International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

A Study on Cointegration and Causality Relationship of Indian Stock Market with Select World Markets

Dr. K. V. Manju[1]., K. S. Sharvaa[2]., R. Sanjay[3]
[1]Associate Professor, School of Management, Sri Krishna College of Engineering and Technology, Coimbatore.
[2]Student, School of Management, Sri Krishna College of Engineering and Technology, Coimbatore.
[3]Student, School of Management, Sri Krishna College of Engineering and Technology, Coimbatore.

ABSTRACT
This study explores the cointegration and causality relationships of the Indian stock market with selected major markets of the world such as the market of USA, Japan, Germany, UK, France, Canada, Italy, Australia, South Korea and Spain. Applying the Johansen cointegration test and Granger causality analysis, the study find that significant long-run equilibrium relationships and short-run influences exist between these several variables. Findings show that the BSE Sensex is more integrated globally than the NSE Nifty 50, suggesting India's increasing prominence in international financial market. The findings offer essential insights to investors pursuing portfolio diversification, policymakers working to improve financial stability, and firms devising global investment strategies. The findings also underscore the influence of economic events and global market interdependencies, which necessitate adaptive and responsive policies in a rapidly changing global financial environment.

INTRODUCTION

The stock markets are key indicators of economic productivity as they showcase how investors are spending their money and paying attention to other global finances. Initially integrated physical shops, stock markets have transformed into advanced electronic systems that provide users with greater accessibility and speed to the trade. Foreign investors can utilize the BSE and the NSE, as stock exchanges in India. Both these exchanges are regulated by the SEBI which assures safety and motivation for both external and internal investors to invest. Due to the increased dependence of economies caused by globalization, the stock markets of India are very sensitive to foreign factors. The United States, Japan, Germany, United Kingdom, France, Canada, Italy, Australia, South Korea, and Spain collectively are a major economy that affects one another through trading, capital transfers, and synchronizing domestic policies The combination of economic policies, geopolitical occurrences, and other technological advancements greatly impacts the movement of markets. For instance, the introduction of algorithmic trading and big data has automated a lot of trading and has made it easier than it was before. Alongside, such automation has also increased volatility and made the market less stable. This paper analyzes the cointegration and causality relationships of the Indian stock market with select global markets to identify any long-term equilibrium relations as well as short-term directional effects. This study tests the hypothesis that fluctuations in global markets lead to movements in the Indian stock market or the contrary using Johansen cointegration and Granger causality test. The study will help investors construct portfolio diversification strategies, aid policy makers in assessing the impact of foreign economies on India, and allow companies and firms to devise sound financial strategies and manage risks in the market appropriately. Previous research has analyzed the two-way interactions between India and some markets, but there are very few studies of India and several developed economies at once. This research attempts to fill this gap by using several econometric methods to analyze the integration of India's economy with the rest of the world.

REVIEW OF LITERATURE

F Ali, P Suri, T Kaur, D Bisht (2024) researched the integration of India's NSE with leading stock markets of the world including US NASDAQ, employing Johansen's Cointegration and Vector Error Correction models. They observed strong cointegration which suggested substantial interest from foreign investors into the market, which reinforces the concepts related to market contagion and portfolio diversification, and has important consequences for price formation in Indian markets.

A Sayed, A Charteris (2024) studied the time-and frequency-varying integration of the stock of new members of BRICS, utilizing the DCC-GARCH model and wavelet coherence. It was noted that there is high level of integration between India and Russia. On the contrary, China and Brazil seem to be rather isolated. New BRICS members are well connected to some of the original members but the effects of systemic crises have over time become more stable.

KK Gokmenoglu (2023) analyzed the causal relationship between the Turkish stock market returns (XU100) and exchange rates (USD/TRY, EUR/TRY) using wavelet coherence methodology for the years of 2000 - 2019. Results indicated the presence of extremely negative associations during crises periods, high volatility during crises periods, negative association between stock returns and exchange rates, and unidirectional causality from stock market to exchange rates with stronger linkage for USD/TRY as compared to EUR/TRY.

T Jacob (2022) studied the short- and long- relationships between NSE Nifty and selected stock markets of Asia and Africa from the years of 2000 - 2021 using the Johansen Cointegration Approach. Results revealed strong correlations (0.68-0.82) with all other countries except China confirming interdependencies and, long term linkages which proves that these markets are highly integrated.

S Ahmad, NU Khan (2022) researched the long-term relationship between Pakistan Stock Exchange (PSX) and six selected stock markets of the world from 1991-2018 using Johansen and Juselius cointegration techniques. The results revealed the presence of weak linkages along with two cointegrating relationships (France-UK, China-Canada) enabling global investors to achieve portfolio diversification.

RESEARCH METHODOLOGY

OBJECTIVES

PRIMARY OBJECTIVE

To study the cointegration and causality relationship of Indian stock market with select world markets

SECONDARY OBJECTIVE

- To capture the trends, similarities and patterns in the activities and movements of the Indian Stock Market in comparison to United States, Japan, Germany, United Kingdom, France, Canada, Italy, Australia, South Korea and Spain.
- To see whether Indian stock market movement are correlated to the stock market returns selected developed countries stock market returns.
- To determining whether Indian stock market is cointegrated with select world markets
- To determine the direction of causality between the Indian stock market and selected developed world markets, identifying whether the Indian market is a leader or follower in terms of global market movements.
- To offer practical insights for investors, policy makers and companies regarding the benefits of portfolio diversification in the context of global stock market linkages.

