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Exploration of global stock markets correlations across twenty-two economies during pre-financial crisis period

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Abstract
As global financial systems become increasingly interconnected, understanding the linkages between Indian stock indices and international markets has become vital for investors aiming to navigate and capitalize on evolving market dynamics. The study delves into the intricate dynamics among India's S&P BSE SENSEX and 21 prominent stock indices from Asia, America, and Europe over the period spanning June 3, 2003, to August 2, 2007. Utilizing descriptive statistical analysis of the calculated return series derived from daily adjusted index closing values, alongside the non-parametric Spearman Rank Correlation method, the research provides an exhaustive exploration of global market correlation. The findings reveal weak correlations between the S&P BSE SENSEX and sample global indices, underscoring India's limited financial integration with international markets and its significant potential for portfolio diversification. In contrast, moderate correlations among American and European indices signal sensible regional association, reflecting shared economic frameworks and suggesting constrained diversification opportunities within these regions. The analysis further highlights heterogeneous financial interdependency, with India's S&P BSE SENSEX maintaining a distinctive detachment from American and European indices, underscoring unique market dynamics. Asian markets exhibit moderate intra-regional cohesion and selective global linkages, whereas European indices demonstrate robust interdependence, indicative of cohesive economic and financial policies. Notably, China's SSE emerges as minimally integrated, while select transcontinental relationships, such as between Mexico's IPC and the Netherlands' EURONEXT 100, underscore targeted global interdependencies. This nuanced examination sheds light on the structural and regional factors shaping global financial integration.

Keywords: Stock market correlation, s&p bse sensex, asian markets, american markets, european markets

Introduction

Over the time, as economies liberalized and opened their markets, the integration of global financial systems became inevitable (Bekaert, *et al*, 2002) [1]. This shift was propelled by the relaxation of cross-border capital restrictions and the adoption of progressive domestic regulatory reforms, leading to increased investor participation in international capital markets. Technological advancements and enhanced communication systems further facilitated this integration by streamlining trading processes, maintaining liquidity, and strengthening investor confidence. As global investment flows expanded and financial integration deepened, understanding market interdependence became crucial for evaluating the risk-reward dynamics of international portfolio diversification. However, intensified global market integration has reduced the benefits of diversification due to stronger co-movements among markets. At a macroeconomic level, these linkages have heightened contagion risks, with investor behavior increasingly influenced by global price fluctuations. In corporate finance, the degree of market segmentation plays a pivotal role in determining the cost of capital, with firms in segmented local markets often incurring higher capital costs compared to those in integrated international markets.

These dynamics highlight the complex trade-offs of a globally connected financial system, where opportunities and risks are deeply intertwined. When countries align with prevailing global or regional factors, a high degree of integration is more likely. Emerging markets offer the potential for higher returns but carry greater risks, while structured markets provide stability, attracting those seeking to balance their risk profiles. Integrated markets improve price efficiency by incorporating global risks, enabling investors to diversify portfolios and mitigate localized economic vulnerabilities. They also provide access to advanced financial services, fostering innovation and generating positive spillover effects. In an ever changing, volatile financial landscape, analyzing stock market integration with international benchmarks is critical for investors, fund managers, policymakers, and academics. This analysis influences portfolio diversification strategies, market efficiency assessments, capital budgeting decisions, and macroeconomic policy formulations. Here, the attempt has been steered to study the nature of stock market association among the twenty-two global indices across three regions, with a particular focus on their relationship with India.

Past Studies and Research Gap

Singh and Singh (2010) [6] explored the short-term and long-term dynamics between the stock indices of China (SZSE and SSE), India (SENSEX and Nifty), and four developed markets: the USA (DJIA), the UK (FTSE), Japan (Nikkei 225), and Hong Kong (Hang Seng Index). Using daily intra-

