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A Study on the Spill Over Effects on Nifty 50 Returns: Evidence from Stock Market Performances of Major Asian Counterparts of India

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Abstract:- This study investigates the spillover effects of major Asian stock market performances on the returns of the Nifty 50, India's benchmark index. Employing advanced econometric techniques, we analyze the dynamic relationships between the Nifty 50 and key Asian counterparts, considering both short-term and long-term horizons. Our research delves into return spillovers aiming to comprehensively assess the interconnectedness and transmission of market movements across the region. This study utilizes an extensive dataset covering Nifty 50 returns from April 1, 2013, to March 31, 2023, along with meticulously documented returns from stock market indexes linked to major strategic alliances in India. By applying advanced multivariate time series analysis techniques, encompassing Vector Autoregression (VAR), Granger causality tests, and impulse response functions, we model the intricate dynamics interweaving these indexes with the Nifty 50. The research endeavors to answer fundamental questions, including assessing short-term and long-term effects resulting from major Asian counterparts of India on Nifty returns, as well as exploring noticeable patterns that indicate the direction of causality between these counterparts and Nifty returns. The outcomes of this study carry substantial implications for decision-makers. Investors can make more informed decisions, businesses planning strategic partnerships can refine their strategies, and policymakers can formulate economic and financial regulations that accurately reflect the complexities of these dynamics. By unveiling the ripple effects of these counterparts on the Nifty 50, this research offers valuable insights into the evolving dynamics of India's financial markets and their integration into the global economy.

Keywords:- *Nifty 50, Asian Stock Markets, Spillover Effects, Return Spillovers, Econometrics, Interconnectedness, Investment Strategies.*

I. INTRODUCTION

The increasing regionalization of economic activities and the liberalization of financial markets since the late 1980s resulted in regional economic integrations 1 around the world. Due to the increasing interdependence of major financial markets all over the world, the transmission of stock market information among the major Asian markets has become a much-researched topic.

The Indian stock market, embodied by the majestic Nifty 50 index, stands tall as a beacon of economic dynamism in Asia. Yet, its fortunes are not solely etched within its own borders. Like threads woven into a tapestry, the Nifty 50's performance is intricately linked to the flow of its Asian counterparts. This intricate dance of interconnectedness, where market movements in one region ripple across others, is the domain of return spillovers.

A. *Global Financial Markets:*

Today, the world of finance has created a complex and interconnected system known as global financial markets. This market connects individuals, institutions, and economies across the globe, facilitating the exchange of financial assets and instruments like stocks, bonds, and currencies. These markets operate electronically, 24/7, with transactions flowing across different time zones and regulatory frameworks. The interconnectedness of global markets promotes economic growth, diversification, and access to capital, but also comes with risks and complexities. Events in one market can significantly affect others, causing volatility and spillover effects. Understanding the dynamics of global financial markets is crucial for navigating the complex world of finance and making informed decisions in our increasingly interconnected world.

B. *Spill Over Effect:*

In the context of the stock market, a spillover effect refers to the phenomenon where movements in one market cause similar or related movements in another market. It's like ripples spreading across a pond when a stone is thrown in.

➢ *Here's How it Works:*

- Let us suppose there are two markets – A and B.
- Market A experiences an event: This could be anything that significantly impacts its prices, like positive news about a major company, rising interest rates, or political uncertainty.
- Impact on Market A: Depending on the event, prices in Market A might rise (positive spillover) or fall (negative spillover) and finally, Spillover to Market B: If markets A

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and B are somehow connected, the movement in Market A can influence prices in Market B. This can happen through - Investor reactions: Investors active in both markets might adjust their holdings based on their understanding of the event in Market A and its potential implications for Market B and Economic linkages: Trade, investment, or financial connections between the two economies can make them sensitive to each other's performance.

C. *Return Spillover Effect:*

Return spillovers capture how the returns, or the profits or losses, generated in one market influence the returns in another. This goes beyond mere correlation, revealing the causal relationships that bind these markets together. When there are changes in the returns of a particular market or asset, these changes can affect or spill over to other related markets or assets. Return spillovers are a common phenomenon in interconnected and global financial markets, and they can have significant implications for investors, portfolio management, and risk assessment.

- *Cross Market Return Spillovers:*

This type of spillover occurs between different financial markets. For example, if there is a sudden drop in stock prices in one country, it may lead to spillover effects on stock markets in other countries due to increased interconnectedness and global economic linkages. It can be driven by various factors, including economic events, geopolitical developments, changes in interest rates, and shifts in investor sentiment. Financial crises, policy decisions, and unexpected shocks can amplify the intensity of return spillovers.

There are several reasons to research return spillover effects. Apart from a range of domestic influences, the volatility of significant foreign trading partners stands out as a crucial factor affecting the volatility of stock returns in a domestic market. Research on return spillovers in stock markets is vital for managing risks, constructing diversified portfolios, understanding global economic linkages, formulating effective policies, assessing market efficiency, improving forecasting models, understanding investor behavior, and promoting financial stability.

Researchers, including Gębka (2005), Jeon & Von Furstenberg (1990), Eun & Shim (1989), etc, have examined return and volatility spillover effects across the globe. The past research revealed substantial interdependence among various stock markets, suggesting that the price movements in one market impacts other markets and research also suggest that emerging markets within the same region influence each other more than markets in different regions. Additionally, studies by researchers such as Kumar & Mukhopadhyay (2007), Kotha Kumar Kiran (2002), and Yang (2003) incorporate the role of the US and say that the US has a significant impact on most of the economies around the world. Further, various studies have been undertaken to measure the interconnectedness among the Asian economies, which also confers with emerging markets of the region influencing each other, including Kedarnath & R K (2008), Habiba (2021), and Joshi (2011). However, there are conflicting views as well, like (Nath & Verma, 2003), that reveal a surprising lack of long-term equilibrium among the major South Asian stock markets.

D. *Scope of the Study:*

This study delves into the complex world of return spillovers, specifically focusing on their impact on India's Nifty 50 index. It aims to comprehensively analyze how fluctuations and trends in the stock markets of major Asian economies influence the returns generated by the Nifty 50.

E. *Objectives of the Research:*

The study on the spillover effects on Nifty 50 returns with a focus on the stock market performances of major Asian counterparts of India aims to achieve several key objectives. Firstly, the primary goal is to comprehensively analyze and understand the dynamics of spillover effects from the major Asian stock markets to the Nifty 50 index. This involves investigating the extent to which fluctuations and trends in the stock markets of countries such as China, Japan, South Korea, and others impact the returns of Nifty 50.

Secondly, the study seeks to identify the factors and mechanisms that drive these spillover effects. This involves a detailed examination of macroeconomic indicators, financial policies, geopolitical events, and other relevant factors that may influence the interconnectedness of the markets. Understanding the underlying drivers is crucial for investors, policymakers, and market participants to make informed decisions in the context of the globalized financial landscape.

Furthermore, the research aims to assess the temporal dimension of spillover effects, examining whether these effects are persistent or transitory. This temporal analysis is essential for developing effective risk management strategies and for providing insights into potential windows of opportunity for investment.

Additionally, the study strives to explore the implications of spillover effects on portfolio diversification strategies for investors. By gaining insights into the correlations and co-movements between Nifty 50 and its Asian counterparts, the research aims to provide practical guidance for investors seeking to optimize their portfolios and manage risk effectively across different markets.

The rest of the paper is organised in the following sequence: Section 2, relevant literature review concerning the spillover effects. Section 3 covers the data description and various statistical tools and techniques used. Section 4 has the results of the study and discussions. Section 5 has the major findings of the study and its conclusion. Section 6 gives the scope for further research in this area of study.

F. *Limitations of the Study:*

- External Factors: Unforeseen global events or significant changes in international markets beyond Asia could potentially impact the results, even if not the primary focus of the study.

- Market Complexity: Financial markets are inherently complex systems with a multitude of interacting factors. The study might not be able to capture every single influence on return spillovers.
- Generalizability: The findings of the study might be specific to the chosen time frame and the Asian markets included. Applying the results to broader contexts or future scenarios might require further research.

G. *Problem Statement:*

To investigate the short run and long run return spillover effects of major Asian Counterparts on Nifty 50 returns in India, using advanced multivariate time series analysis techniques.

➢ *Research Questions:*

- What is the magnitude and direction of the impact of short-term shocks in major Asian markets on the immediate performance of Nifty 50 in India?
- What are the long-term trends and patterns in return spillover effects between major Asian counterparts and the Nifty 50 in India?

H. *Research Hypothesis:*

- Null Hypothesis: There is an insignificant impact of Asian counterparts' Indices performance on the Indian Nifty 50 return/ Returns.
- Alternate Hypothesis: There is a significant impact of Asian counterparts' Indices performance on the Indian Nifty 50 return/Returns

II. LITERATURE REVIEW

Research on stock market integration and information spillover is extensive, exploring various aspects. Some studies focus solely on return spillover, while others delve deeper into both return and volatility spillovers, encompassing the full picture of price movements across markets. Beyond simply detecting interdependence, research has examined the influence of specific events like crises and liberalization on cross-border information flow. Additionally, while most studies analyze the spillover itself, some investigate the underlying factors driving it, seeking to understand the "why" behind market interconnectedness. This diverse body of research offers valuable insights into the complex web of relationships between national equity markets.

It can also be seen that researchers have covered this interconnectedness among Asian economies and other economies around the world as well.

A. *Return and Volatility Spillover Effects Across the Globe:*

Gębka (2005) examined return and volatility spillover across emerging markets in Central and Eastern Europe, Latin America, and South-East Asia. Their analysis separated the influence of regional factors (intra-regional) from global factors (inter-regional) on these spillovers. Interestingly, both types of spillovers were significant, with intra-regional linkages being stronger. This suggests that emerging markets within the same region influence each other more than markets in different regions, even after accounting for the impact of the global market. Jeon & Von Furstenberg (1990) A study using daily stock price data from major global exchanges (Tokyo, Frankfurt, London, New York) revealed a significant shift in interconnectedness and leadership among these markets after the 1987 stock market crash. Yu & Hassan (2008) employing advanced EGARCH-M models and multivariate AR-GARCH models, this study sheds light on the intricate relationships between MENA and world stock markets. The results point to sizeable and predominantly positive volatility spillovers, signifying substantial transmission of volatility fluctuations between regions. Interestingly, each market tends to contribute more to its own volatility than it receives from others, despite the significant overall interdependence. Eun & Shim (1989) employed a sophisticated statistical technique (VAR) to analyze the intricate web of connections between nine major stock markets. Their findings revealed substantial interdependence among these markets, meaning that price movements in one market can rapidly impact others. This suggests that investors should consider the broader international context when making investment decisions, as local markets may be influenced by global trends.

(Ratanapakorn & Sharma, 2002) examines the pre- and post-Asian crisis relationships between stock markets in different regions (US, Europe, Asia, etc.). Before the crisis, no long-term connections were found, but during the crisis, a single long-term relationship and more short-term causal links emerged. Notably, only European markets directly influenced the US during the crisis, while others did so indirectly through Europe.

B. *Spillovers from US Markets:*

Utilizing high-frequency intra-day data, Kumar & Mukhopadhyay (2007) investigated the dynamic connections between India's NSE Nifty and the US NASDAQ Composite. Their study identified significant one-way volatility spillover from NASDAQ to Nifty, meaning Nifty's overnight volatility fluctuations mainly stem from daytime movements in the US market. On average, NASDAQ shocks contribute roughly 9.5% to Nifty's overnight volatility, while Nifty's influence on NASDAQ is negligible.

A similar study can be seen- Kotha Kumar Kiran (2002) reveals a strong US influence on the Indian stock market. US daytime returns (both NASDAQ and S&P 500) Granger cause the Nifty's movement, and both markets' daytime returns significantly impact Nifty overnight returns. Notably, volatility spillover is unidirectional, with NASDAQ shocks influencing Nifty overnight volatility (9.5% impact) far more than Nifty's daytime volatility affecting NASDAQ (0.5% impact). However, incorporating NASDAQ day trading information only improved forecasts of Nifty overnight return levels, not its volatility. Then, Yang (2003) analyzes long-term & short-term connections between US, Japan, & 10 Asian markets before, during, & after the 1997-98 crisis to assess its impact on stock market

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integration. We also have Morana & Beltratti (2008) that reveals stronger integration between the US and European markets compared to Japan. This is attributed to Japan's economic stagnation and weak fundamentals in the 1990s, which seemingly led to more independent market behavior.

