with these global exchanges, reflecting the growing interdependence of financial markets in the context of globalization.

Nair (2017) focused on the relationship between the Nifty index of India's National Stock Exchange and selected Asian stock market indices. The research highlighted the existence of a relationship between the Nifty index and the performance of other Asian stock markets, suggesting that regional economic events and trends play a significant role in shaping India's market behavior. This study is particularly relevant for understanding the dynamics between the Nifty of India, the Dow Jones Industrial Average (DJIA) of the US, and the Shanghai Stock Exchange (SSE) of China in a long-term context.

These studies collectively illustrate the increasing interdependence of global financial markets. Despite the geographical separation, the influence of major stock exchanges extends far beyond their domestic economies, affecting both regional and local markets across the world.

METHODOLOGY

An analytical approach using econometrics modelling has been employed to explore the relationship between Nifty, DJIA (Dow Jones Industrial Average), and SSE Composite. The time series data for the indices has been collected for a period of 16 years ranging from 1st November, 2007 to 31st October, 2023, for a comprehensive investigation. The Yahoo Finance database served as the source of the collected data. First, the gathered data were examined using descriptive statistical methods. The staionarity of the time series has been determined using the ADF - unit root test. The research use EViews 10 Software for application of econometric methods, namely the Johansen Co-integration test, to evaluate if a long-term equilibrium connection exists between the indexes. To further examine the direction and intensity of the causal association between Nifty, DJIA, and SSE, the Granger Causality test is used.