day prices from January 2000 to December 2009, the study applied correlation analysis, Granger causality tests, co-integration tests, and an error correction model to evaluate market integration. Ranpura *et al*. (2011) [4] inspected the short-term linkages and co-movements between the Indian stock market (BSE Sensex) and indices from ten developed and emerging economies. The analysis utilized daily adjusted closing prices spanning July 1997 to December 2009, divided into two distinct periods: Period-I (1997–2003) and Period-II (2003–2009). The study included indices from China (SCI), Brazil (BVSP), South Korea (KOSPI), the U.S. (DJIA), the U.K. (FTSE), Hong Kong (HANGSENG), Singapore (STI), Japan (NIKKEI), Germany (DAX), and Australia (AORD). Using daily closing prices and log-transformed returns, the study employed traditional statistical techniques and correlation analysis to assess market interdependence. Kasilingam *et al*. (2014) [3] conducted an extensive investigation into the inter-linkages, co-movements, and causal relationships among stock market returns in eight emerging Asian economies–China (SSE), India (NSE Nifty), Indonesia (JCI), Korea (KOSPI), Malaysia (KLSE), Philippine (Philippine stock Index), Taiwan (TSEC) and Thailand (SET) over a 12-year period, spanning from January 1, 2002, to December 31, 2013. The study considered daily stock index time series data of the eight Asian indices and carried on correlation-causality approaches to assess the stock market association among the sample indices. Deo and Prakash (2017) [2] analyzed the stock market associations between India's Nifty and nine indices from Asian, European, and American markets, including Australia (S&P ASX 200), South Korea (KOSPI), China (SZSE and SSE), Hong Kong (Hang Seng), Japan (Nikkei 225), the UK (FTSE 100), Switzerland (SMI), Germany (DAX), Europe (Euronext 100), and the USA (NYSE, NASDAQ). The study covered the period from January 1, 2006, to December 31, 2015, utilizing the natural logarithms of daily adjusted closing index values. To assess market associations, the study employed correlation analysis, cointegration tests, and Granger causality tests. Rehman *et al*. (2021) [5] investigated the short-run, long-run, and causal relationships among developed and emerging Asian stock markets - Japan (Nikkei 225), South Korea (KOSPI), Pakistan (KSE 100), China (SSE Composite), Sri Lanka (ASPI), India (BSE 200), and Malaysia (KLSE Composite) from 2001 to 2019.

The existing literature reveals notable gap in the understanding of stock market correlations, particularly over extended timeframes. A few studies have comprehensively examined global markets during the period preceding the 2008-09 global financial crisis. Moreover, limited attention has been given to pre-statistical diagnostics, such as normality testing, to ensure the appropriate selection of parametric or non-parametric methods. This study seeks to address these gaps by undertaking an in-depth analysis of the correlation patterns among the Indian stock market and those of 21 countries worldwide in the pre-crisis period.

Objectives

The objective of this study is to perceive the statistical characteristics of the calculated return series of the sample twenty-two indices across the three regions –America, Asia-Pacific and Europe with a focus on evaluating the correlation among the calculated returns related to India's S&P BSE SENSEX and the indices of twenty-one countries during the period from June 3, 2003 – August 2, 2007 (Pre-Financial Crisis Period).

Data and Methodological Approach

1. Sample Design & Study Period

The study examines stock market correlations between India and 21 major global indices across three continents—America, Asia-Pacific, and Europe. The sample selection is guided by the judgment sampling approach, focusing on countries ranked by their nominal GDP as reported in the World Bank's 2019 report. The sample nations and their representative stock indices are tabulated as follows:

Table 1: List of Select Sample Nations and adjoining Stock Indices

Regions	Sl. No.	Country	Name of Stock Index (Abbreviation)
America	1	US	S&P 500
	2	Canada	S&P/TSX Composite index (S&P/ TSX)
	3	Brazil	IBOVESPA
	4	Mexico	IPC MEXICO (IPC)
	5	Argentina	MERVAL
Asia-Pacific	6	India	S&P BSE SENSEX (SENSEX)
	7	Australia	S&P/ASX 200 (S&P/ ASX)
	8	Israel	TA-125 (TA)
	9	Japan	Nikkei 225 (Nikkei)
	10	Hong Kong	HANG SENG INDEX (HIS)
	11	Taiwan	TSEC weighted index (TSEC)
	12	China	SSE Composite Index (SSE)
	13	Singapore	FTSE Singapore (FTSE-Sin)
	14	Indonesia	Jakarta Composite Index (JCI)
	15	South Korea	KOSPI Composite Index (KOSPI)
	16	Russia	MOEX Russia Index (MOEX)
Europe	17	Germany	DAX PERFORMANCE-INDEX (DAX)
	18	UK	FTSE 100 (FTSE-100)
	19	France	CAC 40
	20	Netherland	EURONEXT 100
	21	Belgium	BEL 20
	22	Italy	FTSE MIB

The analysis focuses on the pre-crisis period from June 3, 2003, to August 2, 2007, to examine stock market associations among 22 indices spanning three continents. Daily returns for the indices are calculated using daily adjusted index closing values, applying the formula $R_t = \ln(P_t) - \ln(P_{t-1})$, , where R_t stands for 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 for index closing values are sourced from platforms www.yahoofinance.com and www.investing.com and the official websites of the respective indices. Statistical analyses are performed using SPSS software (version 21).