CONCEPTUAL MODEL

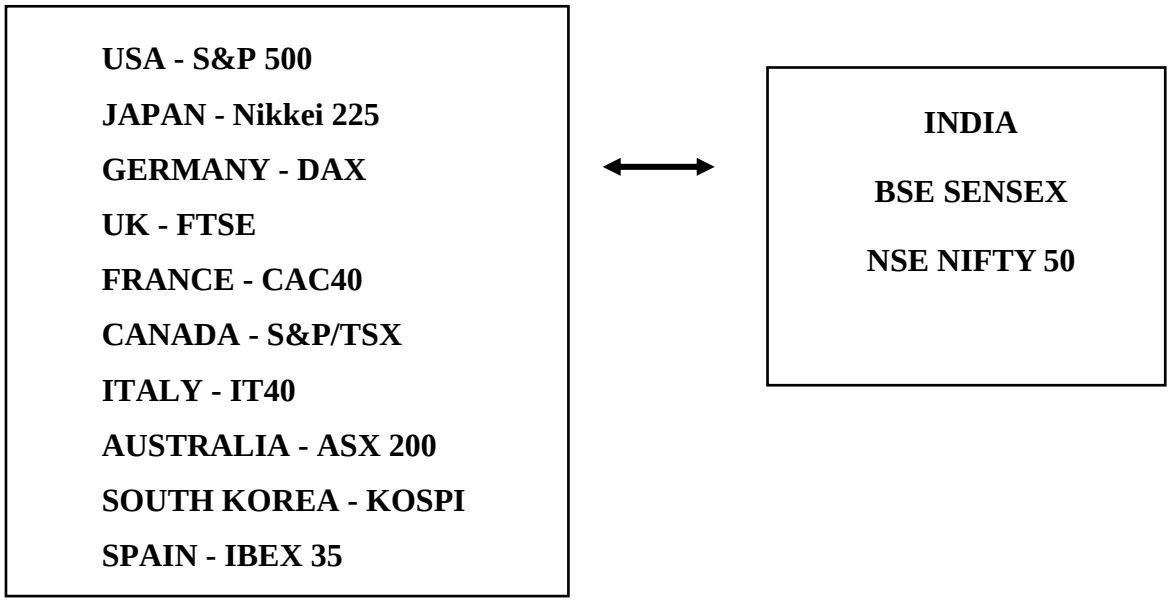


Figure 1

HYPOTHESIS:
H01: There is no long-term linear interdependency between the BSE Index and global index
H11: There is long-term linear interdependency between the BSE Index and global index
H02: There is no long-term linear interdependency between the NSE Index and global index
H12: There is long-term linear interdependency between the NSE Index and global index

RESEARCH METHODOLOGY

A) RESEARCH DESIGN

- Using quantitative methods, this study investigates the relationship between the Indian stock market (BSE Sensex and NSE Nifty 50) and major global indices with the help of monthly stock price data over a period of 11 years. Long-term equilibrium relationships are evaluated through cointegration analysis (Johansen test), and market influences are investigated through Granger causality tests.
- Also, the descriptive researches design analyzes the short-term and long-term interactions focusing on the interdependencies of market trends and fluctuations over time. By assessing the impact of major global indices like S&P 500, Nikkei 225, DAX and others on the Indian market, the study offers guidance on investment opportunities and policy decisions, as well as aids financial analysts in their work which deepens understanding of investment decisions in a globalized economy.

B) DATA COLLECTION

The secondary data will be obtained from reliable sources like FTSE, World Bank, Yahoo Finance, and NSE/BSE databases.

C) VARIABLES

The dependent variables are BSE Sensex and NSE Nifty 50, while the independent variables are S&P 500, Nikkei 225, DAX, FTSE, CAC40, S&P/TSX, IT40, ASX 200, KOSPI, and IBEX 35.

D) TOOLS FOR ANALYSIS OF DATA

- **Descriptive Analysis:** Summarizes key trends in NSE Nifty 50, BSE Sensex and Global Stock Indices by calculating measures such as mean, standard deviation and distribution patterns. The mean provides an indication of average performance, while standard deviation is a measure of volatility.
- **Correlation Analysis:** Measures the relationship between Indian and foreign stock indices. A positive high correlation also means markets move in the same direction, while a negative correlation suggests that they move in an opposite direction. This aids investors in identifying diversification opportunities and analysing the impact of global events on Indian markets.
- **Augmented Dickey-Fuller (ADF) Test:**
- Checks if stock prices are stationary or non-stationary. So, a stationary series is the one whose mean and variance are constant over time, lending itself for forecasting jobs. The series do not stay at the same level; rather, it shows random and erratic price movements. This tests the validity of econometric techniques used in stock market research.
- **Johansen Cointegration Test:** Investigates if Indian and world stock markets are aligned in the long-term equilibrium. This test provides insight into the interlinking of financial markets and whether shocks in one market have positive or negative spillover effects on another market across time.
- **Granger Causality Test**: Determines if lagged values of one index can explain the future of the other. The Indian stock market Granger-causing a world index means that trends in the Indian domestic markets are thereby driving trends internationally. On the other hand, if global indices indeed Granger-cause Indian indices then the domestic stock movements are induced by some external force. This test allows investors and policymakers to gain insights regarding lead-lag relations in order to optimize investment timing and level of risk being exposed.

ANALYSIS

A. DESCRIPTIVE STATISTICS

A descriptive analysis explains and evaluates the data in order to identify useful pieces of information. It comprises the following statistics: the average, median, mode, standard deviation, skewness, and kurtosis that describe the set of data and its distribution. Its purpose is to provide a summary of the data set while highlighting the heterogeneity and potential anomalies of the examined data set. This analysis lays the groundwork for more in-depth statistical modeling by making sure the data is both high-quality and consistent.

	BSE SENSEX	NSE NIFTY 50	S&P 500 (USA)	Nikkei 225 (JAPAN)	DAX (GERMANY)	FTSE (UK)
N	132	132	132	132	132	132
Missing	0	0	0	0	0	0
Mean	43221	12992	3236	24026	13020	7095
Median	37544	11096	2920	22296	12432	7152
Standard deviation	16981	5087	1121	6634	2612	606
Minimum	20514	6090	1783	14304	9306	5577
Maximum	84300	25811	6032	40369	19909	8377

	CAC40 (FRANCE)	S&P/TSX (CANADA)	IT40 (ITALY)	ASX 200 (AUSTRALIA)	KOSPI (SOUTH KOREA)	IBEX 35 (SPAIN)
N	132	132	132	132	132	132
Missing	0	0	0	0	0	0
Mean	5675	17247	2258	6359	2334	9443
Median	5386	16145	2154	6175	2286	9360
Standard deviation	1103	2961	439	883	348	1183
Minimum	4166	12822	1580	4881	1755	6452
Maximum	8206	25648	3381	8436	3297	11877

Table 1

INTERPRETATION

- From 2014 to 2024, descriptive statistics (from Table 1) observed substantial market growth and volatility across global stock indices.
- BSE Sensex, NSE Nifty 50 surge upward, averaging **43,221 and 12,992** with wide-ranging fluctuations, respectively. S&P 500 (USA) and Nikkei 225 (Japan) have performed strongly too, but with differing degree of stability.
- **Sensex (16,981), and Nikkei 225 (6,634), that have higher standard deviations denoting greater volatility**, whereas FTSE 100 (UK) and ASX 200 (Australia) indicate stability.
- Indian indices may present sharp variations with the indices across different markets showcasing steadiness over the long term.