Tan (2001) which says ESEA deregulation (1988-2000) led to increased stock market integration, measured by co-movement in daily returns. Geweke's measure and VAR analysis confirm, but US and Japan's influence remain balanced. Post-crisis, interdependence strengthens significantly.

Some studies can be seen that shows no or significantly low influence of US like - (Ng, 2000) Moving beyond traditional global focus, this study reveals substantial regional volatility spillovers from Japan to Pacific-Basin markets, independent of the US influence. A dedicated model identifies local, regional, and global contributions to each market's volatility, and interestingly, regional factors play a significant role. A significant study can be (Hsiao,2005) which employed a combination of pairwise and vector autoregression (VAR) models to rigorously test the causal relationships between various economic indicators. Their findings suggest that, while overall economic activity in the US may not directly drive individual Asian economies, financial shocks emanating from the US stock market can have significant spillover effects on regional markets. This highlights the importance of considering both real and financial linkages when assessing the interconnectedness of global economies.

C. Spillovers among Asian Economies:

Kedarnath & R K (2008) investigated return and volatility spillover between the Indian stock market and 12 other Asian countries using a GARCH model. They found significant two-way intraday return spillover between India and almost all the studied markets, indicating strong information flow and interconnectedness. Employing an EGARCH model, Habiba (2021) examined volatility spillover across several Asian emerging stock markets. Their analysis revealed statistically insignificant volatility transmission between China and India, China and Indonesia, China and Pakistan, as well as in the reverse directions (i.e., Pakistan to China, Pakistan to Indonesia, Pakistan to Korea, and Pakistan to Taiwan) over the specified study period. Joshi (2011) employed a sophisticated model (GARCH-BEKK) to analyze return and volatility spillover across six Asian stock markets. The study revealed two-way connections between most markets in terms of returns, shocks, and volatility, though the magnitude of these linkages was relatively low, suggesting weak integration. Notably, internal volatility (within each market) was more pronounced than cross-market influences. Japan exhibited the highest overall volatility persistence, while China had the lowest. (Fan, 2003) delves into the interconnectedness of Asia-Pacific stock markets, pushing the boundaries of existing research. Their analysis leverages cutting-edge techniques that handle structural breaks and volatility (GARCH effects). This allows for not only confirming cointegration but also quantifying how interdependence changes over time. Furthermore, Fan introduces novel causality tests suitable for analyzing integrated and cointegrated systems.

There are studies that takes the Asian Financial crisis into consideration as well as it was one of the major events occurred in Asia like (Jang & Sul, 2002) analyzed the changes in the co-movement among the stock markets of the countries which have undergone the Asian Financial crisis directly and the neighboring Asian countries using time series test as co-integration and the granger causality test. Some researchers also represent the pre and post Asian financial crisis conditions like- (Sheng & Tu, 2000) used multivariate cointegration and error correction test found that prior to the Asian financial crisis, stock markets in the Asia-Pacific region were largely independent. However, the crisis triggered a fundamental shift, leading to the formation of long-term linkages between national indices, as evidenced by cointegration analysis.

However, there are some conflicting views as well like the study (Nath Mukherjee & Mishra, 2005) analyzed daily data from 1996 to 2004 and found that, except for a few Asian countries, most markets studied weren't statistically integrated with India in the long run, suggesting limited long-term interdependence. However, short-term relationships were detected, indicating potential diversification opportunities for international investors. The goal was to assess potential diversification benefits for foreign investors in the Indian market. We also have (Nath & Verma, 2003) - Contrary to extensive research on developed markets, this study reveals a surprising lack of long-term equilibrium among the major South Asian stock markets. Despite analyzing data from India, Singapore, and Taiwan, spanning nine years, we found no consistent cointegration between their indices, indicating weak long-term interdependence.

Finally, (Bessler & Yang, 2011) uncover a fascinating interplay of influence among major stock markets. Their research identifies Japan as a bastion of independence, while Canada and France appear more vulnerable to external forces. The U.S. market emerges as a complex entity, both self-driven and receptive to inputs from key players like the U.K. and Switzerland. Most importantly, the U.S. stands alone in its lasting impact on the price movements of other major markets.

There is certain research that shows crucial gaps like - (Pretorius, 2009) While extensive research explores the degree of integration between stock markets, understanding the underlying reasons for this interconnectedness remains unexamined. This study delves into this crucial gap, arguing that comprehending the driving forces behind market relationships is even more valuable than simply confirming their existence.

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III. DATA AND METHODOLOGY

A. Data and Data Sources:

The research utilizes an extensive dataset covering Nifty 50 returns from April 1, 2013, to March 31, 2023, along with meticulously documented returns from stock market indices linked to major Asian counterparts of India, where in Nifty 50 returns serve as the Dependent Variable. The data collected consists of Daily prices spanning the time frame

The data collection will encompass key stock indicators like Opening, High, Low, closing prices, along with the volume of shares traded. The adjusted closing price will be considered, which accommodates factors like Stock Splits, bonuses, ESOPs, etc.

Table 1: Countries and Indices used in the Study

S. No.	Countries	Stock Index
1	India	Nifty 50
2	China	Shanghai Composite
3	Hong Kong	Hang Seng
4	Japan	Nikkie 225
5	South Korea	Kospi 200
6	Pakistan	Karachi 100
7	Malaysia	KLSE Composite
8	Taiwan	Taiwan weighted
9	Thailand	SET

Table 2: List of Variables

Endogenous	Exogenous
Nifty 50 Returns	Nifty 50, Hang Seng, Karachi 100, Kospi 200, Nikkie 225, SET, Taiwan weighted, KLSE Composite, Shanghai Returns

- Type of Research: Secondary
- Tool: E-views
- Technique: Multi-variate time series analysis – VECM
- Time Period for study: Daily data from 2013 to 2023
- Source: Yahoo finance

B. Methodology:

As the tests are being conducted for the returns of the specific indices, the following function will be used to calculate returns:

➢ *Equation 1: Logarithmic Returns*

$$R_t = log\left(\frac{Adjusted\ Close_t}{Adjusted\ Close_{t-1}}\right) * 100$$

The R_t shows the logarithmic returns for a specific index for any given period.

➢ *The Jarque-Bera Test:*

As the data collected is secondary, the statistical properties of the data must be checked to ensure that it follows a normal distribution. For the same, Skewness, Kurtosis, and Jarque-Bera will be conducted.

- *Hypothesis:*

✓ H_0: The data collected is normally distributed
✓ H_a: The data collected is not normally distributed

First, this test will be done for individual indices. The alternate hypothesis will be accepted when the p-value of the test is greater than 0.05 or 5%, concluding that the data is not normally distributed. However, the data for all the indices as a whole follows a normal distribution.

Additionally, we will move forward with the Johansen Cointegration test, a statistical test used to determine the presence and number of cointegrating vectors in a multivariate time series system. Cointegration occurs when two or more non-stationary time series have a long-run equilibrium and move together so that a linear combination results in a stationary time series.

➢ *Test for Stationarity:*

However, using a unit root test, we must make variables stationary for time series analysis. Stationary Data means the statistical characteristics like mean, variance, autocorrelation, etc, do not change over time. Meanwhile, non-stationary data makes it difficult to model and predict future values as new trends or patterns evolve with time.

- *Hypothesis:*

✓ H_0: There is a non-stationarity or Unit root problem in the data.
✓ H_a: There is a stationarity in the data.

➢ *Johansen Cointegration Test to Check Long-Term Relationships:*

Cointegration testing is used in time series analysis to identify whether a long-term relationship exists between two or more time series variables, particularly in modeling and analyzing the relationships between variables that may have a common stochastic trend.

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Cointegration is particularly relevant when variables are expected to move together in the long run, even if they may deviate from each other in the short term.

- *Hypothesis:*

✓ H_0: There are no cointegrating factors among the variables.
✓ H_a: There are cointegrating factors among the variables.

➢ *The Vector Error Correction Model for Multivariate Time Series Analysis:*

Further, the Vector Error Correction Model (VECM) is done. The Vector Error Correction Model (VECM) is commonly used in time series analysis to model the relationship between multiple cointegrated time series.

- *Hypothesis:*

✓ H_o: Exogenous variable does not influence Endogenous variables.
✓ H_a: Exogenous variables do influence Endogenous variables.

The general form of a VECM is given by:

➢ *Equation 1: Vector Error Correction Model*

$$\Delta \boldsymbol{Yt} = \boldsymbol{\alpha} + \boldsymbol{\beta_1} \Delta \boldsymbol{Y_{t-1}} + \boldsymbol{\beta_2} \Delta \boldsymbol{Y_{t-2}} + \cdots + \boldsymbol{\beta_p} \Delta \boldsymbol{Y_{t-p}} + \boldsymbol{\tau D_t} + \boldsymbol{\varepsilon_t}$$

It is a cointegrated VAR model. This idea of the Vector Error Correction Model (VECM) consists of a VAR model of the order p - 1 on the differences of the variables and an error-correction term derived from the known (estimated) cointegrating relationship. This model establishes a short-term relationship between the stock prices while correcting for the deviation from the long-term co-movement of prices. VECM incorporates the concept of an error correction term, which captures the short-term dynamics and adjustments toward the long-term equilibrium. The error correction term helps to model how deviations from the long-term equilibrium are corrected in the short run.

➢ *Granger Causality Test*

After this, we proceed with the Granger Causality test, which is designed to assess whether past values of one variable help predict future values of another variable. It does not imply a true causal relationship in the traditional sense, but rather a predictive relationship. If one variable Granger causes another, it suggests that the first variable contains information that is useful for predicting the second variable's future values.

- *Hypothesis:*

✓ $H_{0:}$ X does not Granger cause Y
✓ $H_{a:}$ X does Granger cause Y

Finally, we conclude with the Impulse Response Functions that provide insights into how a variable reacts to a one-unit shock in another variable, allowing researchers to analyze the short-term and long-term effects of shocks in a dynamic system.

IV. RESULTS AND DISCUSSIONS

A. *Descriptive Statistics:*

Table 3: Descriptive Statistics for Selected Indices

	HANGSENG	KARACHI	KLSE COMPOSITE	KOSPI 200	NIFTY 50	NIKKE 225	SET	SHANGHAI	TAIWAN
Mean	-0.0000565	0.0001008	-0.0000691	0.0000852	0.0004410	0.0003330	0.0000162	0.0001500	0.0002760
Median	0.0003000	0.0000000	0.0000255	0.0004910	0.0006360	0.0007230	0.0003270	0.0005010	0.0006610
Maximum	2.3296240	0.1789180	0.0662630	0.0875480	0.0840030	0.0773140	0.0765310	0.0849470	0.0617260
Minimum	-2.3253660	-0.2133230	-0.0540470	-0.0797800	-0.1390380	-0.0825290	-0.1142820	-0.0887320	-0.0652060
Std. Dev.	0.0938030	0.0244540	0.0069030	0.0104170	0.0108990	0.0130660	0.0098510	0.1325700	0.0095310
Skewness	0.0002670	0.0107700	-0.1317070	-0.0807410	-1.2234360	-0.2525490	-1.3564140	-0.9705850	-0.5595700
Kurtosis	594.1043000	8.0648210	11.2750400	9.2448690	20.4658000	7.3375860	21.7735500	10.8765200	8.1494700
Jarque-Bera	35901299.00	2635.83	7043.07	4009.76	31959.49	1959.42	36970.01	6761.74	2851.71
Probability	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sum	-0.1394420	2.4849430	-0.1704380	0.2099990	1.0877810	0.8207120	0.0399870	0.3698490	0.6808620
Sum Sq. Dev.	21.6896400	1.4740270	0.1174590	0.2928010	0.2928010	0.4208530	0.2392140	0.4332190	0.2239220
Observations	2466	2466	2466	2466	2466	2466	2466	2466	2466

Here, we see the p-value for Jarque Bera of all variables is less than 0.05 and therefore, the null hypothesis of the test is rejected which tells us that the data is not normally distributed.

In a normal distribution, the mean, median, and mode all coincide. As the curve is symmetrical with a single peak at the center, the average (mean), the middlemost value (median), and the most frequent value (mode) all fall at the same point, which is the peak of the curve. A normal distribution, often called a "bell curve," has thin tails at the ends, meaning extreme events (very high positive or negative returns) are unlikely. In contrast, stock returns exhibit fatter tails. This signifies a higher probability of both large gains and significant losses than a normal distribution would predict.

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Stock returns often exhibit skewness. Skewness describes how a distribution of data deviates from symmetry. It tells you whether the data leans more towards one side (left or right) compared to a normal distribution. They may be positively skewed, where there are more frequent small gains with a few exceptional large gains. Alternatively, they might be negatively skewed, with a concentration of small losses and the occasional major crash.