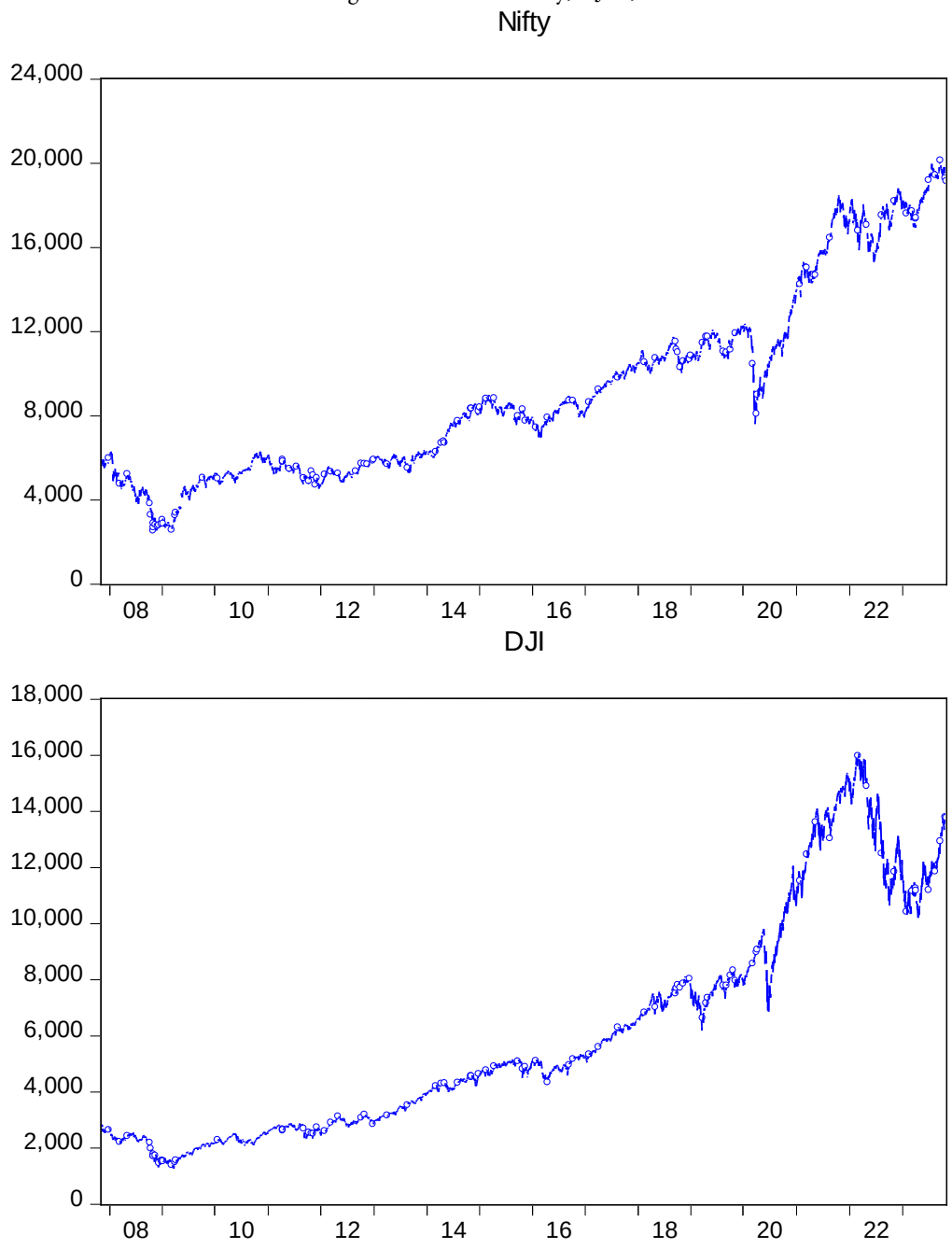
DATA ANALYSIS

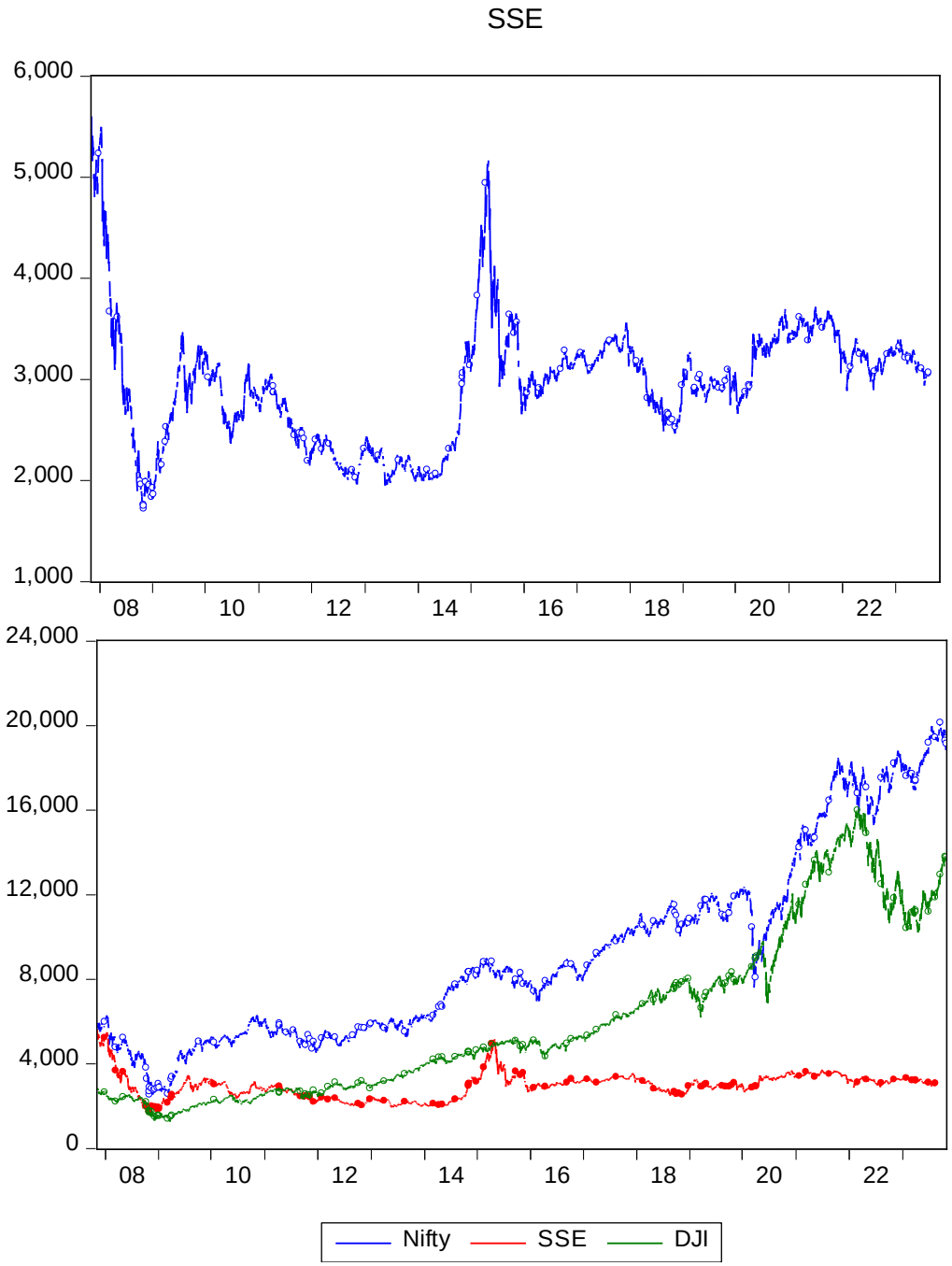
Table 1: Descriptive Statistics of Time Series

