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India and American Stock Markets: A Longitudinal Correlation Study

Siddhartha Sankar Saha[1] | Rapti Deb[2*]

[1]Professor of Commerce, Former Head, Department of Commerce, Former Dean, Faculty Council for Post Graduate Studies in Commerce, Social Welfare and Business Management, Former Director, CUCSE-CEFM & Former Director, IQAC, University of Calcutta, Kolkata, West Bengal, India.
[2]Research Scholar, Department of Commerce, University of Calcutta, Kolkata, West Bengal, India.

*Corresponding Author: debrapti@gmail.com

ABSTRACT

Globalization and liberalization have significantly heightened investors' engagement in international markets, driving financial integration and intensifying stock market co-movements across the globe. Understanding these inter-market linkages is crucial for formulating robust macroeconomic policies and crafting strategic investment approaches that can effectively navigate an increasingly interconnected financial scenery. The current study provides a comprehensive correlation analysis among the calculated returns from India's S&P BSE SENSEX and five prominent American stock indices—US (S&P 500), Canada (S&P/TSX Composite Index), Brazil (IBOVESPA), Mexico (IPC MEXICO), and Argentina (MERVAL)—over a 16-year period from June 3, 2003, to December 30, 2019. The analysis employs descriptive statistics to observe the nature of the calculated return series from the daily index closing data of six sample indices and carries on correlation measures to assess market integration among them. The normality test informed the application of the non-parametric Spearman Rank Correlation method. The findings reveal consistently weak correlations between the S&P BSE SENSEX and the American indices, highlighting limited financial integration and significant potential for portfolio diversification. In contrast, the study identifies strong association among the American indices, indicating high regional market integration and limiting diversification opportunities within the American markets.

***Keywords**: Stock Market Correlation, S&P BSE SENSEX, American Economies.*

Introduction

The perception of stock market integration is crucial for global investors aiming to excellently manage diversification risks and maximize rewards. The rapid transformation of emerging economies, fueled by globalization, technological progress, and financial co-movement (Stiglitz, 2002) underscores the importance of integrated financial markets as catalysts for domestic savings, investments, and economic growth (Mohan, 2004). Financial liberalization has deepened regional integration, spurred cross-market monetary linkages, and bolstered foreign capital flows. It boosts economic stability by mitigating isolated downturn risks, while offering investors opportunities for diversification. India's post-liberalization progress in capital market integration, competitive frameworks, financial innovation, and enhanced liquidity has solidified its role as a key player in the global economy. In this context, examining the correlation between India's stock market and global indices is crucially needed. The imperfect correlations among these indices highlight the potential for risk diversification while maintaining returns, emphasizing the strategic importance of interconnected capital markets for policymakers and investors alike.

When a group of countries is mutually inclined to prevailing global or regional factors, a high degree of integration is likely to occur (Pukthuanthong & Roll, 2009). In the context of rapidly integrating markets, analyzing the nature of stock markets interdependencies become essential for informed macroeconomic policymaking and strategic investment planning. Such studies play a pivotal role in promoting domestic savings, catalyzing investments, and accelerating economic growth.