Further, all variables except Hangseng and Karachi have negative skewness. Skewness tells how symmetrical the data is, and negative and positive skewness refer to the direction of the asymmetry. Positive skewness indicates that the data is clustered on the left side with a longer tail stretching out towards the right side of the distribution. This means there are more frequent lower values and a few higher outliers. Whereas negative skewness indicates that the data is clustered on the right side with a longer tail stretching out towards the left side of the distribution. This means there are more frequently higher values and a few lower outliers.

B. Unit Root Tests:

Table 4: Unit Root Test

	t-Statistic	**P-Value**
Nifty 50	-17.67580	0.0000
Hang Seng	-27.36607	0.0000
Karachi 100	-29.5751	0.0000
KLSE Composite	-32.87299	0.0000
Kospi 200	-32.99415	0.0000
Nikkie 225	-33.57275	0.0000
SET	-50.54347	0.0001
Shanghai	-47.58169	0.0001
Taiwan Weighted	-49.18060	0.0001

A unit root test is a statistical tool used to analyze time series data, specifically to see if the data has a unit root. A unit root basically means that the past value of the series strongly influences the present value. If there's a unit root, an increase today tends to lead to another increase tomorrow, and a decrease today tends to lead to another decrease tomorrow, with the changes just following the trend set by the previous value. The key takeaway is that a unit root makes the data non-stationary. This means the statistical properties of the data (like mean and variance) can change over time, making it difficult to analyze trends or forecast future values using standard methods. The most employed unit root test is the Augmented Dickey-Fuller (ADF) test. The ADF test assesses the null hypothesis that a unit root is present in a time series against the alternative hypothesis of stationarity. The test involves regressing the variable on its lagged values and examining the significance of the coefficient on the lagged variable. If the test statistic is sufficiently negative, and the p-value is below a chosen significance level, the null hypothesis of a unit root is rejected, indicating that the time series is likely stationary.

If the p-value is less than 0.05, then the null hypothesis is rejected. Here the p-value for all the variables is less than 0.05, so the null hypothesis is rejected, and it can be said that the data is stationary. Stationary data is the data for which the statistical properties do not change with time, and it can be easier to predict and model.

C. The Johansen Cointegration Test:

Table 5: The Johanse3n Cointegration Test

Data trend:	**None**	**None**	**Linear**	**Linear**	**Quadratic**
Test type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	9	9	9	9	9
Max-Eig	9	9	9	9	9
Information Criteria by Rank and Model					
Data trend:	None	None	Linear	Linear	Quadratic
Rank or No. of Ces	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Akaike Information Criteria by Rank (Rows) and Model (Columns)					
0	-49.34454	-49.34454	-49.33723	-49.33723	-49.32992
1	-49.77232	-49.77169	-49.76520	-49.76446	-49.75797
2	-50.03887	-50.03751	-50.03183	-50.03031	-50.02463
3	-50.28166	-50.27968	-50.27481	-50.27247	-50.26760

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4	-50.46444	-50.46165	-50.45759	-50.45450	-50.45045
5	-50.62899	-50.62557	-50.62232	-50.61893	-50.61568
6	-50.78823	-50.78556	-50.78312	-50.77914	-50.77670
7	-50.93545	-50.93223	-50.93061	-50.92581	-50.92419
8	-51.07697	-51.07295	-51.07214	-51.06654	-51.06572
9	-51.17346*	-51.16949	-51.16949	-51.16327	-51.16327

Data Trend specifies whether a constant term, a linear trend, or a quadratic trend is included in the model, Test Type shows two options: "No Intercept" and "Intercept". These refer to whether a constant term is included in the cointegration regression equation and Trace and Max-Eig are two test statistics used in the Johansen test to assess the null hypothesis that there are no cointegrating relationships.

We use Akaike Information Criteria by Rank (Rows) and Model (Columns). This criterion is used to compare different models and select the one that best fits the data. The star mark comes at 9 which tells there are 9 lag values and No intercept No Trend model.

Table 6: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	T-Statistic	0.05 Critical Value	Probability
None*	0.205076	2810.267	54.96577	0.0000
At Most 1*	0.156052	2248.	48.87720	0.0000
At Most 2*	0.136566	2810.267	42.77219	0.0000
At Most 3*	0.126697	2810.267	36.63019	0.0000
At Most 4*	0.117355	2810.267	30.43961	0.0000
At Most 5*	0.103229	2810.267	24.15921	0.0000
At Most 6*	0.089582	2810.267	17.79730	0.0000
At Most 7*	0.083289	2810.267	11.22480	0.0000
At Most 8*	0.051467	2810.267	4.129906	0.0000

Cointegration is a statistical concept that helps us understand the long-term relationship between two or more time series variables. In simple terms, if two variables are cointegrated, it means they tend to move together over the long run, even though they might show short-term fluctuations.

Cointegration helps us uncover long-term stable relationships between non-stationary time series variables. These variables might exhibit trends or fluctuations over time, but cointegration indicates they're bound together in the long run. The null hypothesis is that there are no cointegrating factors among the variables. The decision criteria being if Trace Statistic > Critical value, then Reject Ho.

Here, the Trace statistic value is greater than the critical value for all the variables. So therefore, the null hypothesis is rejected and the cointegration test indicates that there are 9 cointegrating equations at 0.05 level.

So, Cointegration exists which means there is a long run relationship among these variables.

If cointegration exists, we proceed with the Vector Error Correction Model. Cointegration tests identify the long-term relationships, and VECMs allow us to explore the short-run dynamics within these systems. It offers a unique advantage by combining short-run and long-run dynamics in a single framework. They capture the immediate impacts of changes in one variable on another (short-run) while simultaneously accounting for the tendency to revert to the long-run equilibrium relationships allowing a richer understanding of how variables interact and influence each other.

D. Vector Error Correction Model:

Table 7: Vector error Correction Estimates

Vector Error Correction Estimates		
Cointegrating Eq:	**Coefficient**	**T-Stat**
NIFTY (-1)	-1.0000	
HANG_SENG (-1)	-122.2281*	-24.1955
KARACHI_100(-1)	-1.029133	-0.2503
KLSE_COMPOSITE (-1)	29.51170	1.71723
KOSPI_200(-1)	40.37238*	2.82220
NIKKIE_225(-1)	38.17963*	3.85138
SET (-1)	0.434041	0.03769
SHANGHAI (-1)	5.053087	0.57993
TAIWAN_WEIGHTED (-1)	20.17730	0.28757

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This table talks about the long-term relationship of the variables with Nifty 50. A variable has a significant impact on the Endogenous variable if the T-Stat value lies between – 1.96 to 1.96. Here, only HangSeng, Kospi 200 and Nikkie 225 have significant impact on Nifty 50 returns.

Moreover, Kospi 200 most significantly impacts Nifty 50 positively in the long run.

Table 8: Error Correction Model

Error Correction		D(NIFTY)
CointEq1	Coefficient	0.00082
	T-stat	3.30556
D (NIFTY (-1))	Coefficient	-0.89444
	T-stat	-43.1692
D (NIFTY (-2))	Coefficient	-0.82449
	T-stat	-29.8440
D (NIFTY (-3))	Coefficient	-0.71561
	T-stat	-22.3440
D (NIFTY (-4))	Coefficient	-0.61225
	T-stat	-17.8867
D (NIFTY (-5))	Coefficient	-0.45224
	T-stat	-12.8199
D (NIFTY (-6))	Coefficient	-0.45731
	T-stat	-13.3971
D (NIFTY (-7))	Coefficient	-0.29388
	T-stat	-9.17861
D (NIFTY (-8))	Coefficient	-0.21696
	T-stat	-7.85657
D (NIFTY (-9))	Coefficient	-0.11358
	T-stat	-5.46181
D (HANG_SENG (-1))	Coefficient	0.099997
	T-stat	3.44987
D (HANG_SENG (-2))	Coefficient	0.09154
	T-stat	3.40865
D (HANG_SENG (-3))	Coefficient	0.07937
	T-stat	3.28953
D (HANG_SENG (-4))	Coefficient	0.06488
	T-stat	3.09322
D (HANG_SENG (-5))	Coefficient	0.05109
	T-stat	2.91634
D (HANG_SENG (-6))	Coefficient	0.03858
	T-stat	2.78148
D (HANG_SENG (-7))	Coefficient	0.02661
	T-stat	2.62542
D (HANG_SENG (-8))	Coefficient	0.01451
	T-stat	2.23793
D (HANG_SENG (-9))	Coefficient	0.00788
	T-stat	2.53500
D (KLSE_COMPOSITE (-1))	Coefficient	-0.0828
	T-stat	-2.57468
D (KLSE_COMPOSITE (-2))	Coefficient	-0.10647
	T-stat	-2.51212
D (KLSE_COMPOSITE (-3))	Coefficient	-0.13531
	T-stat	-2.85358
D (KLSE_COMPOSITE (-4))	Coefficient	-0.09815
	T-stat	-1.96832
D (KOSPI_200 (-6))	Coefficient	0.088596
	T-stat	2.58262
D (KOSPI (-7))	Coefficient	0.097194
	T-stat	2.98875

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D (KOSPI (-8))	Coefficient	0.096272
	T-stat	3.34476
D (KOSPI (-9))	Coefficient	0.080645
	T-stat	3.8054
D (NIKKIE_225 (-4))	Coefficient	0.08151
	T-stat	2.99998
D (NIKKIE_225 (-5))	Coefficient	0.08447
	T-stat	3.03814
D (SET (-1))	Coefficient	-0.04796
	T-stat	-2.16547
D (SET (-4))	Coefficient	0.085962
	T-stat	2.3586
D (SET (-5))	Coefficient	0.131013
	T-stat	3.48822
D (SET (-6))	Coefficient	0.085683
	T-stat	2.34514
D (SET (-7))	Coefficient	0.087485
	T-stat	2.53819

The second table of the VECM model talks about the short-term relation of these variables with Nifty 50. This shows how Nifty 50 is impacted due to the lagged values of these following variables.

- *The Following is the Equation:*

d(NIFTY)-
d(NIFTY(-1)), d(NIFTY(-2)), d(NIFTY(-3)), d(NIFTY(-4)), d(NIFTY(-5)), d(NIFTY(-6)), d(NIFTY(-7)), d(NIFTY(-8)), d(NIFTY(-9)), d(HANG_SENG(-1)), d(HANG_SENG(-2)), d(HANG_SENG(-3)), d(HANG_SENG(-4)), d(HANG_SENG(-5)), d(HANG_SENG(-6)), d(HANG_SENG(-7)), d(HANG_SENG(-8)), d(HANG_SENG(-9)), d(KLSE_COMPOSITE(-1)), d(KLSE_COMPOSITE(-2)), d(KLSE_COMPOSITE(-3)), d(KOSPI_200(-6)), d(KOSPI_200(-7)), d(KOSPI_200(-8)), d(KOSPI_200(-9)), d(NIKKIE_225(-4)), d(NIKKIE_225(-5)), d(SET(-1)), d(SET(-4)), d(SET(-5)), d(SET(-6)), d(SET(-7))..

E. *Granger Causality Test:*

Further, the predictive relationship of the variables was seen using the Granger Causality test which is designed to assess whether past values of one variable help predict future values of another variable. If one variable Granger causes another, it suggests that the first variable contains information that is useful for predicting the second variable's future values.

Table 9: Granger Causality Test

	P value
Nifty does not Granger cause Hang Seng	3.00E-05
Nifty does not Granger cause KLSE Composite	1.00E-11
Kospi 200 does not Granger cause Nifty	4.00E-24
Nifty does not Granger cause Kospi 200	5.00E-08
Nifty does not Granger cause Nikkie 225	4.00E-10
SET does not Granger cause Nifty	3.00E-08
Taiwan Weighted does not Granger cause Nifty	1.00E-08
Nikkie 225 does not Granger cause KLSE Composite	2.00E-16

The p value for these variables is less than 0.05 and therefore, null hypothesis is rejected. It can be said that Nifty can be significant in predicting the future values of Hang Seng, KLSE Composite, Kospi 200 and Nikkie 225. Also, the future values of Nifty are affected by the previous values of Kospi 200, SET and Taiwan weighted.

Here also, South Korea emerges out as the most significant market for India. The indices for both these markets are interdependent.

V. FINDINGS AND CONCLUSIONS

First, it was found that Hangseng and Karachi 100 had positive skewness which means that the returns of these two indices are less than the average returns and the distribution is skewed towards the right meaning the mass of the distribution is concentrated on the left side. However, all the other variables had negative skewness meaning the returns of these indices are higher than the average returns.