	NIFTY	SSE	DJIA
Mean	9204.047	2949.813	6055.499
Median	8213.800	2998.328	4871.760
Maximum	20192.35	5601.783	16057.44
Minimum	2524.200	1706.703	1268.640

Std. Dev.	4454.058	594.1052	3882.260
Skewness	0.814834	0.762897	0.883376
Kurtosis	2.616099	5.085867	2.641212
Jarque-Bera	457.7392	1084.206	534.7835
Probability	0.000000	0.000000	0.000000
Sum	36070661	11492473	23913164
Sum Sq. Dev.	7.77E+10	1.37E+09	5.95E+10
Observations	3919	3896	3949

Chart 1: Charts of Original Time Series Nifty, DJIA, and SSE Time Series



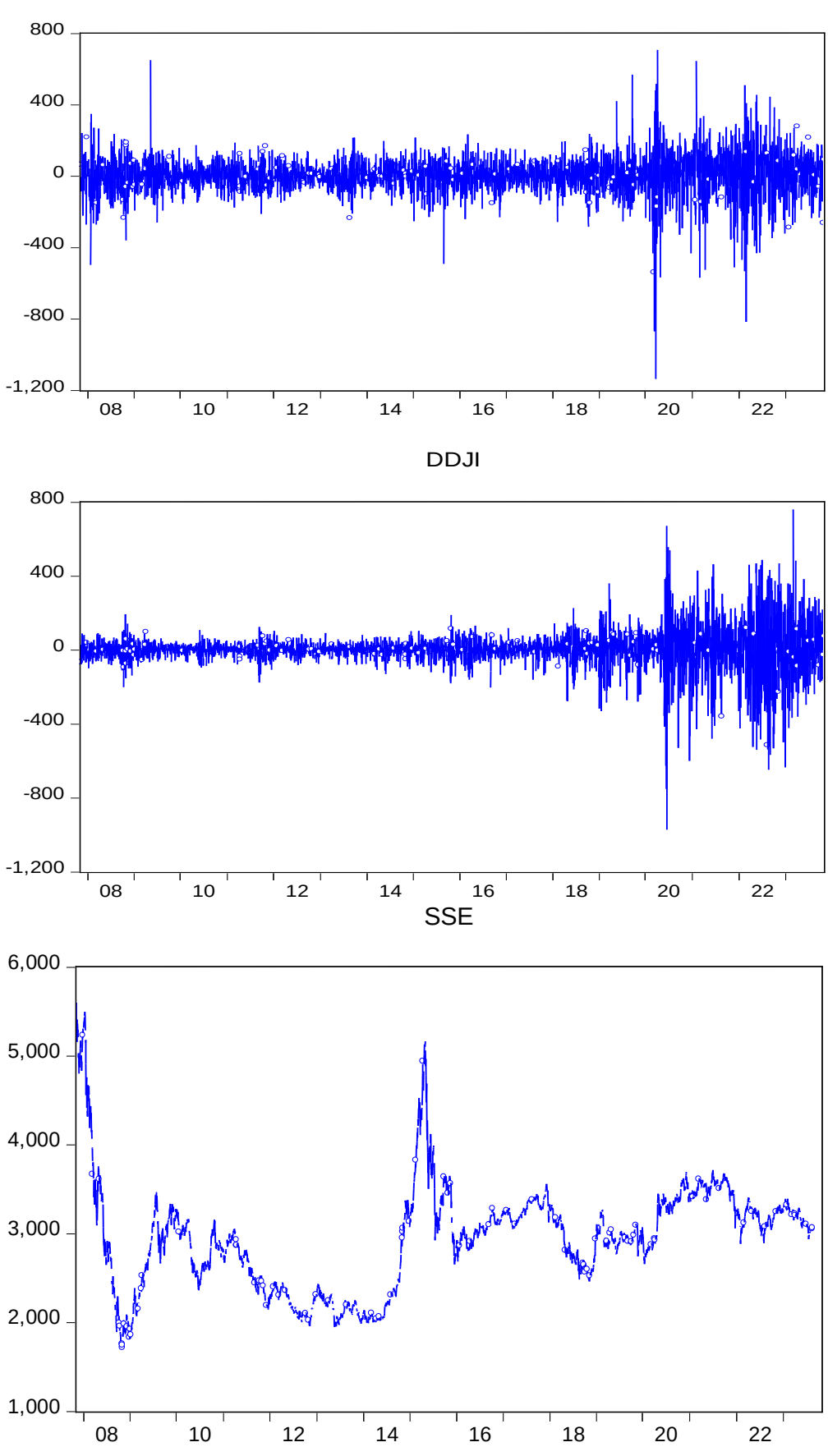


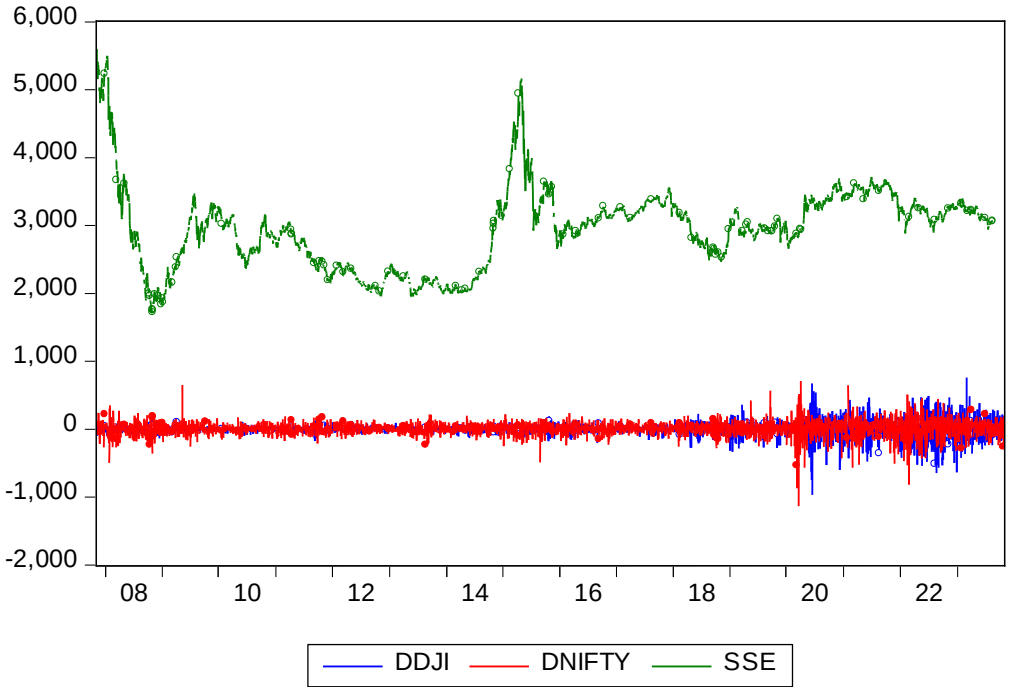
The above table 1 presents descriptive statistics for three different time series - NIFTY, SSE, and DJIA that provides insights into their normality. The mean of NIFTY is having the highest value at 9204.047. The standard deviations indicate that NIFTY shows the highest volatility. The Jarque-Bera test assesses the normality of the data, with p-values close to zero, suggesting significant deviations from normal distribution for all three indices.

Table 2: The t-statistics and p-value of unit root test for selected time series

Series	Nifty	DJIA	SSE
Unit Root test - ADF			
At Level	0.9938	0.9757	0.0002
At 1st Difference	0.0001	0.0000	NA
Stationary	1st Difference	1st Difference	Level

Chart 2: Charts of Stationary Time Series DNifty, DDJIA, and SSE Time Series





The table 2 presents the outcomes of the Augmented Dickey-Fuller (ADF) unit root tests for three selected time series: Nifty, DJIA, and SSE. The results show that the Nifty of India and DJIA of America becomes stationary at first difference while the SSE of China is stationary as original at level.