GRAPH:

Following graphs illustrate the trend movements of NSE Nifty 50, BSE Sensex, and major global stock indices over the past 11 years

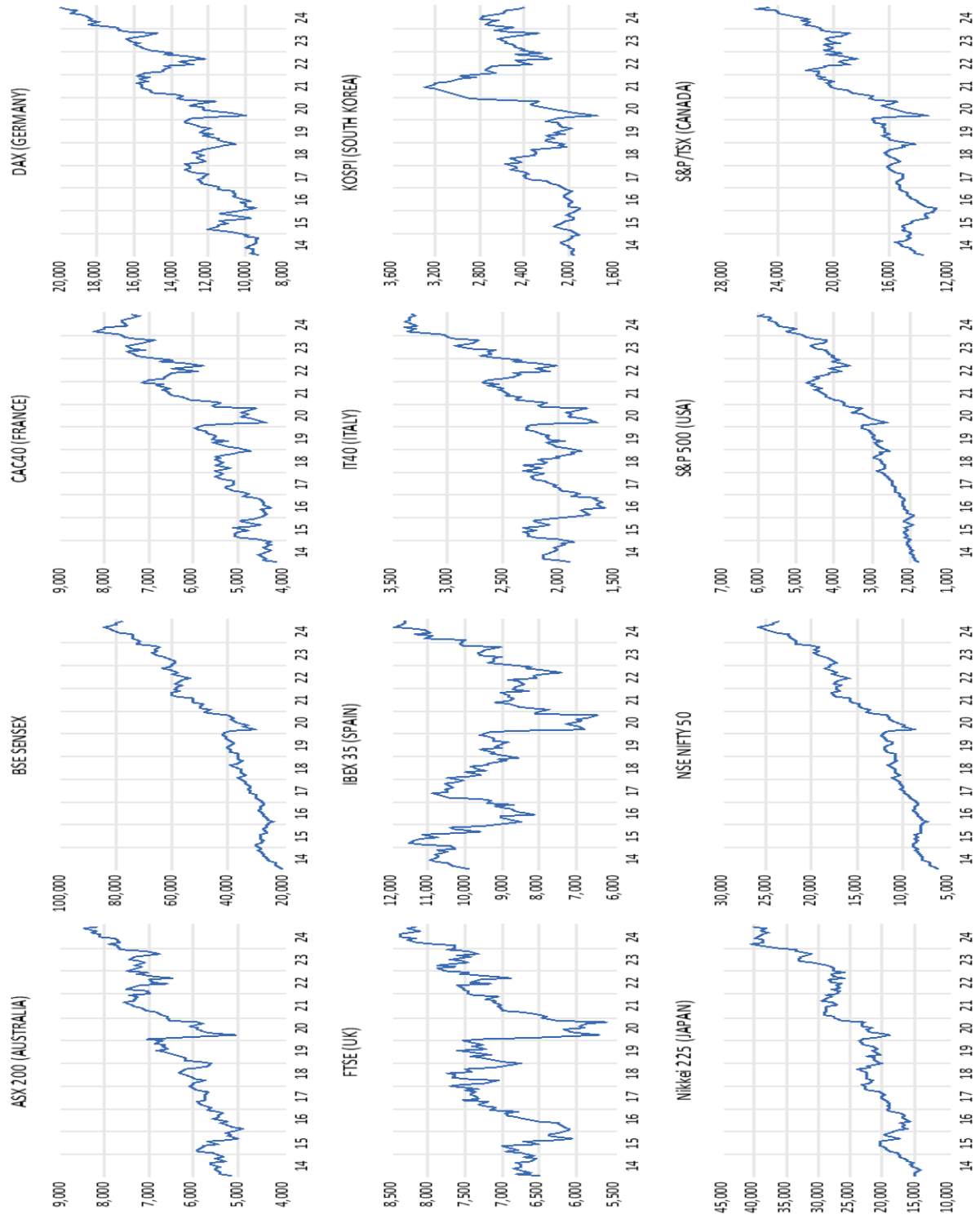
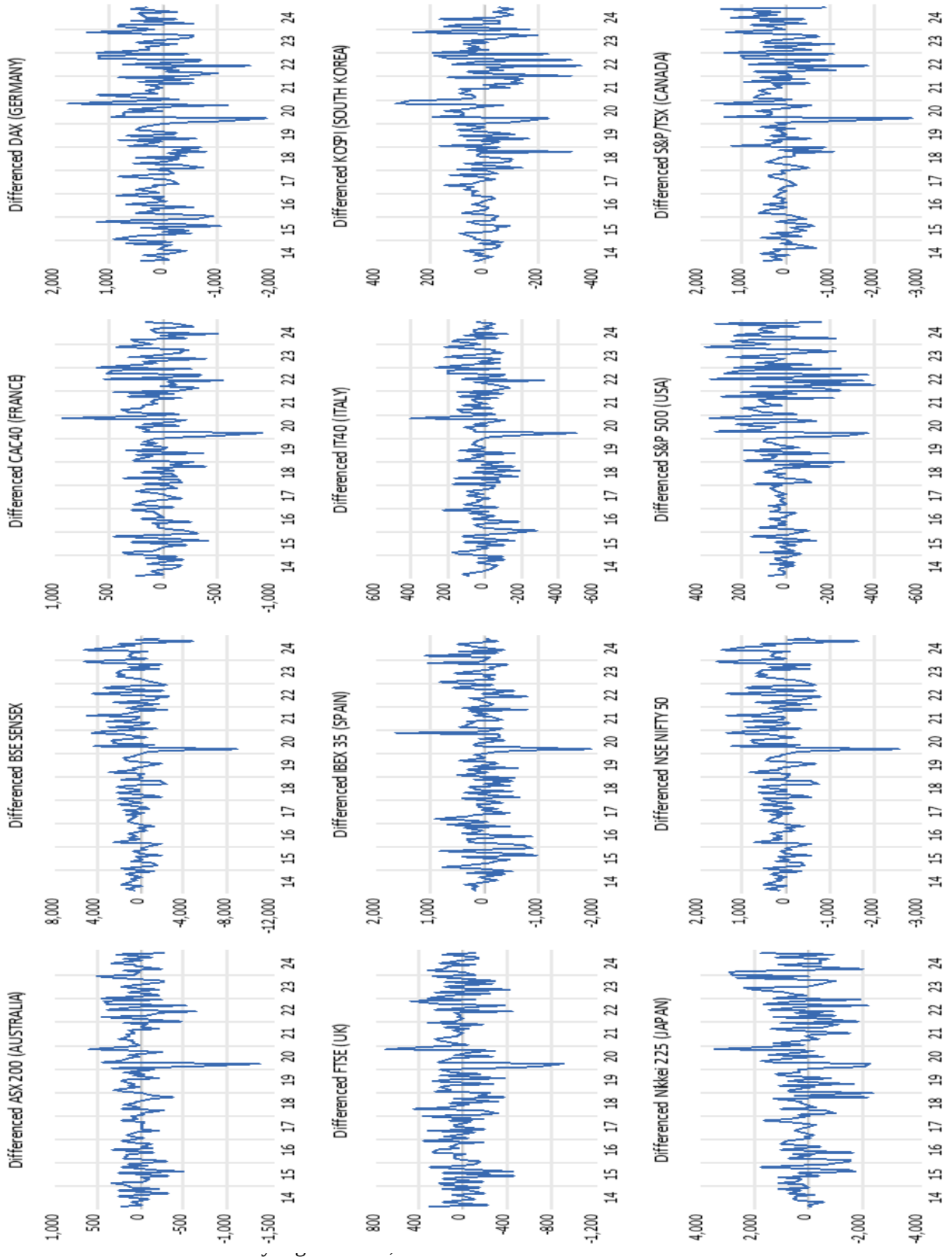