Past Studies and Research Gap

Modi et al. (2010) examined stock market integration among eight indices—India (SENSEX), Hong Kong (HANG SENG), Mexico (MXX), Russia (RTS), Brazil (BVSP), the UK (FTSE-100), and the US (DJIA and NASDAQ)—from 1998 to 2008 using daily returns, correlation tests, Granger causality, and Principal Component Analysis were carried on. The correlation matrix revealed the highest correlation between Mexico (MXX) and Brazil (BVSP), aside from inter-market linkages within the US. The lowest correlations were observed between India (SENSEX) and the US (NASDAQ and DJIA), highlighting significant diversification opportunities for Indian investors. **Lingaraja et al. (2014)** investigated the interlinkages and co-movements among eight Asian emerging stock indices: China (SSE), India (Nifty), Indonesia (JCI), South Korea (KOSPI), Malaysia (KLSE), the Philippines (Philippine Stock Index), Taiwan (TSEC), and Thailand (SET) over the period from January 1, 2002, to December 31, 2013. Using the daily adjusted closing index values of these indices, the study constructed return series for analysis. **Marisetty (2017)** conducted a comprehensive study on the integration of stock markets, focusing on the correlation between the calculated returns from the indices of India (BSE SENSEX) and twelve countries, including Japan (Nikkei 225), Korea (KOSPI), Hong Kong (HANG SENG), China (SSECI), Germany (DAX), France (CAC 40), the UK (Russell 2000), the US (S&P 500, DJIA, and NASDAQ), and Brazil (BOVESPA) over a 20-year period (1998–2017). Correlation tests were conducted to assess the relationship between the returns from BSE SENSEX (India) and the other indices across each of the study year. **Sharma and Asawa (2021)** examined the nature of stock market association among five indices—India (Nifty 50), Germany (DAX 30), the USA (S&P 500), Saudi Arabia (TASI), and Japan (Nikkei 225)—over the period from January 2000 to December 2020 using monthly index closing data. The study, employing Unit Root tests, correlation tests, Granger causality, and the Johansen Cointegration test, revealed strong correlations between India (Nifty 50) and Germany (DAX 30) and US (S&P 500), while moderate correlations were observed with Saudi Arabia (TASI) and Japan (Nikkei 225). **Sayed and Charteris (2024)** analyzed the time and frequency varying stock market integration of BRICS nations, viz. Brazil (IBOVESPA), Russia (MOEX), India (NSE Nifty), China (SSE), South Africa (FTSE/JSE) and new BRICS members, viz., Egypt (EGX 30), Saudi Arab (Tadawul), UAE (Dubai Financial General Market Index) from January 2004 to May 2024 using correlation test, DCC-GARCH and wavelet coherence methods. Weekly returns from eight indices were examined using unfiltered and filtered data to isolate global risk factors. The existing literature highlights critical gaps in understanding stock market correlations, particularly over extended duration. Few studies have comprehensively analyzed the pre-crisis, crisis, and post-crisis periods together in a single timeframe. Moreover, limited attention has been given to conducting pre-statistical test diagnostics, such as, Normality checking to ensure the appropriate application of parametric or non-parametric statistical methods. The present study seeks to address these gaps by providing an in-depth exploration of the correlation patterns among the Indian stock market and five major American economies over the period 2003–2019.

Objectives

The objective of the study is to investigate the statistical properties of the calculated return series of the six sample stock indices with a focus on analyzing the correlation among the calculated returns related to India's S&P BSE SENSEX and the indices of five American economies during the 16 years period from June 3, 2003 to December 30, 2019.

Data and Methodological Approach

Sample Design & Study Period

This study seeks to explore stock market correlations among India and five selected countries from the American region: the US (S&P 500), Canada (S&P/TSX Composite Index), Brazil (IBOVESPA), Mexico (IPC MEXICO), and Argentina (MERVAL) over a sixteen-year period, from June 3, 2003, to December 30, 2019, prior to the onset of the COVID-19 pandemic. Daily adjusted closing index values for the six markets are utilized to calculate daily returns using the formula $R_t = \ln(P_t) - \ln(P_{t-1})$,, where R_t represents the logarithmic return, and P_t and P_{t-1} denote the current and previous day's adjusted market closing values, respectively. The secondary data of index closing values were sourced from web-platforms, such as www.yahoofinance.com and www.investing.com and the official websites of the respective indices.

The selection of sample countries is guided by the 2019 GDP (nominal) rankings list of countries published by the World Bank report, further refined based on data availability and insights from previous studies. A judgment sampling technique is employed to ensure the inclusion of India and five American countries with relevant stock indices, optimizing the study's scope and significance. All statistical analyses are conducted using SPSS software, version 21.