It was also found that co-integration exists among these variables. It means that there is a long-term relationship meaning the variables tend to move together over the long run, even though they might show short-term fluctuations. After this, Vector Error Correction Model was employed in which the error correction term helps to model how deviations from the long-term equilibrium are corrected in the short run. Long run and short run spillover is observed from VECM.

In the long run, the Kospi 200 and Nikkie 225 significantly impact the Nifty 50, where the Kospi 200 is the most significant, i.e., a positive impact of 40%.

The predictive relationship was also seen by employing the Granger Causality test and assessing whether past values of one variable help predict future values of another. It was again found that the Kospi 200 and Nikkie 225 help predict the future values of the Nifty 50, and the Nifty 50 also helps predict the future values of the Kospi 200 and Nikkie 225.

An impulse response function was also employed that provides insights into how a variable reacts to a one-unit shock in another variable, allowing researchers to analyze the short-term and long-term effects of shocks in a dynamic system. The most prominent responses are to innovations in the KOSPI 200, the KLSE Composite, Nikkie 225, and the Hang Seng.

It was confirmed that the model is stable using the AR roots graph, as all the data points lie within or at the circle's boundary.

Therefore, by applying Multivariate time series analysis techniques with the index price data over a period from April 2013 to March 2023, an effort has been made to investigate the stock market integration and return spillover among India and 8 other Asian markets.

The most significant markets for India are South Korea and Japan according to this research as it has a long run relation as well as can be crucial for predicting future values of Nifty 50.

Here are a few additional insights as to why South Korea is significant market for the performance of Nifty 50.

➢ *Bilateral Relation between India and South Korea*

Both countries formed a “Strategic Partnership” in the year 2010, which was elevated to a “Special Strategic Partnership” in the year 2015 during the State Visit of Prime Minister Narendra Modi to Seoul. There are political relations, defense, cultural and economic relations, and bilateral trade.

India played an essential role in the Korean peninsula after Korea's independence in 1945. In June 2020, PM Narendra Modi gave a video message during an event to commemorate the 70th anniversary of the Korean War. An exhibition to celebrate India’s contribution to the Korean War was co-organized in March 2022 by the Embassy of India in Seoul.

PM Narendra Modi paid a State Visit to ROK from 21-22 February 2019 and unveiled a bust of Mahatma Gandhi at the prestigious Yonsei University. Foreign Ministers held discussions on political contacts, trade & investments, defense, S&T, energy, space, semiconductors, emerging technologies, and cultural exchanges during their bilateral meeting on 07 April 2023 in New Delhi.

Bilateral trade in 2022 reached record levels of US$ 27.8 billion. India’s import volume is US$ 18.8 billion, while the export volume is US$ 9 billion. India’s exports to Korea are mineral fuels/oil distillates (mainly naphtha), cereals, iron, and steel. On the other hand, Korea’s main export items are automobile parts, telecommunication equipment, hot rolled iron products, petroleum refined products, base lubricating oils, mechanical appliances, electrical machinery & parts, and iron and steel products.

India and ROK defense relations have strengthened in recent years. The Defense Ministers of ROK and India have been interacting regularly since 2015. A Roadmap for Defense Industries Cooperation was signed between the two countries in September 2019. In recent exchanges, two ROK naval ships visited Chennai port in October 2022. Two Indian naval ships INS Shivalik and INS Kamora visited Busan Naval Base in November 2022.

➢ *Bilateral trade between two countries can have a significant impact on their respective stock market indices:*

- Increased bilateral trade can boost the revenues and profits of companies involved in export and import activities, positively impacting their stock prices. Conversely, trade tensions or disruptions may adversely affect corporate earnings and stock prices.
- It also contributes to overall economic growth, and Positive economic indicators can favor stock market indices.
- Bilateral trade relations can influence investor sentiment. Positive trade agreements or partnerships developments may boost investor confidence, leading to increased investment in the stock market. Trade activities can influence exchange rates. An increase in bilateral trade may impact the value of the currencies involved. Currency movements, in turn, can affect the competitiveness of exports and imports, influencing the stock prices of companies engaged in international trade.

VI. RECOMMENDATIONS

If overseas investors are drawn to the KOSPI 200's notable influence on the Nifty 50, it would be wise for them to learn about the connection between these indices prior to making any investing choices. It is still essential to diversify the assets across a range of asset classes and geographies in order to reduce the risk of linked swings. It is advisable to closely watch geopolitical developments and global

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economic data to assess possible effects on the markets in South Korea and India. Depending on risk tolerance and legal restrictions, it may be advantageous to consider derivatives for hedging. The key to negotiating the complexities of investing in indices impacted by outside events is to be abreast of market movements, seek advice from financial experts knowledgeable in both markets and keep an eye on the big picture. In the end, comprehensive research from the investor's end is crucial.

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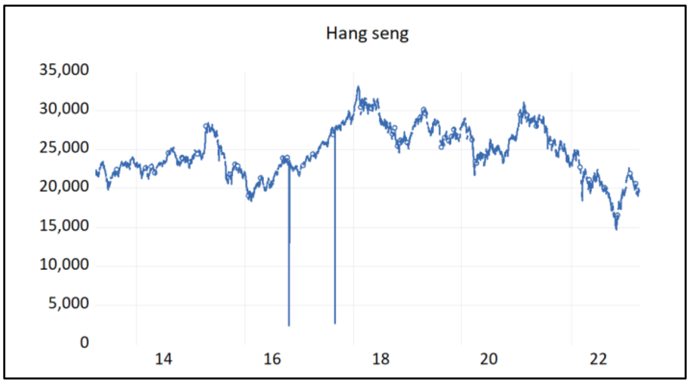
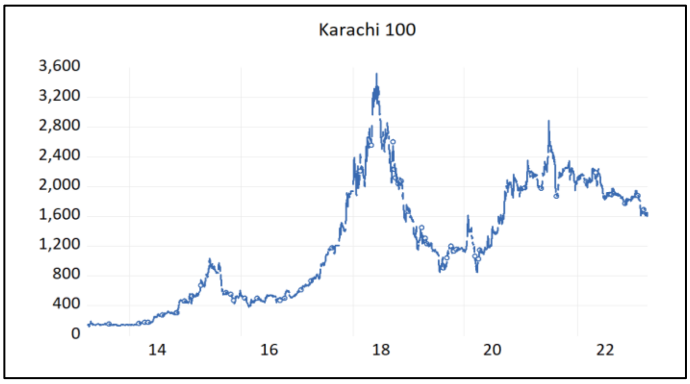
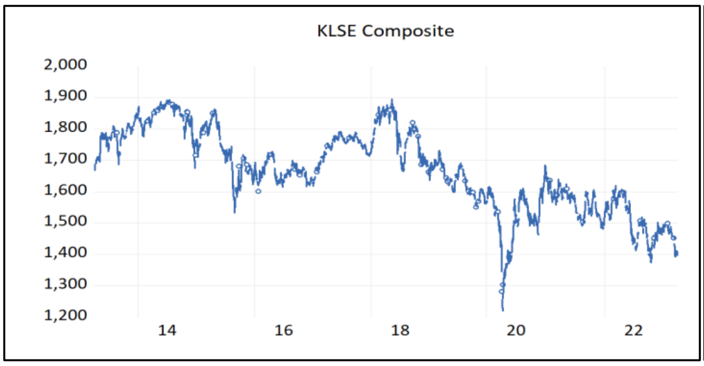
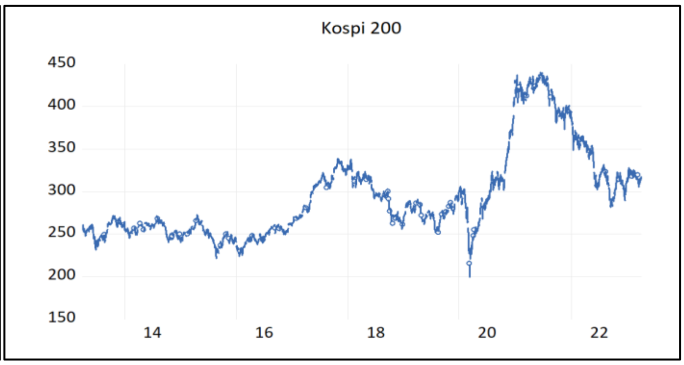
APPENDIX

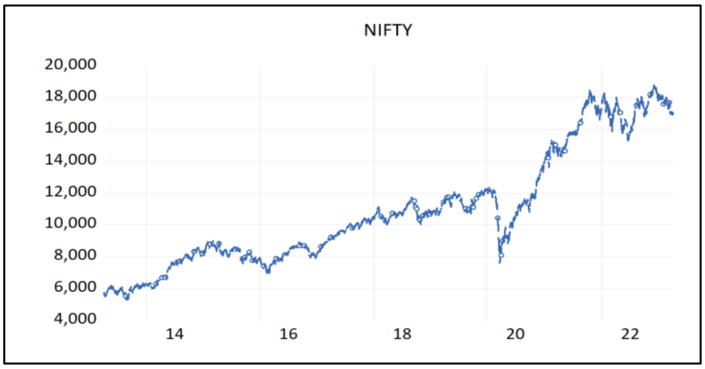
TREND ANALYSIS

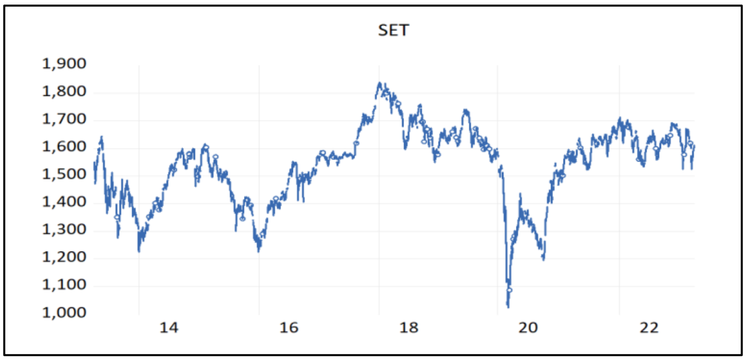


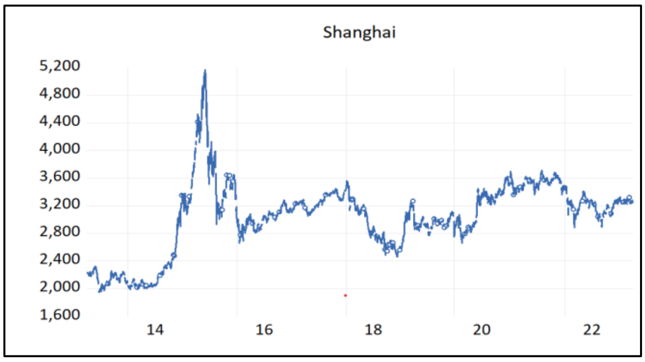












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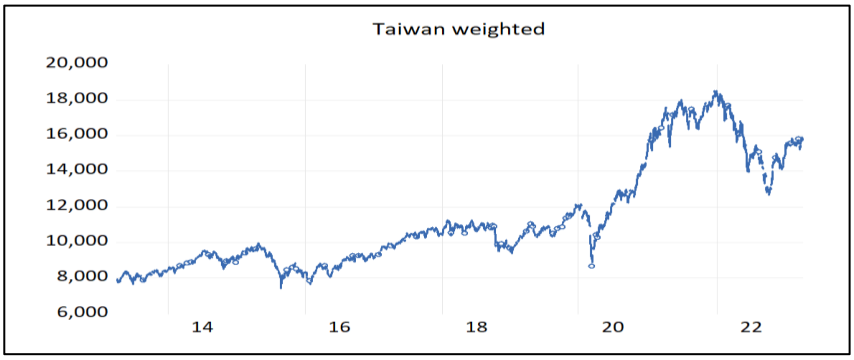

UNIT ROOT TESTS

Null Hypothesis: NIFTY has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-17.67580	0.0000
Test critical values:	1% level	-3.432812	
	5% level	-2.862514	
	10% level	-2.567333	

Null Hypothesis: HANG_SENG has a unit root
Exogenous: Constant
Lag Length: 7 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-27.36607	0.0000
Test critical values:	1% level	-3.432813	
	5% level	-2.862514	
	10% level	-2.567334	

Null Hypothesis: KARACHI_100 has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-29.57509	0.0000
Test critical values:	1% level	-3.432807	
	5% level	-2.862511	
	10% level	-2.567332	