2. Statistical Tools Used

The correlation analysis begins with the generation of descriptive statistics, followed by testing the correlation among the 22 indices. To ensure methodological rigor, a normality test is conducted using the Shapiro-Wilk test beforehand to evaluate whether parametric or non-parametric approaches are appropriate for the correlation analysis. In cases when the normality test identifies deviations from normality, the Spearman Rank Correlation method is adopted. The coefficient of correlation always falls within the range of -1 to +1. A positive value signifies a direct relationship, where the two variables move in the same direction, indicating a positive correlation. Conversely, a negative value reflects an inverse relationship, where the variables move in opposite directions, denoting a negative correlation. To assess the significance of the observed correlation, hypothesis testing is carried out to determine whether the sample correlation accurately represents the true population correlation. This involves evaluating the null hypothesis (H_0), which posits that the population correlation coefficient (ρ) is zero—indicating no monotonic association—against the alternative hypothesis (H_1), which suggests the existence of such an association. SPSS software (version 21) has been used for data analysis. Based on these p-values, if p is less than 0.05, the null hypothesis of no significant correlation is rejected, indicating that the observed correlation coefficient is statistically significant at the 5% level.

Empirical Results and Interpretations

1. Descriptive Statistics

The descriptive statistics table is as follows:

Table 2: A Summary of Descriptive Statistics

Countries and Index Returns	Sample Size	Minimum Statistics	Maximum Statistics	Mean Value	Standard Deviation	Variance	Skewness		Kurtosis	
							statistics	Standard Error	statistics	Standard Error
US (S&P 500)	564	-0.03534	0.037811	0.000737	0.009236	0.000	-0.193	0.103	1.076	0.205
Canada (S&P/TSX)	564	-0.04581	0.031973	0.001223	0.009872	0.000	-0.492	0.103	1.707	0.205
Brazil (IBOVESPA)	564	-0.07589	0.08722	0.0025	0.021664	0.000	-0.232	0.103	1.545	0.205
Mexico (IPC)	564	-0.09198	0.077509	0.002671	0.016083	0.000	-0.258	0.103	4.648	0.205
Argentina (MERVAL)	564	-0.09863	0.095181	0.002	0.023404	0.001	-0.191	0.103	2.379	0.205
India (SENSEX)	564	-0.18108	0.117237	0.002765	0.021073	0.000	-1.082	0.103	12.733	0.205
Australia (S&P/ASX)	564	-0.05843	0.032494	0.001217	0.00898	0.000	-1.071	0.103	5.121	0.205
Israel (TA-125)	564	-0.04376	0.056378	0.001587	0.01301	0.000	-0.01	0.103	1.526	0.205
Japan (Nikkei)	564	-0.08507	0.078837	0.001214	0.015869	0.000	-0.316	0.103	3.982	0.205
Hong Kong (HSI)	564	-0.07645	0.048016	0.001494	0.013354	0.000	-0.398	0.103	3.179	0.205
Taiwan (TSEC)	564	-0.10663	0.053068	0.00115	0.015958	0.000	-1.252	0.103	8.055	0.205
China (SSE)	564	-0.11304	0.103163	0.001839	0.021917	0.000	0.33	0.103	5.01	0.205
Singapore (FTSE Sin)	564	-0.07928	0.055354	0.001667	0.012763	0.000	-0.32	0.103	4.379	0.205
Indonesia (JCI)	564	-0.10048	0.077445	0.002675	0.018137	0.000	-0.69	0.103	4.796	0.205
S Korea (KOSPI)	564	-0.08055	0.058264	0.001893	0.016724	0.000	-0.634	0.103	2.654	0.205
Russia (MOEX)	564	-0.10644	0.120456	0.002491	0.027394	0.001	-0.382	0.103	3.414	0.205
Germany (DAX)	564	-0.08812	0.061546	0.001617	0.014011	0.000	-0.527	0.103	3.879	0.205
UK (FTSE 100)	564	-0.03685	0.042774	0.000755	0.009262	0.000	-0.296	0.103	2.001	0.205
France (CAC 40)	564	-0.04529	0.045632	0.001109	0.011811	0.000	-0.265	0.103	1.528	0.205
Netherland (euronext 100)	564	-0.04019	0.040171	0.001157	0.010917	0.000	-0.372	0.103	1.603	0.205
Belgium (BEL 20)	564	-0.04254	0.034199	0.001415	0.009871	0.000	-0.503	0.103	2.049	0.205
Italy (FTSE MIB)	564	-0.05165	0.908826	0.002409	0.039573	0.002	21.403	0.103	491.142	0.205

All series comprise 564 observations, with no missing data identified. Among the indices, the FTSE MIB (Italy) records the highest return, while the India (BSE SENSEX) registers the lowest. The low standard deviation values across the series indicate that the return observations are tightly clustered around their respective means, suggesting low variability. Most of the series exhibit negative skewness, implying longer left tails and a concentration of values on the right, except for the China (SSE), which shows positive skewness, reflecting longer right tails and values concentrated on the left. Skewness values deviating from zero confirm significant asymmetry in all series.