Statistical Tools Used

Descriptive statistics are used to assess the variability within the data and to provide valuable insights into the distribution and shape of the data, enhancing the depth of the analysis. Parametric statistical tests rely on the assumption that the dataset follows a normal distribution, where the variable x_i has a mean of zero, E(x) =0, signifying that most data points are concentrated around the mean. In view of this, the study utilizes the Shapiro-Wilk test. The normality test reveals non-normality and the Spearman Rank Correlation method has been adopted as non-parametric approach. The correlation coefficient ranges from -1 to +1. A positive value indicates that the two variables move in the same direction, signifying a positive correlation, while a negative value denotes an inverse relationship. Following the correlation test, hypothesis testing is conducted to determine whether the observed sample correlation accurately represents the true population correlation. This process assesses whether the population correlation coefficient (ρ) is approximately zero, indicating no monotonic association in the population, versus the alternative hypothesis (H_1), which suggests the presence of a monotonic association.

Analysis and Discussions

Descriptive Statistics

The descriptive statistics table is presented as follows:

Table 1: A Summary of Descriptive Statistics

Parameters (return of daily adjusted closing series)	Sample Size	Minimum Statistics	Maximum Statistics	Mean Value	Standard Deviation	Variance	Skewness		Kurtosis	
							Statistics	Standard Error	Statistics	Standard Error
S&P BSE SENSEX (India)	2035	–0.1810773992742481	0.1441259584904207	0.0012590 86604974	0.0197426 23509262	0.000	–0.250	0.054	10.286	0.108
S&P 500 (US)	2035	–0.1520177451687369	0.0952236065734594	0.0005890 09418537	0.0143652 11746027	0.000	–1.192	0.054	14.647	0.108
S&P/TSX Composite Index (Canada)	2035	–0.2040780623368518	0.1070154069169741	0.0004437 09682171	0.0138480 93461190	0.000	–1.735	0.054	29.332	0.108
IBOVESPA (Brazil)	2035	–0.2078590503913050	0.1687252124103567	0.0010622 91603670	0.0230682 39602435	0.001	–0.385	0.054	7.221	0.108
IPC MEXICO (Mexico)	2035	–0.1647943213527535	0.1259027438415897	0.0009181 65855297	0.0166281 03981463	0.000	–0.523	0.054	12.782	0.108
MERVAL (Argentina)	2035	–0.3032314450339962	0.1674493037258587	0.0020026 44093960	0.0311979 39328241	0.001	–0.875	0.054	9.869	0.108

Each return series consists of 2,035 observations, with no missing data. The IBOVESPA (Brazil) recorded the highest return value, while the MERVAL (Argentina) exhibited the lowest. The relatively low standard deviation values across the series indicate that the data points are closely clustered around their respective means. All series display negative skewness, signifying distributions with longer left tails and data concentrated on the right side. Since the skewness values deviate from zero, the series do not conform to a normal distribution. Additionally, the positive kurtosis values suggest leptokurtic distributions, characterized by sharper peaks and heavier tails. Overall, the table confirms that none of the return series follows a normal distribution.

Shapiro-Wilk Test of Normality

The Shapiro-Wilk test results with p-value, decision rule and test inferences are as follows:

Table 2: Result of the Shapiro-Wilk Test of Normality

Name of Stock Index	Statistic	P−Value	Decision Rule	Decision on H_0 *(H_0:* The return series are normally distributed.)	Inferences
S&P BSE SENSEX (India)	0.894	0.000	P<0.05	Rejected	Non-normal series
S&P 500 (US)	0.878	0.000	P<0.05	Rejected	Non-normal series
S&P/TSX Composite index (Canada)	0.851	0.000	P<0.05	Rejected	Non-normal series
IBOVESPA (Brazil)	0.941	0.000	P<0.05	Rejected	Non-normal series
IPC MEXICO (Mexico)	0.892	0.000	P<0.05	Rejected	Non-normal series
MERVAL (Argentina)	0.904	0.000	P<0.05	Rejected	Non-normal series

The obtained p-values are all below the 0.05 threshold, resulting in the rejection of the null hypothesis. This indicates that the return series do not follow a normal distribution. As a result, in light of the non-normality of the series (p-values < 0.05), the analysis shifts to a non-parametric approach, utilizing the Spearman Rank Correlation test.