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Null Hypothesis: KLSE_COMPOSITE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-32.87299	0.0000
Test critical values:	1% level	-3.432807	
	5% level	-2.862511	
	10% level	-2.567332	

Null Hypothesis: KLSE_COMPOSITE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-32.87299	0.0000
Test critical values:	1% level	-3.432807	
	5% level	-2.862511	
	10% level	-2.567332	

Null Hypothesis: NIKKIE_225 has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-33.57275	0.0000
Test critical values:	1% level	-3.432811	
	5% level	-2.862513	
	10% level	-2.567333	

Null Hypothesis: SET has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-50.54347	0.0001
Test critical values:	1% level	-3.432806	
	5% level	-2.862511	
	10% level	-2.567332	

Null Hypothesis: SHANGHAI has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-47.58169	0.0001
Test critical values:	1% level	-3.432806	
	5% level	-2.862511	
	10% level	-2.567332	

Null Hypothesis: TAIWAN_WEIGHTED has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=26)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-49.18060	0.0001
Test critical values:	1% level	-3.432806	
	5% level	-2.862511	
	10% level	-2.567332	

JOHANSON COINTEGRATION TEST

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.205092	2809.971	179.5098	0.0000
At most 1 *	0.156017	2248.313	143.6691	0.0000
At most 2 *	0.137677	1833.247	111.7805	0.0000
At most 3 *	0.126225	1470.784	83.93712	0.0000
At most 4 *	0.117197	1140.604	60.06141	0.0000
At most 5 *	0.101779	835.5773	40.17493	0.0000
At most 6 *	0.090547	572.9182	24.27596	0.0000
At most 7 *	0.082762	340.6682	12.32090	0.0000
At most 8 *	0.051460	129.2774	4.129906	0.0000

Trace test indicates 9 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.205092	561.6577	54.96577	0.0000
At most 1 *	0.156017	415.0662	48.87720	0.0000
At most 2 *	0.137677	362.4625	42.77219	0.0000
At most 3 *	0.126225	330.1805	36.63019	0.0000
At most 4 *	0.117197	305.0265	30.43961	0.0000
At most 5 *	0.101779	262.6591	24.15921	0.0000
At most 6 *	0.090547	232.2500	17.79730	0.0000
At most 7 *	0.082762	211.3908	11.22480	0.0000
At most 8 *	0.051460	129.2774	4.129906	0.0000

Max-eigenvalue test indicates 9 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

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VECTOR ERROR CORRECTION MODEL

Vector Autoregression Estimates

Vector Autoregression Estimates
Date: 03/18/24 Time: 13:19
Sample (adjusted): 4/12/2013 3/29/2023
Included observations: 2449 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	NIFTY	HANG_SENG	KARACHI_...	KLSE_CO...	KOSPI_200	NIKKIE_225	SET	SHANGHAI	TAIWAN_W...
NIFTY(-1)	-0.026019	0.229918	0.090323	0.025657	0.088411	0.010556	0.025694	-0.011261	0.028085
	(0.02086)	(0.14639)	(0.04718)	(0.01348)	(0.01990)	(0.02569)	(0.01961)	(0.02658)	(0.01867)
	[-1.24726]	[1.57060]	[1.91440]	[1.90382]	[4.44184]	[0.41086]	[1.31028]	[-0.42372]	[1.50413]
NIFTY(-2)	-0.063058	0.107887	-0.028924	0.033592	-0.057749	0.091468	0.012013	-0.029260	-0.024010
	(0.02089)	(0.14658)	(0.04724)	(0.01349)	(0.01993)	(0.02573)	(0.01964)	(0.02661)	(0.01870)
	[-3.01879]	[0.73601]	[-0.61223]	[2.48936]	[-2.89749]	[3.55536]	[0.61182]	[-1.09951]	[-1.28420]
NIFTY(-3)	-0.016828	0.166537	0.040149	0.057839	-0.041742	0.037887	0.005859	0.011105	0.004919
	(0.02091)	(0.14674)	(0.04729)	(0.01351)	(0.01995)	(0.02575)	(0.01966)	(0.02664)	(0.01872)
	[-0.80475]	[1.13490]	[0.84891]	[4.28160]	[-2.09210]	[1.47109]	[0.29805]	[0.41685]	[0.26282]
NIFTY(-4)	-0.025101	0.245762	-0.060414	-0.027539	-0.047451	0.081383	-0.039509	-0.056799	0.004306
	(0.02065)	(0.14494)	(0.04671)	(0.01334)	(0.01971)	(0.02544)	(0.01941)	(0.02631)	(0.01849)
	[-1.21531]	[1.69567]	[-1.29331]	[-2.06402]	[-2.40789]	[3.19934]	[-2.03496]	[-2.15865]	[0.23294]
NIFTY(-5)	0.055433	0.343012	0.051710	-0.033308	-0.069796	0.015359	0.000146	0.070341	-0.010417
	(0.02070)	(0.14529)	(0.04683)	(0.01338)	(0.01975)	(0.02550)	(0.01946)	(0.02638)	(0.01853)
	[2.67743]	[2.36090]	[1.10430]	[-2.49030]	[-3.53314]	[0.60233]	[0.00753]	[2.66681]	[-0.56214]
NIFTY(-6)	-0.106658	0.092389	-0.012121	0.012929	0.008567	-0.019776	0.014469	0.016054	-0.017395
	(0.02074)	(0.14554)	(0.04691)	(0.01340)	(0.01979)	(0.02554)	(0.01950)	(0.02642)	(0.01856)
	[-5.14284]	[0.63482]	[-0.25840]	[0.96497]	[0.43293]	[-0.77423]	[0.74216]	[0.60760]	[-0.93709]
NIFTY(-7)	0.052525	0.273287	-0.037993	-0.000990	0.006616	0.100676	-0.030449	-0.009268	0.029050
	(0.02073)	(0.14549)	(0.04689)	(0.01339)	(0.01978)	(0.02553)	(0.01949)	(0.02641)	(0.01856)
	[2.53355]	[1.87845]	[-0.81026]	[-0.07394]	[0.33448]	[3.94286]	[-1.56240]	[-0.35090]	[1.56546]
NIFTY(-8)	-0.024764	0.051241	-0.011710	0.040259	0.007651	0.096154	-0.018061	-0.003982	0.014687
	(0.02079)	(0.14587)	(0.04702)	(0.01343)	(0.01983)	(0.02560)	(0.01954)	(0.02648)	(0.01861)
	[-1.19130]	[0.35127]	[-0.24906]	[2.99789]	[0.38574]	[3.75570]	[-0.92428]	[-0.15038]	[0.78936]
NIFTY(-9)	0.004549	0.348920	0.024267	0.012998	0.025306	0.029906	0.027012	-0.011981	0.004943
	(0.02079)	(0.14587)	(0.04701)	(0.01343)	(0.01983)	(0.02560)	(0.01954)	(0.02648)	(0.01861)
	[0.21886]	[2.39196]	[0.51617]	[0.96792]	[1.27588]	[1.16813]	[1.38236]	[-0.45243]	[0.26567]
HANG_SENG(-1)	0.004970	-0.837726	-0.002000	-0.001050	-0.001748	0.001946	-0.002473	-0.003487	0.001579
	(0.00292)	(0.02047)	(0.00660)	(0.00188)	(0.00278)	(0.00359)	(0.00274)	(0.00372)	(0.00261)
	[1.70369]	[-40.9224]	[-0.30308]	[-0.55738]	[-0.62784]	[0.54167]	[-0.90187]	[-0.93824]	[0.60457]
HANG_SENG(-2)	0.001060	-0.700743	0.001672	-0.000227	-0.003995	0.005969	-0.003613	-0.004016	0.001497
	(0.00379)	(0.02659)	(0.00857)	(0.00245)	(0.00362)	(0.00467)	(0.00356)	(0.00483)	(0.00339)
	[0.27969]	[-26.3504]	[0.19507]	[-0.09273]	[-1.10479]	[1.27893]	[-1.01411]	[-0.83183]	[0.44144]
HANG_SENG(-3)	0.000392	-0.577423	0.011576	0.001150	-0.004769	0.011156	-0.004833	-0.001640	5.53E-05
	(0.00426)	(0.02988)	(0.00963)	(0.00275)	(0.00406)	(0.00524)	(0.00400)	(0.00542)	(0.00381)
	[0.09196]	[-19.3238]	[1.20201]	[0.41816]	[-1.17374]	[2.12726]	[-1.20738]	[-0.30228]	[0.01451]
HANG_SENG(-4)	-0.000768	-0.472027	0.005546	0.003220	-0.003358	0.009017	-0.002145	-0.001235	-0.000337
	(0.00451)	(0.03161)	(0.01019)	(0.00291)	(0.00430)	(0.00555)	(0.00423)	(0.00574)	(0.00403)
	[-0.17040]	[-14.9311]	[0.54435]	[1.10633]	[-0.78133]	[1.62510]	[-0.50647]	[-0.21516]	[-0.08355]
HANG_SENG(-5)	0.000360	-0.380883	0.008976	0.003176	-0.000323	0.010472	0.001846	-0.000730	-0.001895
	(0.00458)	(0.03213)	(0.01036)	(0.00296)	(0.00437)	(0.00564)	(0.00430)	(0.00583)	(0.00410)
	[0.07862]	[-11.8536]	[0.86671]	[1.07378]	[-0.07402]	[1.85690]	[0.42889]	[-0.12509]	[-0.46247]
HANG_SENG(-6)	0.001128	-0.294619	0.005920	0.003464	0.001168	0.022935	0.000493	0.000929	-0.004324
	(0.00451)	(0.03162)	(0.01019)	(0.00291)	(0.00430)	(0.00555)	(0.00424)	(0.00574)	(0.00403)
	[0.25033]	[-9.31736]	[0.58093]	[1.18990]	[0.27173]	[4.13266]	[0.11630]	[0.16180]	[-1.07207]
HANG_SENG(-7)	0.000707	-0.216995	-0.004558	0.002180	0.001240	0.011526	0.002474	-0.001022	-0.006274
	(0.00427)	(0.03000)	(0.00967)	(0.00276)	(0.00408)	(0.00526)	(0.00402)	(0.00545)	(0.00383)
	[0.16531]	[-7.23424]	[-0.47145]	[0.78959]	[0.30414]	[2.18931]	[0.61568]	[-0.18772]	[-1.63984]
HANG_SENG(-8)	-0.000809	-0.137290	-0.004343	0.002355	0.000516	0.006694	0.001742	-0.001183	-0.006872
	(0.00381)	(0.02671)	(0.00861)	(0.00246)	(0.00363)	(0.00469)	(0.00358)	(0.00485)	(0.00341)
	[-0.21270]	[-5.14089]	[-0.50454]	[0.95780]	[0.14217]	[1.42818]	[0.48684]	[-0.24399]	[-2.01747]
HANG_SENG(-9)	0.002854	-0.066443	0.004390	0.001460	-0.002555	0.000935	0.000971	0.001020	-0.004190
	(0.00293)	(0.02058)	(0.00663)	(0.00189)	(0.00280)	(0.00361)	(0.00276)	(0.00374)	(0.00263)
	[0.97293]	[-3.22783]	[0.66170]	[0.77061]	[-0.91283]	[0.25868]	[0.35199]	[0.27298]	[-1.59593]