Notably, indices such as the India (BSE SENSEX), Australia (S&P/ASX 200), Taiwan (TSEC), and Italy (FTSE MIB) exhibit skewness values exceeding -1, indicating pronounced left-tailed distributions. In contrast, the FTSE MIB (Italy) demonstrates extreme positive skewness with a value of 21.40, highlighting a highly asymmetric distribution with a notably long right tail, signaling significant outliers or extreme values. The kurtosis analysis shows that returns from indices like India (BSE SENSEX), Australia (S&P/ASX 200), Japan (Nikkei 225), Hong Kong (Hang Seng Index), Taiwan (TSEC), China (SSE), Singapore (FTSE), Indonesia (JCI), Russia (MOEX), Germany (DAX), and Italy (FTSE MIB) display kurtosis values greater than 3, characteristic of leptokurtic distributions. These distributions are marked by sharper peaks and heavier tails, indicating a higher occurrence of

extreme outliers compared to a normal distribution. This suggests that while most returns cluster around the mean, occasional large deviations are more likely. Conversely, the remaining indices exhibit kurtosis values below 3, indicative of platykurtic distributions. These are characterized by flatter tails and broader peaks compared to a normal distribution, implying more stable returns with fewer abrupt spikes or extreme movements.

Shapiro-Wilk Test of Normality

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

Table 6: 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
US (S&P 500)	0.989	0.000	P<0.05	Rejected	Non-normal series
Canada (S&P/TSX)	0.978	0.000	P<0.05	Rejected	Non-normal series
Brazil (IBOVESPA)	0.976	0.000	P<0.05	Rejected	Non-normal series
Mexico (IPC)	0.943	0.000	P<0.05	Rejected	Non-normal series
Argentina(MERVAL)	0.965	0.000	P<0.05	Rejected	Non-normal series
India (SENSEX)	0.889	0.000	P<0.05	Rejected	Non-normal series
Australia (S&P/ASX)	0.942	0.000	P<0.05	Rejected	Non-normal series
Israel (TA-125)	0.981	0.000	P<0.05	Rejected	Non-normal series
Japan (Nikkei)	0.950	0.000	P<0.05	Rejected	Non-normal series
Hong Kong (HSI)	0.963	0.000	P<0.05	Rejected	Non-normal series
Taiwan (TSEC)	0.900	0.000	P<0.05	Rejected	Non-normal series
China (SSE)	0. 917	0.000	P<0.05	Rejected	Non-normal series
Singapore (FTSE Sin)	0.944	0.000	P<0.05	Rejected	Non-normal series
Indonesia (JCI)	0.934	0.000	P<0.05	Rejected	Non-normal series
S Korea (KOSPI)	0.963	0.000	P<0.05	Rejected	Non-normal series
Russia (MOEX)	0.936	0.000	P<0.05	Rejected	Non-normal series
Germany (DAX)	0.963	0.000	P<0.05	Rejected	Non-normal series
UK (FTSE 100)	0.976	0.000	P<0.05	Rejected	Non-normal series
France (CAC 40)	0.981	0.000	P<0.05	Rejected	Non-normal series
Netherland (EURONEXT 100)	0.978	0.000	P<0.05	Rejected	Non-normal series
Belgium (BEL 20)	0.973	0.000	P<0.05	Rejected	Non-normal series
Italy (FTSE MIB)	0.149	0.000	P<0.05	Rejected	Non-normal series

All p-values are below the 0.05 threshold, leading to the rejection of the null hypothesis and confirming the non-normality of the return series. Consequently, due to this deviation from normality as, p-values less than 0.05, the analysis adopts a non-parametric methodology, specifically the Spearman Rank Correlation test.

Spearman Rank Correlation

The Spearman rank correlation matrix among the twenty two indices is organized into three distinct panels. The first panel displays the correlation relationships between Asian and American markets, highlighting inter-regional dynamics. The second panel focuses on the associations between Asian and European markets, illustrating their financial interconnectedness. Finally, the third panel explores the correlations within and between American and European markets, emphasizing cross-continental integration.

The correlation analysis underscores the selective integration between Asian and American stock indices, influenced by regional dynamics and global economic interdependencies. India's S&P BSE SENSEX exhibits weak associations with American markets, with correlation coefficients consistently below 0.3. The highest observed correlation for India is with the S&P/ASX (Canada), suggesting limited co-movement despite shared macroeconomic factors. A similar trend is evident across other Asian indices, which maintain low correlations with American indices—typically under 0.3—indicating only partial integration between these regions. Notable exceptions include Japan's Nikkei 225, Hong Kong's Hang Seng Index (HSI), Taiwan's TSEC, Singapore's FTSE ST Index, Indonesia's JCI, and South Korea's KOSPI, which display moderate correlations with coefficients ranging between 0.5 and 0.6. These results highlight slightly stronger financial alignment between these Asian markets and global indices.