Figure 2

Zeroing in on a few of the graphs, we can see an upward trend in more than one of the stock index markets around the globe.

VOLATILITY CLUSTERING PLOT OF MONTHLY RETURNS TO ASX 200, BSE SENSEX, CAC 40, DAX, FTSE, IBEX 35, IT 40, KOSPI, NIKKEI 225, NSE NIFTY 50, S P 500, S P TSX



Fi
Al

B. CORRELATION MATRIX FOR MONTHLY RETURN RETURNS OF INDICES

Correlation tests establish both the direction and the strength of relationships from multiple variables. The pearson correlation metric goes from -1 (no correlation) to +1 (heavily correlated) where it is +0 means that there is no correlation. Correlation shows how variables move together, but they don't imply causality. So that is popular in finance, economics, and research for checking how the factors depend on each other.

	ASX 200 AUSTRALIA	BSE SENSEX	CAC40 FRANCE	DAX GERMANY	FTSE UK	IBEX 35 SPAIN
ASX 200 AUSTRALIA	1.000	0.949	0.946	0.941	0.733	0.086
BSE SENSEX	0.949	1.000	0.953	0.942	0.675	0.054
CAC40 FRANCE	0.946	0.953	1.000	0.953	0.757	0.146
DAX GERMANY	0.941	0.942	0.953	1.000	0.727	0.185
FTSE UK	0.733	0.675	0.757	0.727	1.000	0.496
IBEX 35 SPAIN	0.086	0.054	0.146	0.185	0.496	1.000
IT40 ITALY	0.856	0.874	0.908	0.914	0.732	0.455
KOSPI SOUTH KOREA	0.731	0.682	0.713	0.751	0.439	-0.057
NIKKEI 225 JAPAN	0.922	0.967	0.940	0.967	0.656	0.113
NSE NIFTY 50	0.947	0.999	0.953	0.947	0.689	0.078
S P 500 USA	0.955	0.978	0.933	0.957	0.619	-0.015
S P TSX CANADA	0.971	0.964	0.939	0.944	0.716	0.104

	IT40 ITALY	KOSPI SOUTH KOREA	NIKKEI 225 JAPAN	NSE NIFTY 50	S P 500 USA	S P TSX CANADA
ASX 200 AUSTRALIA	0.856	0.731	0.922	0.947	0.955	0.971
BSE SENSEX	0.874	0.682	0.967	0.999	0.978	0.964
CAC40 FRANCE	0.908	0.713	0.940	0.953	0.933	0.939
DAX GERMANY	0.914	0.751	0.967	0.947	0.957	0.944
FTSE UK	0.732	0.439	0.656	0.689	0.619	0.716
IBEX 35 SPAIN	0.455	-0.057	0.113	0.078	-0.015	0.104
IT40 ITALY	1.000	0.605	0.899	0.881	0.849	0.867
KOSPI SOUTH KOREA	0.605	1.000	0.714	0.680	0.749	0.733
NIKKEI 225 JAPAN	0.899	0.714	1.000	0.969	0.965	0.925

NSE NIFTY 50	0.881	0.680	0.969	1.000	0.976	0.964
S P 500 USA	0.849	0.749	0.965	0.976	1.000	0.970
S P TSX CANADA	0.867	0.733	0.925	0.964	0.970	1.000

Table 2

INTERPRETATION

The correlation matrix (Table 2) above illustrates the level of dependency between Indian stock market (BSE Sensex & NSE Nifty 50) and major global stock indices starting from top 10 GDP developed countries. Close to 1 means the stock markets tend to move in the same direction while lower means they have weaker relationships.

BSE SENSEX INTERACTION:

For global indices, the BSE Sensex also has a very high positive correlation especially with the S&P 500 with a correlation coefficient of 0.9977, Nikkei 225 at 0.9864, and DAX at 0.9567, which suggests that movements in these markets have a high impact on the Indian stock market. The S&P 500 correlation high, as it should be points to strong linkages with the U.S. market, driven by foreign institutional investments and economic interdependencies. The IT40 (0.9545) and CAC40 (0.9435) correlations also suggest that European markets have an impact on the BSE Sensex. The lower correlation with respect to FTSE (0.8601) and IBEX 35 (0.9045), however, provides less linkage with respect to the UK and Spanish markets, which implies that the Indian stock market is in a different process with less linkages difference in integration of Indian stock market with respect to different financial centers across the globe.