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KARACHI_100(-1)	0.008343	0.044839	0.155479	0.005613	-0.004929	0.015959	-0.004961	-0.000789	-0.008958
	(0.00921)	(0.06464)	(0.02083)	(0.00595)	(0.00879)	(0.01134)	(0.00866)	(0.01174)	(0.00824)
	[0.90571]	[0.69367]	[7.46296]	[0.94320]	[-0.56081]	[1.40669]	[-0.57297]	[-0.06720]	[-1.08647]
KARACHI_100(-2)	-0.000845	-0.054579	0.081793	-0.001812	0.014416	-0.025163	-0.008380	0.016814	-0.001988
	(0.00928)	(0.06511)	(0.02098)	(0.00599)	(0.00885)	(0.01143)	(0.00872)	(0.01182)	(0.00830)
	[-0.09110]	[-0.83825]	[3.89767]	[-0.30230]	[1.62837]	[-2.20203]	[-0.96081]	[1.42247]	[-0.23933]
KARACHI_100(-3)	0.002801	0.043678	-0.038243	-0.012066	0.012694	-0.008531	-0.003031	3.85E-05	0.004222
	(0.00917)	(0.06433)	(0.02073)	(0.00592)	(0.00875)	(0.01129)	(0.00862)	(0.01168)	(0.00820)
	[0.30551]	[0.67899]	[-1.84454]	[-2.03747]	[1.45130]	[-0.75560]	[-0.35176]	[0.00329]	[0.51462]
KARACHI_100(-4)	0.004713	0.029680	-0.014840	0.001969	-0.013679	0.003906	-0.007107	0.015813	-0.007965
	(0.00918)	(0.06440)	(0.02075)	(0.00593)	(0.00876)	(0.01130)	(0.00863)	(0.01169)	(0.00821)
	[0.51361]	[0.46089]	[-0.71501]	[0.33207]	[-1.56232]	[0.34558]	[-0.82393]	[1.35258]	[-0.96965]
KARACHI_100(-5)	0.004473	-0.060744	-0.021889	0.004277	-0.012491	0.000314	0.001831	-0.012256	0.011536
	(0.00917)	(0.06438)	(0.02075)	(0.00593)	(0.00875)	(0.01130)	(0.00862)	(0.01169)	(0.00821)
	[0.48754]	[-0.94355]	[-1.05493]	[0.72166]	[-1.42698]	[0.02779]	[0.21237]	[-1.04860]	[1.40484]
KARACHI_100(-6)	0.018637	-0.036121	0.003985	-0.010672	0.009967	0.021896	-0.000686	-0.024010	-0.007239
	(0.00917)	(0.06437)	(0.02074)	(0.00593)	(0.00875)	(0.01130)	(0.00862)	(0.01169)	(0.00821)
	[2.03187]	[-0.56119]	[0.19208]	[-1.80107]	[1.13885]	[1.93831]	[-0.07962]	[-2.05473]	[-0.88174]
KARACHI_100(-7)	-0.013255	-0.049532	0.004865	0.004628	0.003795	0.007500	0.002844	-0.004090	0.001299
	(0.00918)	(0.06441)	(0.02076)	(0.00593)	(0.00876)	(0.01130)	(0.00863)	(0.01169)	(0.00822)
	[-1.44417]	[-0.76901]	[0.23437]	[0.78056]	[0.43336]	[0.66345]	[0.32968]	[-0.34980]	[0.15812]
KARACHI_100(-8)	-0.011611	0.006714	-0.059626	-0.010071	0.010152	-0.006362	-0.009244	0.005799	0.012974
	(0.00914)	(0.06414)	(0.02067)	(0.00590)	(0.00872)	(0.01126)	(0.00859)	(0.01164)	(0.00818)
	[-1.27038]	[0.10467]	[-2.88444]	[-1.70572]	[1.16419]	[-0.56518]	[-1.07595]	[0.49806]	[1.58586]
KARACHI_100(-9)	0.008313	0.062110	0.052226	-0.003875	-0.006256	0.006589	-0.002181	0.014674	-0.002302
	(0.00904)	(0.06342)	(0.02044)	(0.00584)	(0.00862)	(0.01113)	(0.00850)	(0.01151)	(0.00809)
	[0.91988]	[0.97933]	[2.55504]	[-0.66366]	[-0.72549]	[0.59199]	[-0.25678]	[1.27448]	[-0.28455]
KLSE_COMPOSITE(-1)	-0.060677	0.056411	-0.043368	-0.033727	-0.016152	0.014726	0.017335	0.024733	-0.013843
	(0.03181)	(0.22325)	(0.07195)	(0.02055)	(0.03035)	(0.03918)	(0.02991)	(0.04053)	(0.02848)
	[-1.90725]	[0.25268]	[-0.60273]	[-1.64103]	[-0.53211]	[0.37584]	[0.57967]	[0.61024]	[-0.48615]
KLSE_COMPOSITE(-2)	-0.041941	0.127812	-0.050573	0.032153	0.006757	-0.004900	-0.024439	-0.049000	0.044962
	(0.03175)	(0.22283)	(0.07182)	(0.02051)	(0.03030)	(0.03911)	(0.02985)	(0.04045)	(0.02842)
	[-1.32081]	[0.57359]	[-0.70419]	[1.56744]	[0.22302]	[-0.12530]	[-0.81874]	[-1.21127]	[1.58198]
KLSE_COMPOSITE(-3)	-0.059965	-0.012073	0.062455	0.008610	0.032193	-0.064923	0.001405	0.014554	0.054550
	(0.03175)	(0.22277)	(0.07180)	(0.02051)	(0.03029)	(0.03910)	(0.02984)	(0.04044)	(0.02841)
	[-1.88897]	[-0.05420]	[0.86987]	[0.41983]	[1.06286]	[-1.66052]	[0.04709]	[0.35987]	[1.91982]
KLSE_COMPOSITE(-4)	0.006776	0.027710	0.032301	0.020382	0.033975	0.035225	0.021813	0.004015	0.006657
	(0.03169)	(0.22240)	(0.07168)	(0.02047)	(0.03024)	(0.03903)	(0.02979)	(0.04038)	(0.02837)
	[0.21381]	[0.12459]	[0.45062]	[0.99549]	[1.12352]	[0.90243]	[0.73216]	[0.09944]	[0.23468]
KLSE_COMPOSITE(-5)	0.004236	0.036706	0.022327	-0.009596	-0.059693	-0.006370	0.027790	-0.005937	0.001811
	(0.03155)	(0.22140)	(0.07136)	(0.02038)	(0.03010)	(0.03886)	(0.02966)	(0.04019)	(0.02824)
	[0.13426]	[0.16579]	[0.31289]	[-0.47081]	[-1.98296]	[-0.16394]	[0.93704]	[-0.14772]	[0.06415]
KLSE_COMPOSITE(-6)	-0.023400	-0.004194	-0.076408	-0.043342	-0.003681	0.018733	-0.001346	-0.006512	0.001149
	(0.03129)	(0.21957)	(0.07077)	(0.02021)	(0.02985)	(0.03854)	(0.02941)	(0.03986)	(0.02801)
	[-0.74786]	[-0.01910]	[-1.07972]	[-2.14424]	[-0.12330]	[0.48612]	[-0.04577]	[-0.16336]	[0.04103]
KLSE_COMPOSITE(-7)	0.012454	-0.153319	-0.043728	-0.021414	-0.088758	-0.031825	0.036090	0.025839	0.027395
	(0.03113)	(0.21844)	(0.07040)	(0.02011)	(0.02970)	(0.03834)	(0.02926)	(0.03966)	(0.02786)
	[0.40010]	[-0.70187]	[-0.62110]	[-1.06488]	[-2.98837]	[-0.83011]	[1.23336]	[0.65156]	[0.98321]
KLSE_COMPOSITE(-8)	0.001353	-0.107232	0.184922	-0.032033	0.009777	0.061123	-0.014906	0.031102	-0.010708
	(0.03102)	(0.21771)	(0.07017)	(0.02004)	(0.02960)	(0.03821)	(0.02916)	(0.03952)	(0.02777)
	[0.04361]	[-0.49255]	[2.63545]	[-1.59828]	[0.33030]	[1.59968]	[-0.51111]	[0.78691]	[-0.38560]
KLSE_COMPOSITE(-9)	-0.035097	-0.159383	-0.003679	-0.015364	-0.059727	0.068614	-0.038270	0.020843	-0.031173
	(0.03098)	(0.21742)	(0.07007)	(0.02002)	(0.02956)	(0.03816)	(0.02912)	(0.03947)	(0.02773)
	[-1.13281]	[-0.73307]	[-0.05250]	[-0.76763]	[-2.02039]	[1.79811]	[-1.31400]	[0.52805]	[-1.12408]
KOSPI_200(-1)	0.074170	-0.084282	0.044330	0.005048	-0.069070	-0.019370	0.021127	0.038786	0.102140
	(0.02163)	(0.15178)	(0.04892)	(0.01397)	(0.02064)	(0.02664)	(0.02033)	(0.02756)	(0.01936)
	[3.42910]	[-0.55527]	[0.90618]	[0.36129]	[-3.34679]	[-0.72712]	[1.03908]	[1.40753]	[5.27582]
KOSPI_200(-2)	0.027893	-0.233737	0.039759	0.004837	0.010297	-0.000249	-0.003037	-0.039309	0.077172
	(0.02166)	(0.15202)	(0.04900)	(0.01399)	(0.02067)	(0.02668)	(0.02036)	(0.02760)	(0.01939)
	[1.28757]	[-1.53752]	[0.81147]	[0.34559]	[0.49814]	[-0.00933]	[-0.14914]	[-1.42428]	[3.97992]

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KOSPI_200(-3)	0.038314	-0.086698	0.102195	0.004942	-0.033694	0.040134	0.016126	-0.001053	0.044986
	(0.02166)	(0.15199)	(0.04899)	(0.01399)	(0.02067)	(0.02668)	(0.02036)	(0.02759)	(0.01939)
	[1.76893]	[-0.57041]	[2.08616]	[0.35318]	[-1.63039]	[1.50451]	[0.79205]	[-0.03815]	[2.32045]
KOSPI_200(-4)	0.049640	-0.097457	0.006344	0.019375	-0.053534	0.008108	-0.052373	-0.006346	0.075462
	(0.02157)	(0.15139)	(0.04879)	(0.01394)	(0.02058)	(0.02657)	(0.02028)	(0.02748)	(0.01931)
	[2.30102]	[-0.64376]	[0.13003]	[1.39023]	[-2.60078]	[0.30516]	[-2.58259]	[-0.23088]	[3.90803]
KOSPI_200(-5)	0.015002	-0.028333	-0.068073	0.012919	-0.064186	0.037262	-0.006317	0.070009	0.030525
	(0.02150)	(0.15088)	(0.04863)	(0.01389)	(0.02051)	(0.02648)	(0.02021)	(0.02739)	(0.01924)
	[0.69773]	[-0.18779]	[-1.39985]	[0.93007]	[-3.12874]	[1.40713]	[-0.31255]	[2.55585]	[1.58614]
KOSPI_200(-6)	0.150968	-0.318097	0.066738	0.027211	-0.061697	-0.025126	-0.000690	-0.004666	0.009229
	(0.02143)	(0.15037)	(0.04846)	(0.01384)	(0.02045)	(0.02639)	(0.02014)	(0.02730)	(0.01918)
	[7.04546]	[-2.11546]	[1.37708]	[1.96576]	[-3.01768]	[-0.95209]	[-0.03424]	[-0.17093]	[0.48119]
KOSPI_200(-7)	0.080022	-0.224352	0.044303	0.016176	-0.011234	-0.027384	0.018780	-0.002425	0.032896
	(0.02168)	(0.15214)	(0.04904)	(0.01401)	(0.02069)	(0.02670)	(0.02038)	(0.02762)	(0.01941)
	[3.69097]	[-1.47463]	[0.90350]	[1.15492]	[-0.54305]	[-1.02552]	[0.92150]	[-0.08781]	[1.69521]
KOSPI_200(-8)	0.079367	-0.136352	0.051131	-0.005993	0.001864	-0.009631	-0.032295	0.035054	0.034219
	(0.02173)	(0.15249)	(0.04915)	(0.01404)	(0.02073)	(0.02676)	(0.02043)	(0.02768)	(0.01945)
	[3.65230]	[-0.89415]	[1.04034]	[-0.42690]	[0.08991]	[-0.35984]	[-1.58094]	[1.26618]	[1.75926]
KOSPI_200(-9)	0.087833	0.318201	-0.000938	-0.025611	0.018929	-0.000166	0.019407	-0.002682	0.091193
	(0.02137)	(0.15000)	(0.04834)	(0.01381)	(0.02039)	(0.02633)	(0.02009)	(0.02723)	(0.01913)
	[4.10916]	[2.12138]	[-0.01939]	[-1.85470]	[0.92816]	[-0.00630]	[0.96585]	[-0.09847]	[4.76652]
NIKKIE_225(-1)	0.019739	0.122362	0.083643	0.020330	0.044184	-0.049835	-0.030147	0.011715	0.006219
	(0.01671)	(0.11724)	(0.03779)	(0.01079)	(0.01594)	(0.02058)	(0.01571)	(0.02129)	(0.01495)
	[1.18145]	[1.04365]	[2.21350]	[1.88354]	[2.77166]	[-2.42184]	[-1.91952]	[0.55039]	[0.41587]
NIKKIE_225(-2)	0.039185	0.103547	-0.036055	0.028870	0.002997	0.035178	-0.001722	0.028931	-0.001760
	(0.01670)	(0.11719)	(0.03777)	(0.01079)	(0.01593)	(0.02057)	(0.01570)	(0.02128)	(0.01495)
	[2.34645]	[0.88360]	[-0.95461]	[2.67606]	[0.18807]	[1.71037]	[-0.10971]	[1.35984]	[-0.11775]
NIKKIE_225(-3)	0.048018	0.048573	-0.011327	0.029546	-0.009034	-0.057351	0.010294	-0.017391	-0.013097
	(0.01668)	(0.11708)	(0.03774)	(0.01078)	(0.01592)	(0.02055)	(0.01568)	(0.02126)	(0.01493)
	[2.87801]	[0.41486]	[-0.30018]	[2.74124]	[-0.56748]	[-2.79100]	[0.65635]	[-0.81819]	[-0.87704]