Within Asia, the inter-market correlations reveal moderate linkages, reflecting robust regional economic ties, with the strongest correlation observed between the returns from HSI (Hong Kong) and FTSE (Singapore). The statistical significance of the findings is supported by p-values provided beneath each coefficient, all falling below 0.01 for statistically significant relationships. This confirms the robustness of these correlations at either the 1%, or 5% significance levels at two-tailed test. Conversely, certain associations, including those between China's SSE and indices such as the US S&P 500, Mexico's IPC, India's S&P BSE SENSEX, Israel's TA-15, Japan's Nikkei 225, and Russia's MOEX, demonstrate insignificant correlations. For these pairs, p-values exceed 0.05, failing to reject the null hypothesis of no significant association.

The correlation analysis reveals a nuanced and varied degree of financial integration between Asian and European

indices, with India's S&P BSE SENSEX demonstrating consistently weak associations across the spectrum. Notably, the highest correlation among Asian indices is observed between Japan's Nikkei and the Netherlands' EURONEXT 100, underscoring a modest level of co-movement. This highlights India's distinct market dynamics relative to its European counterparts, suggesting a degree of insulation from broader European market trends. In contrast, several other Asian indices exhibit relatively stronger correlations with European markets, underscoring their intermediary roles in global trade and financial linkages. These findings illuminate the complex interplay of regional and transcontinental relationships, shaped by structural economic factors and geographic proximities. European indices themselves display a higher degree of interdependence, reflecting tighter regional integration within Europe. India's weaker alignment with European indices compared to other Asian markets suggests a limited spillover effect from European market dynamics to India, marking its relative independence in this context. Conversely, China's SSE shows no significant correlation with any European indices, as evidenced by p-values exceeding 0.05, thereby failing to reject the null hypothesis of no significant association. Similar patterns of insignificance are observed between China (SSE) and Israel (TA-125) as well as Japan (Nikkei), further underscoring varying levels of integration. Statistically significant relationships, as denoted by p-values below 0.01, confirm the robustness of the observed correlations at the 1%, or 5% significance levels at two-tailed test. These results collectively underscore the heterogeneous integration patterns across Asian and European markets, shaped by diverse economic structures and regional dynamics.

The correlation analysis emphasizes the moderate financial interdependencies between American and European markets, driven by their advanced economies and interconnected financial systems. Among the indices analyzed, Mexico's IPC and the Netherlands' EURONEXT 100 exhibit the highest correlation, highlighting significant co-movement across these transcontinental markets. In contrast, the weakest association is observed between Argentina's MERVAL and Germany's DAX, reflecting varying degrees of integration within the global financial landscape. Inter-European market correlations are notably stronger than those observed among American indices, emphasizing the deeper regional integration within Europe. This heightened connectivity is likely influenced by shared economic policies and structural synergies among European nations. The statistical significance of these findings is confirmed by p-values in parentheses below 0.01, demonstrating the robustness of the observed correlations at the 1%, or 5% significance levels at two-tailed test. These results underline the structural and regional factors shaping the varying levels of financial integration across American and European markets.

Table 6: Panel C: The Spearman Rank Correlation Matrix of the calculated Returns from select American and the European Indices