NSE NIFTY 50 INTERACTION:

In this regard, it would be appropriate to mention that the NSE Nifty 50 is perfectly correlated with BSE Sensex (0.9998), verifying that the two indices move in close proximity to each other. Moreover, the extreme correlation with S&P 500 (0.9968), Nikkei 225 (0.9839), and DAX (0.9527) illustrates how intertwined, India's correlation as, an emerging market with international capital flows and economic environment of dynamic and world class markets of developed economies. Additionally, given the moderate correlation with KOSPI and ASX at 0.9234 and 0.9039, respectively, this further implies a significant yet comparatively weaker interaction with the South Korean and Australian markets, thus highlighting the possible market dynamics and corresponding trade linkages specific to the region.

C. AUGMENTED DICKEY-FULLER TEST STATISTIC

Uses unit root test to check whether the time series is stationary or non-stationary. For reliable time-series modeling stationarity is essential. These tests are referred to the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests for testing the presence of unit roots. We are not ready for that, however only if the series has a unit root, there will be a trend in the series that decides a trend for a standard regression analysis. As a result, when working with time series data you may need to difference or transform to prevent spurious relationships.

Variables		**Co – efficient**	**Std. Error**	**t – statistic**	**Critical value at 5% level**	**Probability**
ASX 200 AUSTRALIA	I (0)	-0.032985	0.025509	-1.293075	-2.883579	0.6316
	I (1)	-1.073271	0.088434	- 12.13635	- 2.883753	0.0000
BSE SENSEX	I (0)	0.003133	0.010088	0.310573	-2.883579	0.9781
	I (1)	-1.026126	0.088769	- 11.55949	-2.883753	0.0000
CAC40 FRANCE	I (0)	-0.025458	0.020525	-1.240321	-2.883579	0.6556
	I (1)	-1.067857	0.088014	-12.13279	-2.883753	0.0000
DAX GERMANY	I (0)	-0.007811	0.020774	-0.376007	-2.883579	0.9088
	I (1)	-1.051301	0.088223	-11.91646	-2.883753	0.0000

FTSE UK	I (0)	-0.067897	0.033964	-1.999074	-2.883579	0.2870
	I (1)	-1.096629	0.087562	-12.52398	-2.883753	0.0000
IBEX 35 SPAIN	I (0)	-0.060803	0.33266	-1.827786	-2.883579	0.3675
	I (1)	-1.077847	0.088070	-12.23852	-2.883753	0.0000
IT40 ITALY	I (0)	-0.017623	0.024300	-0.725224	-2.883579	0.8357
	I (1)	-1.087488	0.087875	-12.37546	-2.883753	0.0000
KOSPI SOUTH KOREA	I (0)	-0.054751	0.027418	-1.996887	-2.883579	0.2880
	I (1)	-1.083452	0.088146	-12.29153	-2.883753	0.0000
NIKKEI 225 JAPAN	I (0)	0.001129	0.014888	0.075827	-2.883579	0.9627
	I (1)	-1.010278	0.089003	-11.35107	-2.883753	0.0000
NSE NIFTY 50	I (0)	0.003474	0.010151	0.342231	-2.883579	0.9797
	I (1)	-0.980802	0.088765	-11.04942	-2.883753	0.0000
S P 500 USA	I (0)	0.006347	0.011977	0.529921	-2.883579	0.9872
	I (1)	-1.166862	0.087634	-13.31524	-2.883753	0.0000
S P TSX CANADA	I (0)	-0.003954	0.019267	-0.205235	-2.883579	0.9337
	I (1)	-1.165006	0.087899	-13.25399	-2.883753	0.0000

Table 3

INTERPRETATION:

At Level (I (0)) – non-stationary:

- All indices have t-statistics greater than the critical value and p-values > 0.05, meaning we fail to reject the null hypothesis (H_0).
- This indicates that stock prices follow a trend and are non-stationary.

At First Difference (I (1)) – Stationary:

- After differencing, all indices have negative t-statistics lower than the critical value and p-values = 0.0000, so we reject H_0.
- This confirms that stock returns are stationary (from Table 3), making them suitable for further analysis like cointegration and causality tests.

D. JOHANSEN'S COINTEGRATION TEST

The Johansen cointegration test identifies long-term relationships between multiple non-stationary time series. It determines whether variables move together over time despite short-term fluctuations. Using Trace and Maximum Eigenvalue statistics, the test evaluates the number of cointegrating equations. If cointegration exists, it suggests a stable equilibrium, making it useful for economic and financial modeling.

1. BSE SENSEX

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		**Trace**	**0.05**	**Prob.****
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Critical Value**
None *	0.465060	379.362373	285.142508	0.0000
At most 1 *	0.400333	299.911001	239.235415	0.0000
At most 2 *	0.370733	234.965561	197.370873	0.0002

At most 3 *	0.356424	176.139169	159.529698	0.0045
At most 4	0.276153	120.168352	125.615433	0.1025
At most 5	0.202719	79.125134	95.753661	0.3943
At most 6	0.152446	50.353453	69.818888	0.6223
At most 7	0.096615	29.347602	47.856127	0.7516
At most 8	0.069470	16.443528	29.797073	0.6808
At most 9	0.055818	7.299441	15.494713	0.5431
At most 10	0.000040	0.005051	3.841465	0.9424

Table 4

Trace test indicates 4 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

INTERPRETATION:

The Trace Test checks the null hypothesis that there are at most 'r' cointegrating equations against the alternative hypothesis of more than 'r'.

The trace statistics are greater than the critical values for None, At most 1, At most 2, and At most 3 cointegrating equations.

The p-values for these cases are below 0.05, leading to the rejection of the null hypothesis at those levels. The highlighted conclusion states that there are **4 cointegrating equations at the 5% level (from Table 4)**, meaning the system exhibits strong long – term equilibrium relationships.