NIKKIE_225(-4)	0.070171	0.059823	-0.006884	0.069974	-0.011670	-0.028297	-0.008014	0.019852	0.012577
	(0.01661)	(0.11654)	(0.03756)	(0.01073)	(0.01585)	(0.02045)	(0.01561)	(0.02116)	(0.01486)
	[4.22533]	[0.51332]	[-0.18326]	[6.52222]	[-0.73647]	[-1.38345]	[-0.51336]	[0.93832]	[0.84609]
NIKKIE_225(-5)	0.029896	0.037124	0.019628	0.042554	-0.011641	-0.014564	-0.020689	0.000122	0.033642
	(0.01678)	(0.11774)	(0.03795)	(0.01084)	(0.01601)	(0.02066)	(0.01577)	(0.02138)	(0.01502)
	[1.78183]	[0.31530]	[0.51723]	[3.92592]	[-0.72716]	[-0.70480]	[-1.31174]	[0.00572]	[2.24011]
NIKKIE_225(-6)	-0.007905	0.087686	-0.012730	0.015751	-1.44E-05	-0.046275	-0.002407	-0.020155	-0.009159
	(0.01678)	(0.11776)	(0.03795)	(0.01084)	(0.01601)	(0.02067)	(0.01577)	(0.02138)	(0.01502)
	[-0.47105]	[0.74462]	[-0.33542]	[1.45290]	[-0.00090]	[-2.23897]	[-0.15256]	[-0.94276]	[-0.60979]
NIKKIE_225(-7)	-0.031462	-0.011606	0.048997	0.014770	0.000378	-0.037959	0.002470	0.023500	-0.024235
	(0.01673)	(0.11740)	(0.03784)	(0.01081)	(0.01596)	(0.02060)	(0.01573)	(0.02131)	(0.01497)
	[-1.88066]	[-0.09886]	[1.29497]	[1.36667]	[0.02369]	[-1.84233]	[0.15704]	[1.10262]	[-1.61853]
NIKKIE_225(-8)	0.024144	0.058853	0.013542	-0.001700	0.013161	-0.000718	0.013813	-0.004422	0.009433
	(0.01671)	(0.11728)	(0.03780)	(0.01080)	(0.01595)	(0.02058)	(0.01571)	(0.02129)	(0.01496)
	[1.44474]	[0.50184]	[0.35828]	[-0.15750]	[0.82538]	[-0.03491]	[0.87926]	[-0.20772]	[0.63063]
NIKKIE_225(-9)	0.019562	-0.057554	0.003632	0.010914	-0.004762	0.008945	-0.012215	-0.002232	-0.004775
	(0.01667)	(0.11695)	(0.03769)	(0.01077)	(0.01590)	(0.02053)	(0.01567)	(0.02123)	(0.01492)
	[1.17380]	[-0.49212]	[0.09637]	[1.01368]	[-0.29950]	[0.43580]	[-0.77969]	[-0.10512]	[-0.32007]
SET(-1)	-0.034787	0.085745	-0.093471	-0.004720	-0.021923	-0.025567	-0.008981	0.002915	-0.023320
	(0.02185)	(0.15334)	(0.04942)	(0.01412)	(0.02085)	(0.02691)	(0.02054)	(0.02784)	(0.01956)
	[-1.59198]	[0.55918]	[-1.89131]	[-0.33435]	[-1.05152]	[-0.95001]	[-0.43723]	[0.10470]	[-1.19234]
SET(-2)	0.032635	0.080638	0.003093	-0.033987	0.005790	-0.021406	0.032085	0.084326	0.016372
	(0.02178)	(0.15286)	(0.04927)	(0.01407)	(0.02078)	(0.02683)	(0.02048)	(0.02775)	(0.01950)
	[1.49818]	[0.52752]	[0.06277]	[-2.41519]	[0.27856]	[-0.79788]	[1.56688]	[3.03859]	[0.83969]
SET(-3)	0.086270	0.018430	0.085771	-0.022036	0.017748	-0.004265	0.027230	0.066343	0.021599
	(0.02185)	(0.15335)	(0.04942)	(0.01412)	(0.02085)	(0.02691)	(0.02054)	(0.02784)	(0.01956)
	[3.94790]	[0.12019]	[1.73544]	[-1.56100]	[0.85125]	[-0.15847]	[1.32563]	[2.38305]	[1.10427]
SET(-4)	0.054274	-0.100683	0.049385	0.032721	0.049844	0.012225	0.004742	-0.023274	0.046190
	(0.02193)	(0.15391)	(0.04961)	(0.01417)	(0.02093)	(0.02701)	(0.02062)	(0.02794)	(0.01963)
	[2.47455]	[-0.65416]	[0.99556]	[2.30933]	[2.38179]	[0.45255]	[0.23001]	[-0.83292]	[2.35287]

SET(-5)	0.074209	0.058910	0.026068	-0.001776	0.023399	0.075923	0.083224	0.006163	-0.023599
	(0.02192)	(0.15381)	(0.04957)	(0.01416)	(0.02091)	(0.02700)	(0.02060)	(0.02792)	(0.01962)
	[3.38563]	[0.38300]	[0.52584]	[-0.12544]	[1.11886]	[2.81242]	[4.03919]	[0.22071]	[-1.20290]
SET(-6)	-0.014572	-0.006385	-0.022417	0.029902	0.051293	0.021361	-0.061150	-0.025164	-0.027114
	(0.02197)	(0.15419)	(0.04970)	(0.01419)	(0.02097)	(0.02706)	(0.02065)	(0.02799)	(0.01967)
	[-0.66318]	[-0.04141]	[-0.45109]	[2.10657]	[2.44658]	[0.78933]	[-2.96056]	[-0.89894]	[-1.37865]
SET(-7)	0.032385	0.000911	0.095981	0.028232	0.044550	-0.004257	-0.006117	-0.010629	0.086416
	(0.02202)	(0.15455)	(0.04981)	(0.01423)	(0.02101)	(0.02713)	(0.02070)	(0.02806)	(0.01971)
	[1.47043]	[0.00590]	[1.92687]	[1.98430]	[2.12003]	[-0.15695]	[-0.29545]	[-0.37881]	[4.38370]
SET(-8)	-0.081706	0.117309	-0.057296	-0.006961	0.152661	-0.024131	0.036216	0.042545	0.006859
	(0.02217)	(0.15556)	(0.05014)	(0.01432)	(0.02115)	(0.02730)	(0.02084)	(0.02824)	(0.01984)
	[-3.68582]	[0.75411]	[-1.14280]	[-0.48609]	[7.21765]	[-0.88385]	[1.73798]	[1.50647]	[0.34568]
SET(-9)	0.020517	0.060216	-0.007929	0.009267	0.037856	-0.046407	-0.020395	-0.004165	0.057851
	(0.02242)	(0.15734)	(0.05071)	(0.01448)	(0.02139)	(0.02761)	(0.02108)	(0.02856)	(0.02007)
	[0.91505]	[0.38271]	[-0.15637]	[0.63979]	[1.76953]	[-1.68053]	[-0.96764]	[-0.14582]	[2.88269]
SHANGHAI(-1)	0.013496	0.072834	0.015822	-0.012777	-0.008608	-0.007311	0.012393	0.044128	-0.009381
	(0.01614)	(0.11329)	(0.03651)	(0.01043)	(0.01540)	(0.01988)	(0.01518)	(0.02057)	(0.01445)
	[0.83598]	[0.64290]	[0.43333]	[-1.22509]	[-0.55885]	[-0.36767]	[0.81663]	[2.14550]	[-0.64923]
SHANGHAI(-2)	-0.004786	0.053552	0.077529	0.002878	-0.012782	0.013256	0.001898	-0.011764	0.004187
	(0.01614)	(0.11326)	(0.03650)	(0.01043)	(0.01540)	(0.01988)	(0.01517)	(0.02056)	(0.01445)
	[-0.29653]	[0.47285]	[2.12397]	[0.27608]	[-0.83007]	[0.66688]	[0.12511]	[-0.57216]	[0.28985]
SHANGHAI(-3)	-0.004911	0.062425	-0.005634	0.006410	0.003178	0.010996	0.030645	-0.002090	0.005195
	(0.01615)	(0.11335)	(0.03653)	(0.01044)	(0.01541)	(0.01989)	(0.01518)	(0.02058)	(0.01446)
	[-0.30401]	[0.55072]	[-0.15422]	[0.61426]	[0.20617]	[0.55270]	[2.01823]	[-0.10155]	[0.35933]
SHANGHAI(-4)	-0.000657	-0.038906	0.045738	0.002985	0.023438	0.032869	0.021802	0.042913	-0.009616
	(0.01610)	(0.11298)	(0.03641)	(0.01040)	(0.01536)	(0.01983)	(0.01513)	(0.02051)	(0.01441)
	[-0.04084]	[-0.34436]	[1.25609]	[0.28699]	[1.52579]	[1.65764]	[1.44056]	[2.09222]	[-0.66732]
SHANGHAI(-5)	-0.002945	-0.026973	0.030216	0.009112	0.032724	0.037877	0.006366	-0.016514	0.027099
	(0.01609)	(0.11289)	(0.03638)	(0.01039)	(0.01535)	(0.01981)	(0.01512)	(0.02049)	(0.01440)
	[-0.18306]	[-0.23893]	[0.83050]	[0.87683]	[2.13201]	[1.91178]	[0.42100]	[-0.80579]	[1.88207]
SHANGHAI(-6)	-0.018148	0.064053	0.027433	0.008956	-0.000809	0.057845	0.012995	-0.075448	-0.026438
	(0.01609)	(0.11293)	(0.03640)	(0.01040)	(0.01535)	(0.01982)	(0.01513)	(0.02050)	(0.01440)
	[-1.12772]	[0.56720]	[0.75372]	[0.86151]	[-0.05267]	[2.91851]	[0.85904]	[-3.68006]	[-1.83545]
SHANGHAI(-7)	-0.007521	0.091560	0.011528	-0.003610	0.025588	0.013291	-0.004122	0.027639	-0.000766
	(0.01617)	(0.11348)	(0.03657)	(0.01045)	(0.01543)	(0.01992)	(0.01520)	(0.02060)	(0.01447)
	[-0.46509]	[0.80687]	[0.31520]	[-0.34561]	[1.65844]	[0.66734]	[-0.27119]	[1.34161]	[-0.05293]
SHANGHAI(-8)	0.000450	0.108964	0.114533	-0.010638	0.008535	0.012199	0.043917	0.044817	0.005218
	(0.01612)	(0.11312)	(0.03646)	(0.01041)	(0.01538)	(0.01985)	(0.01515)	(0.02054)	(0.01443)
	[0.02792]	[0.96326]	[3.14147]	[-1.02154]	[0.55489]	[0.61446]	[2.89823]	[2.18230]	[0.36166]
SHANGHAI(-9)	-0.021173	0.120920	0.054211	0.006964	0.023338	-0.020975	-0.002647	0.012883	-0.024375
	(0.01619)	(0.11361)	(0.03662)	(0.01046)	(0.01545)	(0.01994)	(0.01522)	(0.02063)	(0.01449)
	[-1.30784]	[1.06435]	[1.48053]	[0.66583]	[1.51085]	[-1.05194]	[-0.17392]	[0.62463]	[-1.68214]
TAIWAN_WEIGHTED(-1)	0.019686	0.093744	0.047933	0.017767	0.174349	0.018777	-0.032754	0.010752	-0.024726
	(0.02296)	(0.16112)	(0.05193)	(0.01483)	(0.02191)	(0.02828)	(0.02158)	(0.02925)	(0.02055)
	[0.85743]	[0.58184]	[0.92308]	[1.19788]	[7.95881]	[0.66402]	[-1.51764]	[0.36760]	[-1.20321]
TAIWAN_WEIGHTED(-2)	0.029499	0.252041	-0.084666	0.015269	0.057310	0.002523	0.036228	-0.071061	0.014412
	(0.02327)	(0.16330)	(0.05263)	(0.01503)	(0.02220)	(0.02866)	(0.02188)	(0.02965)	(0.02083)
	[1.26761]	[1.54338]	[-1.60862]	[1.01564]	[2.58106]	[0.08803]	[1.65609]	[-2.39688]	[0.69192]
TAIWAN_WEIGHTED(-3)	-0.044720	0.347158	-0.046563	-0.007138	0.033936	0.011603	0.012436	0.032291	-0.024738
	(0.02330)	(0.16351)	(0.05270)	(0.01505)	(0.02223)	(0.02870)	(0.02190)	(0.02968)	(0.02086)
	[-1.91925]	[2.12316]	[-0.88357]	[-0.47421]	[1.52646]	[0.40434]	[0.56776]	[1.08780]	[-1.18617]
TAIWAN_WEIGHTED(-4)	0.031890	0.207158	-0.023234	-0.007738	0.063141	-0.029791	0.021452	0.002061	-0.060343
	(0.02331)	(0.16360)	(0.05273)	(0.01506)	(0.02224)	(0.02871)	(0.02192)	(0.02970)	(0.02087)
	[1.36785]	[1.26623]	[-0.44064]	[-0.51376]	[2.83848]	[-1.03754]	[0.97883]	[0.06938]	[-2.89173]
TAIWAN_WEIGHTED(-5)	0.007121	0.196697	0.072986	-0.003947	0.076794	0.030703	-0.015897	-0.014123	-0.068223
	(0.02331)	(0.16354)	(0.05271)	(0.01506)	(0.02224)	(0.02870)	(0.02191)	(0.02969)	(0.02086)
	[0.30555]	[1.20272]	[1.38468]	[-0.26216]	[3.45348]	[1.06968]	[-0.72562]	[-0.47568]	[-3.27055]
TAIWAN_WEIGHTED(-6)	-0.022372	0.014346	0.011588	0.012647	0.104832	-0.012995	-0.009563	0.002543	-0.029402
	(0.02326)	(0.16321)	(0.05260)	(0.01503)	(0.02219)	(0.02865)	(0.02186)	(0.02963)	(0.02082)
	[-0.96189]	[0.08790]	[0.22030]	[0.84169]	[4.72395]	[-0.45364]	[-0.43740]	[0.08581]	[-1.41234]