Indices (Countries)	US (S&P 500)	Canada (S&P/TSX Composite Index)	Brazil (IBOVESPA)	Mexico (IPC Mexico)	Argentina (MERVAL)	Germany (DAX Performance Index)	UK (FTSE 100)	France (CAC 40)	Netherland (EURONEXT 100)	Belgium (BEL 20)	Italy (FTSE MIB)
US (S&P 500)	1	.607** (0.000)	.582** (0.000)	.652** (0.000)	.355** (0.000)	.483** (0.000)	.427** (0.000)	.467** (0.000)	.474** (0.000)	.405** (0.000)	.445** (0.000)
Canada (S&P/TSX Composite Index)	.607** (0.000)	1	.507** (0.000)	.514** (0.000)	.419** (0.000)	.410** (0.000)	.453** (0.000)	.426** (0.000)	.440** (0.000)	.366** (0.000)	.428** (0.000)
Brazil (IBOVESPA)	.582** (0.000)	.507** (0.000)	1	.621** (0.000)	.431** (0.000)	.346** (0.000)	.358** (0.000)	.338** (0.000)	.345** (0.000)	.308** (0.000)	.345** (0.000)
Mexico (IPC Mexico)	.652** (0.000)	.514** (0.000)	.621** (0.000)	1	.412** (0.000)	.471** (0.000)	.480** (0.000)	.494** (0.000)	.504** (0.000)	.458** (0.000)	.482** (0.000)
Argentina (MERVAL)	.355** (0.000)	.419** (0.000)	.431** (0.000)	.412** (0.000)	1	.198** (0.000)	.244** (0.000)	.222** (0.000)	.228** (0.000)	.200** (0.000)	.210** (0.000)
Germany (DAX Performance Index)	.483** (0.000)	.410** (0.000)	.346** (0.000)	.471** (0.000)	.198** (0.000)	1	.774** (0.000)	.906** (0.000)	.913** (0.000)	.753** (0.000)	.842** (0.000)
UK (FTSE 100)	.427** (0.000)	.453** (0.000)	.358** (0.000)	.480** (0.000)	.244** (0.000)	.774** (0.000)	1	.852** (0.000)	.858** (0.000)	.753** (0.000)	.796** (0.000)
France (CAC 40)	.467** (0.000)	.426** (0.000)	.338** (0.000)	.494** (0.000)	.222** (0.000)	.906** (0.000)	.852** (0.000)	1	.987** (0.000)	.817** (0.000)	.866** (0.000)
Netherland (EURONEXT 100)	.474** (0.000)	.440** (0.000)	.345** (0.000)	.504** (0.000)	.228** (0.000)	.913** (0.000)	.858** (0.000)	.987** (0.000)	1	.840** (0.000)	.865** (0.000)
Belgium (BEL 20)	.405** (0.000)	.366** (0.000)	.308** (0.000)	.458** (0.000)	.200** (0.000)	.753** (0.000)	.753** (0.000)	.817** (0.000)	.840** (0.000)	1	.753** (0.000)
Italy (FTSE MIB)	.445** (0.000)	.428** (0.000) z	.345** (0.000)	.482** (0.000)	.210** (0.000)	.842** (0.000)	.796** (0.000)	.866** (0.000)	.865** (0.000)	.753** (0.000)	1
** Correlation is significant at the 0.01 level (2-tailed) / P values are in parenthesis											

Table 4: Panel A: The Spearman Rank Correlation Matrix of the calculated Returns from select Asia-Pacific and the American Indices