Unrestricted Cointegration Rank Test (Max-eigenvalue)

Hypothesized		**Max-Eigen**	**0.05**	**Prob.****
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Critical Value**
None *	0.465060	79.451373	70.535134	0.0061
At most 1 *	0.400333	64.945440	64.504717	0.0453
At most 2 *	0.370733	58.826392	58.433538	0.0457
At most 3 *	0.356424	55.970818	52.362610	0.0205
At most 4	0.276153	41.043218	46.231420	0.1620
At most 5	0.202719	28.771681	40.077574	0.5073
At most 6	0.152446	21.005851	33.876867	0.6837
At most 7	0.096615	12.904074	27.584338	0.8902
At most 8	0.069470	9.144087	21.131616	0.8206
At most 9	0.055818	7.294390	14.264600	0.4549
At most 10	0.000040	0.005051	3.841465	0.9424

Table 5

Max-eigenvalue test indicates 4 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

INTERPRETATION:

The Max-Eigenvalue Test checks whether there is exactly 'r' cointegrating equations against the alternative hypothesis of 'r+1'.

The max-eigen statistics are greater than the critical values for None, At most 1, At most 2, and At most 3.

The p-values for these cases are below 0.05, leading to rejection of the null hypothesis at those ranks.

However, the highlighted conclusion states that there are only **4 cointegrating equations at the 5% level (from Table 5)**, confirming the trace test results.

2. NSE NIFTY 50

Unrestricted Cointegration Rank Test (Trace)

Hypothesized		**Trace**	**0.05**	**Prob.****
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Critical Value**
None *	0.469952	382.964962	285.142508	0.0000
At most 1 *	0.412606	302.346976	239.235415	0.0000
At most 2 *	0.366175	234.775456	197.370873	0.0002
At most 3 *	0.354878	176.865665	159.529698	0.0040
At most 4	0.275893	121.199646	125.615433	0.0901
At most 5	0.191508	80.202033	95.753661	0.3579
At most 6	0.161764	53.203835	69.818888	0.4962
At most 7	0.096554	30.793931	47.856127	0.6775
At most 8	0.082804	17.898520	29.797073	0.5736
At most 9	0.053014	6.921425	15.494713	0.5868
At most 10	0.000028	0.003569	3.841465	0.9513

Table 6

Trace test indicates 4 cointegrating equation(s) at the 0.05 level

* Denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

INTERPRETATION:

The Trace Test checks for the number of cointegrating equations by evaluating whether the trace statistic exceeds the critical value at a 5% significance level.

The test rejects the null hypothesis (no cointegration) for up to 4 cointegrating equations since the trace statistics for "None," "At most 1," "At most 2," and "At most 3" exceed their respective critical values, and their p-values are less than 0.05.

For "At most 4" and beyond, the test fails to reject the null hypothesis, meaning there is no strong evidence of further cointegrating relationships.

There are **4 significant cointegrating relationships among the time series at a 5% level (from Table 6)**, suggesting that four linear combinations of the variables exhibit a stable long-run equilibrium.

Unrestricted Cointegration Rank Test (Max-eigenvalue)

Hypothesized		**Max-Eigen**	**0.05**	**Prob.****
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Critical Value**
None *	0.469952	80.617986	70.535134	0.0045
At most 1 *	0.412606	67.571521	64.504717	0.0247
At most 2	0.366175	57.909791	58.433538	0.0562
At most 3	0.354878	55.666019	52.362610	0.0221
At most 4	0.275893	40.997613	46.231420	0.1636
At most 5	0.191508	26.998198	40.077574	0.6331
At most 6	0.161764	22.409905	33.876867	0.5759
At most 7	0.096554	12.895410	27.584338	0.8906
At most 8	0.082804	10.977095	21.131616	0.6496
At most 9	0.053014	6.917856	14.264600	0.4989
At most 10	0.000028	0.003569	3.841465	0.9513

Table 7

Max-eigenvalue test indicates 2 cointegrating equation(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

INTERPRETATION:

The Max-Eigenvalue Test examines whether each individual eigenvalue significantly contributes to cointegration.
The test identifies 2 cointegrating equations at the 5% level, rejecting the null hypothesis for "None" and "At most 1" since their test statistics exceed the critical values and p-values are below 0.05.
However, for "At most 2" and beyond, the test statistics are below the critical values, meaning the test fails to find additional significant cointegrating relationships.
There **are 2 significant cointegrating equations (from Table 7)**, suggesting at least two stable long-term equilibrium relationships among the variables.

E. PAIRWISE GRANGER CAUSALITY TEST

The Granger causality test checks if past values of one variable can predict another. It does not establish true causation but identifies predictive relationships using vector autoregression (VAR). If adding lagged values of an independent variable improves the dependent variable's forecast, it is said to "Granger-cause" it. This test is widely used in time-series forecasting and econometrics.

A. BSE SENSEX

Null hypothesis	Causality	F-statistic	Prob.
ASX 200 AUSTRALIA does not Granger Cause BSE SENSEX		2.85184	0.0615
BSE SENSEX does not Granger Cause ASX 200 AUSTRALIA	*	9.91284	0.0001
CAC40 FRANCE does not Granger Cause BSE SENSEX		0.12453	0.8830
BSE SENSEX does not Granger Cause CAC40 FRANCE	*	5.74586	0.0041
DAX GERMANY does not Granger Cause BSE SENSEX		0.02137	0.9789
BSE SENSEX does not Granger Cause DAX GERMANY	*	4.00711	0.0206
FTSE UK does not Granger Cause BSE SENSEX		1.76566	0.1753
BSE SENSEX does not Granger Cause FTSE UK		2.37667	0.0970
IBEX 35 SPAIN does not Granger Cause BSE SENSEX		1.67644	0.1912
BSE SENSEX does not Granger Cause IBEX 35 SPAIN		0.62172	0.5387
IT40 ITALY does not Granger Cause BSE SENSEX		0.47470	0.6232
BSE SENSEX does not Granger Cause IT40 ITALY	*	3.97484	0.0212
KOSPI SOUTH KOREA does not Granger Cause BSESENSEX		0.52903	0.5905
BSE SENSEX does not Granger Cause KOSPI SOUTH KOREA		0.03508	0.9655
NIKKEI 225 JAPAN does not Granger Cause BSE SENSEX		2.03804	0.1346
BSE SENSEX does not Granger Cause NIKKEI 225 JAPAN		2.22167	0.1127
S P 500 USA does not Granger Cause BSE SENSEX		1.24484	0.2915
BSE SENSEX does not Granger Cause S P 500 USA		0.81776	0.4438
S P TSX CANADA does not Granger Cause BSE SENSEX		0.62884	0.5349
BSE SENSEX does not Granger Cause S P TSX CANADA	*	5.72765	0.0042