Table 3: VAR Lag Order Selection Criteria

Endogenous variables: DDJIA DNIFTY SSE
Exogenous variables: C
Sample: 11/01/2007 10/30/2023
Included observations: 3357

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-66970.97	NA	4.28e+13	39.90108	39.90655	39.90304
1	-58604.44	16713.11	2.94e+11	34.92192	**34.94379***	**34.92974***
2	-58599.38	10.10984	2.95e+11	34.92426	34.96254	34.93795
3	-58590.81	17.07466	2.95e+11	34.92452	34.97920	34.94408
4	-58580.29	20.96132	2.95e+11	34.92362	34.99470	34.94904
5	-58564.23	31.96830	2.94e+11	34.91941	35.00690	34.95070
6	-58550.50	27.31358	2.93e+11	34.91659	35.02048	34.95375
7	-58533.15	34.45650	2.91e+11	34.91162	35.03192	34.95464
8	-58520.47	25.17322	2.91e+11	34.90943	35.04613	34.95832
9	-58505.19	30.31573	2.90e+11	34.90568	35.05879	34.96044
10	-58496.50	17.20986	2.90e+11	34.90587	35.07538	34.96650
11	-58486.81	19.19788	2.90e+11*	**34.90545***	35.09137	34.97195
12	-58482.00	9.508221	2.90e+11	34.90795	35.11027	34.98031
13	-58475.12	13.58595	2.91e+11	34.90922	35.12794	34.98744
14	-58465.97	18.07954	2.91e+11	34.90913	35.14425	34.99322
15	-58454.35	22.92385*	2.90e+11	34.90756	35.15910	34.99752

Table 3 presents the results of Lag Order Selection Criteria. The asterisk (*) indicates the lag order selected by each criterion. The decision of lag selection is taken based on AIC criteria, at lag order 11, both AIC and LR criteria choose it as the optimal order.

Table 4: Pairwise Granger Causality Tests

Sample: 11/01/2007 10/30/2023
Lags: 11

Null Hypothesis:	Obs	F-Statistic	Prob.
DJIA doesn't Granger Cause NIFTY	3595	0.83061	0.6093
NIFTY doesn't Granger Cause DJIA		2.43691	0.0050
SSE doesn't Granger Cause NIFTY	3509	1.30241	0.2160
NIFTY doesn't Granger Cause SSE		1.80789	0.0474
SSE doesn't Granger Cause DJIA	3852	0.15856	0.9992
DJIA doesn't Granger Cause SSE		0.94936	0.4912

The table 4 presents the results of Pairwise Granger Causality Tests to assess the causal relationships among DJIA, NIFTY, and SSE. The result shows that p-value for Nifty-DJIA and Nifty-SSE are less than 0.05, which means here null hypothesis is rejected. This suggests that the Nifty of India granger causes DJIA of America and Nifty of India also granger causes SSE of China. This means the past values of Nifty contain information that helps to predict future values of DJIA and SSE.

Table 5: Johansen Co-integration Test

Sample (adjusted): 11/21/2007 8/16/2023
Included observations: 3450
Trend assumption: Linear deterministic trend
Series: DDJIA DNIFTY SSE
Lags interval (in first differences): 1 to 11

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.076267	546.9755	29.79707	0.0001
At most 1 *	0.072017	273.2796	15.49471	0.0001
At most 2 *	0.004460	15.42029	3.841466	0.0001

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesised No. of CE	Eigenvalue	Max Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.076267	273.6959	21.13162	0.0001
At most 1 *	0.072017	257.8593	14.26460	0.0001
At most 2 *	0.004460	15.42029	3.841466	0.0001

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

DDJIA	DNIFTY	SSE
0.027709	0.019005	-0.000138
-0.022458	0.024472	-9.93E-05
0.000287	0.001352	0.001776

Unrestricted Adjustment Coefficients (alpha):