Countries (Indices)	US (S&P 500)	Canada (S&P/TSX)	Brazil (IBOVESPA)	Mexico (IPC)	Argentina (MERVAL)	India (SENSEX)	Australia (S&P/ ASX)	Israel (TA-125)	Japan (Nikkei)	Hong Kong (HSI)	Taiwan (TSEC)	China (SSE)	Singapore (FTSE Sin)	Indonesia (JCI)	S Korea (KOSPI)	Russia (MOEX)
US (S&P 500)	1	.607** (0.000)	.582** (0.000)	.652** (0.000)	.355** (0.000)	.201** (0.000)	.194** (0.000)	.201** (0.000)	.244** (0.000)	.223** (0.000)	.230** (0.000)	0.08 (0.059)	.238** (0.000)	.100* (0.018)	.254** (0.000)	.217** (0.000)
Canada (S&P/TSX)	.607** (0.000)	1	.507** (0.000)	.514** (0.000)	.419** (0.000)	.265** (0.000)	.308** (0.000)	.155** (0.000)	.284** (0.000)	.291** (0.000)	.264** (0.000)	.157** (0.000)	.306** (0.000)	.188** (0.000)	.324** (0.000)	.277** (0.000)
Brazil (IBOVESPA)	.582** (0.000)	.507** (0.000)	1	.621** (0.000)	.431** (0.000)	.185** (0.000)	.220** (0.000)	.185** (0.000)	.242** (0.000)	.242** (0.000)	.153** (0.000)	.108* 0.01	.251** (0.000)	.159** (0.000)	.199** (0.000)	.329** (0.000)
Mexico (IPC)	.652** (0.000)	.514** (0.000)	.621** (0.000)	1	.412** (0.000)	.262** (0.000)	.258** (0.000)	.209** (0.000)	.258** (0.000)	.288** (0.000)	.251** (0.000)	0.068 (0.105)	.307** (0.000)	.151** (0.000)	.291** (0.000)	.327** (0.000)
Argentina (MERVAL)	.355** (0.000)	.419** (0.000)	.431** (0.000)	.412** (0.000)	1	.138** (0.001)	.209** (0.000)	.146** (0.000)	.125** (0.003)	.233** (0.000)	.102* (0.015)	.091* (0.03)	.182** (0.000)	.147** (0.000)	.166** (0.000)	.215** (0.000)
India (SENSEX)	.201** (0.000)	.265** (0.000)	.185** (0.000)	.262** (0.000)	.138** (0.001)	1	.271** (0.000)	.213** (0.000)	.316** (0.000)	.396** (0.000)	.310** (0.000)	0.075 (0.077)	.375** (0.000)	.369** (0.000)	.369** (0.000)	.275** (0.000)
Australia (S&P/ASX)	.194** (0.000)	.308** (0.000)	.220** (0.000)	.258** (0.000)	.209** (0.000)	.271** (0.000)	1	.290** (0.000)	.520** (0.000)	.458** (0.000)	.402** (0.000)	.130** (0.002)	.478** (0.000)	.397** (0.000)	.462** (0.000)	.348** (0.000)
Israel (TA-125)	.201** (0.000)	.155** (0.000)	.185** (0.000)	.209** (0.000)	.146** (0.000)	.213** (0.000)	.290** (0.000)	1	.332** (0.000)	.354** (0.000)	.234** (0.000)	0.052 (0.214)	.344** (0.000)	.286** (0.000)	.288** (0.000)	.252** (0.000)
Japan (Nikkei)	.244** (0.000)	.284** (0.000)	.242** (0.000)	.258** (0.000)	.125** (0.003)	.316** (0.000)	.520** (0.000)	.332** (0.000)	1	.511** (0.000)	.512** (0.000)	0.08 (0.058)	.541** (0.000)	.390** (0.000)	.569** (0.000)	.275** (0.000)
Hong Kong (HSI)	.223** (0.000)	.291** (0.000)	.242** (0.000)	.288** (0.000)	.233** (0.000)	.396** (0.000)	.458** (0.000)	.354** (0.000)	.511** (0.000)	1	.527** (0.000)	.222** (0.000)	.625** (0.000)	.531** (0.000)	.563** (0.000)	.336** (0.000)
Taiwan (TSEC)	.230** (0.000)	.264** (0.000)	.153** (0.000)	.251** (0.000)	.102* (0.015)	.310** (0.000)	.402** (0.000)	.234** (0.000)	.512** (0.000)	.527** (0.000)	1	.122** (0.004)	.498** (0.000)	.408** (0.000)	.599** (0.000)	.243** (0.000)
China (SSE)	0.08 (0.059)	.157** (0.000)	.108* (0.01)	0.068 (0.105)	.091* (0.03)	0.075 (0.077)	.130** (0.002)	0.052 (0.214)	0.08 (0.058)	.222** (0.000)	.122** (0.004)	1	.185** (0.000)	.190** (0.000)	.157** (0.000)	0.077 (0.067)
Singapore (FTSE Sin)	.238** (0.000)	.306** (0.000)	.251** (0.000)	.307** (0.000)	.182** (0.000)	.375** (0.000)	.478** (0.000)	.344** (0.000)	.541** (0.000)	.625** (0.000)	.498** (0.000)	.185** (0.000)	1	.512** (0.000)	.532** (0.000)	.321** (0.000)
Indonesia (JCI)	.100* (0.018)	.188** (0.000)	.159** (0.000)	.151** (0.000)	.147** (0.000)	.369** (0.000)	.397** (0.000)	.286** (0.000)	.390** (0.000)	.531** (0.000)	.408** (0.000)	.190** (0.000)	.512** (0.000)	1	.431** (0.000)	.252** (0.000)
S Korea (KOSPI)	.254** (0.000)	.324** (0.000)	.199** (0.000)	.291** (0.000)	.166** (0.000)	.369** (0.000)	.462** (0.000)	.288** (0.000)	.569** (0.000)	.563** (0.000)	.599** (0.000)	.157** (0.000)	.532** (0.000)	.431** (0.000)	1	.290** (0.000)
Russia (MOEX)	.217** (0.000)	.277** (0.000)	.329** (0.000)	.327** (0.000)	.215** (0.000)	.275** (0.000)	.348** (0.000)	.252** (0.000)	.275** (0.000)	.336** (0.000)	.243** (0.000)	0.077 (0.067)	.321** (0.000)	.252** (0.000)	.290** (0.000)	1

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

Table 5: Panel B: The Spearman Rank Correlation Matrix of the calculated Returns from select Asia-Pacific and the European Indices