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TAIWAN_WEIGHTED(-7)	0.054969	0.396974	0.047410	-0.021434	-0.010046	-0.004517	-0.014288	0.031027	0.022107
	(0.02334)	(0.16376)	(0.05278)	(0.01508)	(0.02227)	(0.02874)	(0.02194)	(0.02973)	(0.02089)
	[2.35560]	[2.42418]	[0.89829]	[-1.42184]	[-0.45119]	[-0.15717]	[-0.65135]	[1.04366]	[1.05839]
TAIWAN_WEIGHTED(-8)	-0.008210	0.175106	0.088322	-0.009588	0.020316	-0.072919	-0.056723	0.014877	-0.012713
	(0.02333)	(0.16368)	(0.05276)	(0.01507)	(0.02226)	(0.02873)	(0.02193)	(0.02972)	(0.02088)
	[-0.35197]	[1.06978]	[1.67419]	[-0.63632]	[0.91285]	[-2.53827]	[-2.58698]	[0.50064]	[-0.60893]
TAIWAN_WEIGHTED(-9)	-0.008722	0.149397	0.083364	-0.010713	0.007562	-0.001892	0.061288	0.009509	-0.032549
	(0.02321)	(0.16288)	(0.05250)	(0.01499)	(0.02215)	(0.02859)	(0.02182)	(0.02957)	(0.02077)
	[-0.37578]	[0.91724]	[1.58804]	[-0.71448]	[0.34144]	[-0.06619]	[2.80900]	[0.32159]	[-1.56674]
C	0.000356	-0.001659	0.000717	-0.000182	-5.23E-05	0.000142	5.05E-05	0.000116	0.000312
	(0.00021)	(0.00150)	(0.00048)	(0.00014)	(0.00020)	(0.00026)	(0.00020)	(0.00027)	(0.00019)
	[1.66774]	[-1.10898]	[1.48639]	[-1.32460]	[-0.25714]	[0.53950]	[0.25195]	[0.42874]	[1.63495]
R-squared	0.125725	0.421487	0.086412	0.090728	0.126239	0.072519	0.050936	0.043380	0.082754
Adj. R-squared	0.095807	0.401690	0.055148	0.059612	0.096339	0.040780	0.018458	0.010644	0.051365
Sum sq. resids	0.254784	12.54669	1.303306	0.106331	0.231952	0.386478	0.225140	0.413528	0.204121
S.E. equation	0.010375	0.072806	0.023465	0.006702	0.009899	0.012778	0.009753	0.013218	0.009286
F-statistic	4.202300	21.29042	2.763984	2.915830	4.221979	2.284854	1.568344	1.325141	2.636428
Log likelihood	7754.632	2983.005	5755.951	8824.678	7869.593	7244.435	7906.098	7161.596	8026.111
Akaike AIC	-6.265931	-2.369135	-4.633688	-7.139794	-6.359815	-5.849273	-6.389627	-5.781622	-6.487636
Schwarz SC	-6.071614	-2.174818	-4.439371	-6.945478	-6.165498	-5.654956	-6.195310	-5.587305	-6.293319
Mean dependent	0.000453	-3.47E-05	0.001085	-7.00E-05	8.96E-05	0.000293	1.93E-05	0.000153	0.000301
S.D. dependent	0.010911	0.094124	0.024140	0.006912	0.010414	0.013047	0.009844	0.013289	0.009534

Determinant resid covariance (dof adj.)	3.05E-34
Determinant resid covariance	2.24E-34
Log likelihood	63599.65
Akaike information criterion	-51.33659
Schwarz criterion	-49.58774
Number of coefficients	738

GRANGER CAUSALITY TEST

Pairwise Granger Causality Tests
Date: 03/18/24 Time: 13:28
Sample: 4/01/2013 3/29/2023
Lags: 9

Null Hypothesis:	Obs	F-Statistic	Prob.
HANG_SENG does not Granger Cause NIFTY	2460	0.75226	0.6610
NIFTY does not Granger Cause HANG_SENG		4.14004	3.E-05
KARACHI_100 does not Granger Cause NIFTY	2460	1.54065	0.1279
NIFTY does not Granger Cause KARACHI_100		1.65198	0.0953
KLSE_COMPOSITE does not Granger Cause NIFTY	2460	0.68895	0.7196
NIFTY does not Granger Cause KLSE_COMPOSITE		7.95732	1.E-11
KOSPI_200 does not Granger Cause NIFTY	2460	15.0729	4.E-24
NIFTY does not Granger Cause KOSPI_200		5.81397	5.E-08
NIKKIE_225 does not Granger Cause NIFTY	2449	3.70444	0.0001
NIFTY does not Granger Cause NIKKIE_225		7.03704	4.E-10
SET does not Granger Cause NIFTY	2460	5.92489	3.E-08
NIFTY does not Granger Cause SET		1.31604	0.2229
SHANGHAI does not Granger Cause NIFTY	2460	0.69711	0.7121
NIFTY does not Granger Cause SHANGHAI		1.14529	0.3267
TAIWAN_WEIGHTED does not Granger Cause NIFTY	2460	6.22305	1.E-08
NIFTY does not Granger Cause TAIWAN_WEIGHTED		1.26012	0.2537
KARACHI_100 does not Granger Cause HANG_SENG	2460	0.76733	0.6469
HANG_SENG does not Granger Cause KARACHI_100		0.79897	0.6173
KLSE_COMPOSITE does not Granger Cause HANG_SENG	2460	0.53912	0.8468
HANG_SENG does not Granger Cause KLSE_COMPOSITE		0.77187	0.6426
KOSPI_200 does not Granger Cause HANG_SENG	2460	1.57966	0.1155
HANG_SENG does not Granger Cause KOSPI_200		0.54644	0.8412

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NIKKIE_225 does not Granger Cause HANG_SENG HANG_SENG does not Granger Cause NIKKIE_225	2449	1.39613 3.43666	0.1840 0.0003
SET does not Granger Cause HANG_SENG HANG_SENG does not Granger Cause SET	2460	0.32676 0.49759	0.9665 0.8770
SHANGHAI does not Granger Cause HANG_SENG HANG_SENG does not Granger Cause SHANGHAI	2460	0.61172 0.14062	0.7880 0.9985
TAIWAN_WEIGHTED does not Granger Cause HANG_SENG HANG_SENG does not Granger Cause TAIWAN_WEIGHTED	2460	2.24236 0.50845	0.0171 0.8694
KLSE_COMPOSITE does not Granger Cause KARACHI_100 KARACHI_100 does not Granger Cause KLSE_COMPOSITE	2460	1.26987 1.12508	0.2481 0.3409
KOSPI_200 does not Granger Cause KARACHI_100 KARACHI_100 does not Granger Cause KOSPI_200	2460	2.01249 1.26692	0.0344 0.2498
NIKKIE_225 does not Granger Cause KARACHI_100 KARACHI_100 does not Granger Cause NIKKIE_225	2449	1.06042 1.85269	0.3891 0.0546
SET does not Granger Cause KARACHI_100 KARACHI_100 does not Granger Cause SET	2460	2.02148 0.42098	0.0335 0.9246
SHANGHAI does not Granger Cause KARACHI_100 KARACHI_100 does not Granger Cause SHANGHAI	2460	2.62140 1.18888	0.0051 0.2974
TAIWAN_WEIGHTED does not Granger Cause KARACHI_100 KARACHI_100 does not Granger Cause TAIWAN_WEIGHTED	2460	2.51664 0.80975	0.0072 0.6072
KOSPI_200 does not Granger Cause KLSE_COMPOSITE KLSE_COMPOSITE does not Granger Cause KOSPI_200	2460	2.04252 1.80945	0.0314 0.0618
NIKKIE_225 does not Granger Cause KLSE_COMPOSITE KLSE_COMPOSITE does not Granger Cause NIKKIE_225	2449	10.7149 1.79074	2.E-16 0.0651
SET does not Granger Cause KLSE_COMPOSITE KLSE_COMPOSITE does not Granger Cause SET	2460	3.28735 0.56761	0.0005 0.8246

SHANGHAI does not Granger Cause KLSE_COMPOSITE KLSE_COMPOSITE does not Granger Cause SHANGHAI	2460	0.93979 0.51385	0.4890 0.8655
TAIWAN_WEIGHTED does not Granger Cause KLSE_COMPOSITE KLSE_COMPOSITE does not Granger Cause TAIWAN_WEIGHTED	2460	1.15712 1.39907	0.3186 0.1827
NIKKIE_225 does not Granger Cause KOSPI_200 KOSPI_200 does not Granger Cause NIKKIE_225	2449	1.39117 0.65609	0.1862 0.7493
SET does not Granger Cause KOSPI_200 KOSPI_200 does not Granger Cause SET	2460	9.79894 1.61440	7.E-15 0.1054
SHANGHAI does not Granger Cause KOSPI_200 KOSPI_200 does not Granger Cause SHANGHAI	2460	2.07908 1.32415	0.0282 0.2187
TAIWAN_WEIGHTED does not Granger Cause KOSPI_200 KOSPI_200 does not Granger Cause TAIWAN_WEIGHTED	2460	12.3794 11.0352	2.E-19 5.E-17
SET does not Granger Cause NIKKIE_225 NIKKIE_225 does not Granger Cause SET	2449	1.52358 0.94695	0.1337 0.4827
SHANGHAI does not Granger Cause NIKKIE_225 NIKKIE_225 does not Granger Cause SHANGHAI	2449	2.09284 0.56496	0.0270 0.8267
TAIWAN_WEIGHTED does not Granger Cause NIKKIE_225 NIKKIE_225 does not Granger Cause TAIWAN_WEIGHTED	2449	1.14609 1.18271	0.3261 0.3015
SHANGHAI does not Granger Cause SET SET does not Granger Cause SHANGHAI	2460	1.71039 2.23420	0.0813 0.0176
TAIWAN_WEIGHTED does not Granger Cause SET SET does not Granger Cause TAIWAN_WEIGHTED	2460	2.73014 6.24921	0.0036 9.E-09
TAIWAN_WEIGHTED does not Granger Cause SHANGHAI SHANGHAI does not Granger Cause TAIWAN_WEIGHTED	2460	1.20971 1.02951	0.2841 0.4135

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IMPULSE RESPONSE FUNCTION