Table 8

INTERPRETATION

1. BSE SENSEX Granger Cause ASX 200 AUSTRALIA
2. BSE SENSEX Granger Cause CAC40 FRANCE
3. BSE SENSEX Granger Cause DAX GERMANY
4. BSE SENSEX Granger Cause IT40 ITALY
5. BSE SENSEX Granger Cause S P TSX CANADA

B. NSE NIFTY 50

Null Hypothesis:	Causality	F-Statistic	Prob.
ASX 200 AUSTRALIA does not Granger Cause NSE NIFTY 50		2.95639	0.0557
NSE NIFTY 50 does not Granger Cause ASX 200 AUSTRALIA	*	9.66445	0.0001
CAC40 FRANCE does not Granger Cause NSE NIFTY 50		0.03893	0.9618
NSE NIFTY 50 does not Granger Cause CAC40 FRANCE	*	5.36886	0.0058
DAX GERMANY does not Granger Cause NSE NIFTY 50		0.06088	0.9410
NSE NIFTY 50 does not Granger Cause DAX GERMANY	*	4.44982	0.0136
FTSE UK does not Granger Cause NSE NIFTY 50		2.05291	0.1327
NSE NIFTY 50 does not Granger Cause FTSE UK		2.64717	0.0748
IBEX 35 SPAIN does not Granger Cause NSE NIFTY 50		1.70742	0.1855
NSE NIFTY 50 does not Granger Cause IBEX 35 SPAIN		0.72469	0.4865
IT40 ITALY does not Granger Cause NSE NIFTY 50		0.52241	0.5944
NSE NIFTY 50 does not Granger Cause IT40 ITALY	*	4.26497	0.0162
KOSPI SOUTH KOREA does not Granger Cause NSE NIFTY 50		0.46486	0.6293
NSE NIFTY 50 does not Granger Cause KOSPI SOUTH KOREA		0.09019	0.9138
NIKKEI 225 JAPAN does not Granger Cause NSE NIFTY 50		2.08614	0.1285
NSE NIFTY 50 does not Granger Cause NIKKEI 225 JAPAN		2.24627	0.1100
S P 500 USA does not Granger Cause NSE NIFTY 50		1.11604	0.3308
NSE NIFTY 50 does not Granger Cause S P 500 USA		0.80170	0.4509
S P TSX CANADA does not Granger Cause NSE NIFTY 50		0.77746	0.4618
NSE NIFTY 50 does not Granger Cause S P TSX CANADA	*	6.19188	0.0027

Table 9

INTERPRETATION

1. NSE NIFTY 50 Granger Cause ASX 200 AUSTRALIA
2. NSE NIFTY 50 Granger Cause CAC40 FRANCE
3. NSE NIFTY 50 Granger Cause DAX GERMANY
4. NSE NIFTY 50 Granger Cause IT40 ITALY
5. NSE NIFTY 50 Granger Cause S P TSX CANADA

C. OTHER INDICES

Null Hypothesis:	Causality	F-Statistic	Prob.
NIKKEI 225 JAPAN does not Granger Cause ASX 200 AUSTRALIA	*	5.07747	0.0076
ASX 200 AUSTRALIA does not Granger Cause NIKKEI 225 JAPAN		0.12213	0.8851
S P 500 USA does not Granger Cause ASX 200 AUSTRALIA	**	9.26889	0.0002
ASX 200 AUSTRALIA does not Granger Cause S P 500 USA		3.54565	0.0318
S P TSX CANADA does not Granger Cause ASX 200 AUSTRALIA	*	4.14430	0.0181
ASX 200 AUSTRALIA does not Granger Cause S P TSX CANADA		1.39156	0.2525
IBEX 35 SPAIN does not Granger Cause CAC40 FRANCE	*	3.45326	0.0347
CAC40 FRANCE does not Granger Cause IBEX 35 SPAIN		0.19919	0.8197
NIKKEI 225 JAPAN does not Granger Cause DAX GERMANY	*	3.22548	0.0431
DAX GERMANY does not Granger Cause NIKKEI 225 JAPAN		0.41583	0.6607
KOSPI SOUTH KOREA does not Granger Cause FTSE UK	*	1.61262	0.2035
FTSE UK does not Granger Cause KOSPI SOUTH KOREA		4.12518	0.0184
KOSPI SOUTH KOREA does not Granger Cause IBEX 35 SPAIN	*	0.05538	0.9461
IBEX 35 SPAIN does not Granger Cause KOSPI SOUTH KOREA		3.28091	0.0409
NIKKEI 225 JAPAN does not Granger Cause IT40 ITALY	*	3.64737	0.0289

IT40 ITALY does not Granger Cause NIKKEI 225 JAPAN		1.54213	0.2180
S P TSX CANADA does not Granger Cause S P 500 USA	**	3.91001	0.0225
S P 500 USA does not Granger Cause S P TSX CANADA		5.61238	0.0046

Table 10

INTERPRETATION

1. NIKKEI 225 JAPAN Granger Cause ASX 200 AUSTRALIA
2. S P 500 USA Granger Cause ASX 200 AUSTRALIA
3. ASX 200 AUSTRALIA Granger Cause S P 500 USA
4. S P TSX CANADA Granger Cause ASX 200 AUSTRALIA
5. IBEX 35 SPAIN Granger Cause CAC40 FRANCE
6. NIKKEI 225 JAPAN Granger Cause DAX GERMANY
7. FTSE UK Granger Cause KOSPI SOUTH KOREA
8. IBEX 35 SPAIN Granger Cause KOSPI SOUTH KOREA
9. NIKKEI 225 JAPAN Granger Cause IT40 ITALY
10. S P TSX CANADA Granger Cause S P 500 USA
11. S P 500 USA Granger Cause S P TSX CANADA

FINDINGS

- **Strong Global Integration:** The Johansen Cointegration Test confirms that BSE Sensex and NSE Nifty 50 both have significant long-term relations with major international indices, with Sensex showing deeper integration.
- **High Global Correlation:** Indian indices have a greater correlation with S&P 500 (USA), Nikkei 225 (Japan), DAX (Germany) suggesting their impact of the Indian Markets.
- **India as a Laggard Market:** Using the Granger Causality Test, we find that Indian indices are responsible for driving some markets (ASX 200, CAC 40, DAX), but major global indices such as S&P 500 and Nikkei 225 do not have any significant impact on Indian indices.
- **Volatility & Risk Factors:** Indian markets are more volatile as compared to the Developed markets and thus more vulnerable to external financial shocks
- **Investment Diversification Opportunities:** While Indian indices are highly correlated to some markets, they are loosely coupled with both FTSE (UK) and IBEX 35 (Spain) offering global portfolio diversification opportunities.
- **Examining Policy and Regulators (Greater, the particle must be observed):** Greater particle translates into better regulations, market stability, and risk mitigation measures to protect against any external disruptions
- **Corporate Strategy Implications:** For organizations which are globally exposed, international expansion strategies need to be aligned with strongly connected markets primarily in and outside Europe and North America.