D(DDJIA)	-23.33903	18.43098	-0.234594
D(DNIFTY)	-19.52816	-23.16793	-0.542989
D(SSE)	0.884711	0.495175	-3.064805

1 Cointegrating Equation(s):	Log likelihood	-60220.25

Normalized cointegrating coefficients - standard error in parentheses

DDJIA	DNIFTY	SSE
1.000000	0.685876	-0.004981
	(0.06664)	(0.00383)

Adjustment coefficients - standard error in parentheses

D(DDJIA)	-0.646704
	(0.05046)
D(DNIFTY)	-0.541108
	(0.05224)
D(SSE)	0.024515
	(0.02183)

2 Cointegrating Equation(s):	Log likelihood	-60091.32

Normalized cointegrating coefficients (standard error in parentheses)

DDJIA	DNIFTY	SSE
1.000000	0.000000	-0.001350
		(0.00301)
0.000000	1.000000	-0.005295
		(0.00349)

Adjustment coefficients (standard error in parentheses)

D(DDJIA)	-1.060620	0.007481
	(0.06398)	(0.05558)
D(DNIFTY)	-0.020812	-0.938095
	(0.06574)	(0.05711)
D(SSE)	0.013394	0.028932
	(0.02809)	(0.02441)

The table 5 presents the results of Johansen Co-integration Test.

The Unrestricted Co-integration Rank Test - Maximum Eigenvalue assesses the number of co-integrating equations in the system, providing critical information about the long-term relationships among variables. In this specific output, three hypothesized scenarios are tested. The null hypotheses suggest that there are no co-integrating equations, and the test statistic significantly exceeds the critical value at 0.05 significance level indicates the rejection of this hypothesis. The next hypotheses, "At most 1" and "At most 2," assume the presence of one and two co-integrating equations, respectively. Both are also rejected based on the test statistics exceeding their respective critical values. This implies that the system indeed has at least three co-integrating equations, providing evidence of a complex, multi-dimensional long-term relationship among the variables DDJIA, DNIFTY, and SSE. The extremely low p-values (0.0001) reinforce the statistical significance of these results. The co-integrating coefficients shed light on the nature of these long-term relationships. The emphasis on DNIFTY in the first co-integrating equation suggests its substantial impact on the overall equilibrium, indicating its pivotal role in the system. The second co-integrating equation further underscores the strong link between DNIFTY and SSE, with DNIFTY exerting dominance. The adjustment coefficients provide a practical understanding of the speed at which the system corrects any deviations from equilibrium,

allowing for a nuanced interpretation of the system's dynamic behavior. Overall, these findings contribute valuable insights into the interconnected dynamics of the variables, emphasizing the existence of a stable, long-term equilibrium relationship among them.

IMPLICATIONS

Theory: The Granger causality results indicate that past Nifty values play a crucial role in predicting future values of DJIA and SSE, aligning with the global interconnectedness of financial markets. The Unrestricted Co-integration Rank Test strengthens this framework, revealing a complex, multi-dimensional long-term relationship among DJIA, NIFTY, and SSE, with NIFTY emphasized in maintaining overall equilibrium.

Practice and Policy: These findings have practical implications for investors, analysts, and policymakers. Investors can use Granger causality information for informed portfolio diversification, analysts can enhance forecasting models, and policymakers may consider these relationships for managing spill-over effects in international financial markets. The evidence of co-integration and Granger causality can inform collaborative international financial policies, requiring coordination to address contagion effects and ensure stability.

Future Research: The study opens avenues for future research into the specific mechanisms of Nifty's influence on DJIA and SSE, providing a foundation for a nuanced understanding of international financial market dynamics.

CONCLUSION

In conclusion, the Pairwise Granger Causality Tests reveal that the Nifty of India granger causes both the DJIA of America and the SSE of China, indicating that past values of Nifty contain valuable information for predicting future values of DJIA and SSE. Moving on to the Unrestricted Co-integration Rank Test - Maximum Eigenvalue, the results decisively reject hypotheses suggesting fewer co-integrating equations, establishing the presence of at least three co-integrating equations. This signifies a complex, multi-dimensional long-term relationship among DJIA, NIFTY, and SSE. The co-integrating coefficients highlight the substantial impact of NIFTY on the overall equilibrium, with the second equation emphasizing a strong link between NIFTY and SSE. These findings contribute valuable insights into the stable, long-term equilibrium relationship among the variables, supported by robust statistical significance.

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