Spearman Rank Correlation

The Spearman rank correlation matrix is given as follows:

Table 3: The Spearman Rank Correlation Matrix of the Returns among India and the select five sample countries' Stock Indices belong to the American Region during 16-year span from June 3, 2003, to December 30, 2019

Indices (Countries)	S&P BSE SENSEX (India)	S&P 500 (US)	S&P/TSX Composite index (Canada)	IBOVESPA (Brazil)	IPC MEXICO (Mexico)	MERVAL (Argentina)
S&P BSE SENSEX (India)	1.000	0.310** (0.000)	0.301** (0.000)	0.261** (0.000)	0.288** (0.000)	0.191** (0.000)
S&P 500 (US)	0.310** (0.000)	1.000	0.685** (0.000)	0.562** (0.000)	0.624** (0.000)	0.452** (0.000)
S&P/TSX Composite Index (Canada)	0.301** (0.000)	0.685** (0.000)	1.000	0.561** (0.000)	0.548** (0.000)	0.465** (0.000)
IBOVESPA (Brazil)	0.261** (0.000)	0.562** (0.000)	0.561** (0.000)	1.000	0.577** (0.000)	0.527** (0.000)
IPC MEXICO (Mexico)	0.288** (0.000)	0.624** (0.000)	0.548** (0.000)	0.577** (0.000)	1.000	0.436** (0.000)
MERVAL (Argentina)	0.191** (0.000)	0.452** (0.000)	0.465** (0.000)	0.527** (0.000)	0.436** (0.000)	1.000

** Correlation is significant at the 0.01 level (2-tailed)/P values are in parenthesis

The Spearman Rank Correlation matrix indicates that the returns from India's BSE SENSEX showed very weak correlations with the returns of all the five sample American indices during the study period. While positive correlations were observed, the coefficients were all below 0.4, signifying very low associations. The p-values, presented in parentheses beneath the coefficients, are all below 0.01, indicating statistical significance at the 1%, 5%, and 10% levels at the two-tailed test. In addition to the weak correlations between BSE SENSEX (India) and the five American indices, the matrix reveals strong correlations among the American indices themselves. The strongest correlation was found between the returns of the S&P/TSX Composite Index (Canada) and the S&P 500 (US), while the weakest correlation was between MERVAL (Argentina) and BSE SENSEX (India), followed by the correlations between BSE SENSEX (India) and the other American indices. All of these coefficients are statistically significant at the 1%, or 5% significance levels, with p-values below 0.01.

Conclusion

The returns from India's S&P BSE SENSEX exhibited consistently weak correlations with the five American indices over the 16-year period from June 3, 2003, to December 30, 2019. While the correlations were positive and statistically significant, the coefficients remained low, consistently falling below 0.4. This suggests limited integration between India's market and the sample American indices. In contrast, the correlations among the five American indices were very strong, with coefficients generally exceeding 0.5, indicating a considerably high degree of market integration within the American region. This strong interconnectedness among American financial markets reduces the potential for investment diversification. The persistently low correlations between India's stock market and the American indices highlight India's relatively independent market status. This low level of integration signals significant potential for portfolio diversification, offering global investors an opportunity to hedge against synchronized market downturns and reduce risk by investing in less correlated markets. India's weaker correlation with major international markets enhances its attractiveness as an investment destination, providing solid opportunities for diversification and greater risk-adjusted returns. By including Indian equities in their portfolios, investors can protect their portfolios from global financial shocks while achieving superior returns.

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