SUGGESTIONS

- **Portfolio Diversification Strategies for Investors**

The results of the Granger causality show that BSE Sensex and NSE Nifty 50 Causality towards ASX 200 (Australia), CAC 40(France), DAX (Germany), IT40(IT) and S&P/TSX (Canada), hence reducing the chance of diversification in these markets. This non-causality provides an opportunity that the current TBG and PSA industries can use to better manage risk by investing in S&P 500 (USA), Nikkei 225 (Japan), and KOSPI (South Korea). However, as mentioned earlier, S&P TSX (Canada) and ASX 200 (Australia) are subject to the influence of the S&P 500 (USA), and thus these markets should not be overexposed, as this would carry an indirect risk of being too reliant on the US economy.

- **Risk Management and Hedging Strategies**

The robust causality findings between Indian indices and European markets imply that the Indian stock market can be affected by external shocks that find incrementally across the European equity sector. Trends in European economies, thus, should be closely watched by investors who can hedge risks using index-based derivatives, ETFs and sectoral diversification. Since Indian indices witness high level of correlation with many global indices, trading in equity index futures contracts and options can reduce portfolio volatility and also protect them against sudden swings in market.

- **Policy Implications for Financial Market Stability**

The benefits of India's increasing integration with global capital markets necessitate the building of robust regulatory frameworks, improved liquidity in the markets and effective mechanisms for the surveillance of financial institutions and markets. S&P 500 (USA) does not Granger-cause Indian indices directly, but an indirect indirect spillover effect via Canada (S&P TSX) and Australia (ASX 200) should be watched for. Further liberalizing bilateral trade agreements and foreign investment policies will bolster India's position in global finance with reduced market risks.

- **Corporate Decision-Making for Global Expansion**

Strategies of Indian firms with international exposure should be aligned with economies with strong causal links, like Europe and Canada. S&P 500 (USA) and Nikkei 225 (Japan) have no causality with the examined markets, thus, incentivizing companies considering minimizing their risks in domestic market volatilities. Businesses expanding globally can use foreign exchange hedging, keep an eye on economic indicators, and diversify investments in order to mitigate exposure to financial uncertainties.

- **Strengthening Financial Infrastructure and Investor Confidence**

It is only because of this, that Indian stock markets become increasingly entrenched into global linkages and it also facilitates the need for more and more financial instruments such as derivatives, Exchange Traded Funds (ETFs), structured financial products, etc. Transparency improvement, regulatory compliance enhancement, and investor education promotion could improve confidence in the market. The use of technology-driven financial infrastructure will enhance market surveillance and reduce the repercussions of global uncertainties on Indian stock exchanges.

CONCLUSION

The finding of this study support the notion of the growing linkages between the financial world, as they suggest evidence of a long-term integration of Indian stock market with major world markets. Cointegration analysis reveals that Indian stock market indices (BSE Sensex and NSE Nifty 50) are cointegrated with major international stock market indices suggesting they have long-run stable relationships whereas results of Granger causality test shows both direct and indirect effects between Indian stock market and the world. The results imply, that the Indian stock market is at least reactive, if not more so, and helps towards shaping global economic flows. For investors, it means that careful diversification across financial markets can help balance risks and opportunities. Rule makers need to place heightened attention on improving market robustness by implementing regulatory improvement as well as measures aimed at risk mitigation to soften the acute impact of global economic shocks. Moreover, corporations with stakes in international markets can leverage this information to refine and improve their investments and growth initiatives. “India's footprint in the global economy is expected to expand with increased financial integration, underscoring the need for ongoing surveillance and adaptive policies in a dynamic financial landscape,” said the report.

REFERENCE

- Ali, F., Suri, P., Kaur, T., & Bisht, D. (2024). Cointegration and causality relationship of Indian stock market with selected world markets. F1000Research, 11, 1241. https://doi.org/10.12688/f1000research.123849.4
- Sayed, A., & Charteris, A. (2024). Integration among the BRICS stock markets: Filtering out global factors. Investment Analysts Journal, 53(3), 207–230. https://doi.org/10.1080/10293523.2024.2366565
- He, X., Gokmenoglu, K. K., Kirikkaleli, D., & Rizvi, S. K. A. (2023). Co-movement of foreign exchange rate returns and stock market returns in an emerging market: Evidence from the wavelet coherence approach. International Journal of Finance & Economics, 28(2), 1994-2005.
- Jacob, T., & Littleflower, P. J. (2022). Cointegration and stock market interdependence: Evidence from India and selected Asian and African stock markets. Theoretical and Applied Economics, XXIX (4(633)).

- Ahmad, S., Khan, N. U., Shah, M. H., & Khan, M. N. (2022). An Analysis of the Dynamic Linkages of Pakistani Stock Market with the World's Leading Stock Markets. Journal of Management Practices Humanities and Social Sciences, 6(5). https://doi.org/10.33152/jmphss-6.5.3
- National Stock Exchange - https://www.nseindia.com/national-stock-exchange/about-nse-company
- Bombay Stock Exchange - https://www.bseindia.com/about.html
- World Economic Outlook Database - https://www.imf.org/en/Publications/WEO/weo-database/2024/April/groups-and-aggregates
- World Bank - https://globalpeoservices.com/top-15-countries-by-gdp-in-2024/
- FTSE - Equity Country Classification | LSEG
- Yahoo Finance - https://finance.yahoo.com/markets/world-indices/