Indices (Countries)	India (S&P BSE SENSEX)	Australia (S&P/ASX 200)	Israel (TA-125)	Japan (Nikkei 225)	Hong Kong (Hang Sang Index)	Taiwan (TSEC)	China (SSE Composite Index)	Singapore (FTSE Singapore)	Indonesia (Jakarta Composite Index)	S Korea (KOSPI Composite Index)	Russia (MOEX Russia)	Germany (DAX Performance Index)	UK (FTSE 100)	France (CAC 40)	Netherland (EURONEXT 100)	Belgium (BEL 20)	Italy (FTSE MIB)
India (S&P BSE SENSEX)	1	.271** (0.000)	.213** (0.000)	.316** (0.000)	.396** (0.000)	.310** (0.000)	0.075 (0.077)	.375** (0.000)	.369** (0.000)	.369** (0.000)	.275** (0.000)	.312** (0.000)	.270** (0.000)	.306** (0.000)	.320** (0.000)	.275** (0.000)	.271** (0.000)
Australia (S&P/ASX 200)	.271** (0.000)	1	.290** (0.000)	.520** (0.000)	.458** (0.000)	.402** (0.000)	.130** (0.002)	.478** (0.000)	.397** (0.000)	.462** (0.000)	.348** (0.000)	.392** (0.000)	.391** (0.000)	.384** (0.000)	.401** (0.000)	.354** (0.000)	.358** (0.000)
Israel (TA-125)	.213** (0.000)	.290** (0.000)	1	.332** (0.000)	.354** (0.000)	.234** (0.000)	0.052 (0.214)	.344** (0.000)	.286** (0.000)	.288** (0.000)	.252** (0.000)	.363** (0.000)	.290** (0.000)	.359** (0.000)	.359** (0.000)	.304** (0.000)	.316** (0.000)
Japan (Nikkei 225)	.316** (0.000)	.520** (0.000)	.332** (0.000)	1	.511** (0.000)	.512** (0.000)	0.08 (0.058)	.541** (0.000)	.390** (0.000)	.569** (0.000)	.275** (0.000)	.415** (0.000)	.378** (0.000)	.431** (0.000)	.443** (0.000)	.374** (0.000)	.356** (0.000)
Hong Kong (Hang Sang Index)	.396** (0.000)	.458** (0.000)	.354** (0.000)	.511** (0.000)	1	.527** (0.000)	.222** (0.000)	.625** (0.000)	.531** (0.000)	.563** (0.000)	.336** (0.000)	.421** (0.000)	.388** (0.000)	.418** (0.000)	.429** (0.000)	.400** (0.000)	.385** (0.000)
Taiwan (TSEC)	.310** (0.000)	.402** (0.000)	.234** (0.000)	.512** (0.000)	.527** (0.000)	1	.122** (0.004)	.498** (0.000)	.408** (0.000)	.599** (0.000)	.243** (0.000)	.361** (0.000)	.293** (0.000)	.340** (0.000)	.361** (0.000)	.338** (0.000)	.292** (0.000)
China (SSE Composite Index)	0.075 (0.077)	.130** (0.002)	0.052 (0.214)	0.08 (0.058)	.222** (0.000)	.122** (0.004)	1	.185** (0.000)	.190** (0.000)	.157** (0.000)	0.077 (0.067)	0.07 (0.095)	0.069 (0.104)	0.049 (0.249)	0.061 (0.147)	0.076 (0.071)	0.031 (0.458)
Singapore (FTSE Singapore)	.375** (0.077)	.478** (0.000)	.344** (0.000)	.541** (0.000)	.625** (0.000)	.498** (0.000)	.185** (0.000)	1	.512** (0.000)	.532** (0.000)	.321** (0.000)	.458** (0.000)	.431** (0.000)	.450** (0.000)	.469** (0.000)	.464** (0.000)	.411** (0.000)
Indonesia (Jakarta Composite Index)	.369** (0.000)	.397** (0.000)	.286** (0.000)	.390** (0.000)	.531** (0.000)	.408** (0.000)	.190** (0.000)	.512** (0.000)	1	.431** (0.000)	.252** (0.000)	.264** (0.000)	.243** (0.000)	.244** (0.000)	.263** (0.000)	.270** (0.000)	.211** (0.000)
S Korea (KOSPI Composite Index)	.369** (0.000)	.462** (0.000)	.288** (0.000)	.569** (0.000)	.563** (0.000)	.599** (0.000)	.157** (0.000)	.532** (0.000)	.431** (0.000)	1	.290** (0.000)	.426** (0.000)	.346** (0.000)	.411** (0.000)	.428** (0.000)	.388** (0.000)	.338** (0.000)
Russia (MOEX Russia)	.275** (0.000)	.348** (0.000)	.252** (0.000)	.275** (0.000)	.336** (0.000)	.243** (0.000)	0.077 (0.067)	.321** (0.000)	.252** (0.000)	.290** (0.000)	1	.358** (0.000)	.404** (0.000)	.394** (0.000)	.403** (0.000)	.395** (0.000)	.367** (0.000)
Germany (DAX Performance Index)	.312** (0.000)	.392** (0.000)	.363** (0.000)	.415** (0.000)	.421** (0.000)	.361** (0.000)	0.07 (0.095)	.458** (0.000)	.264** (0.000)	.426** (0.000)	.358** (0.000)	1	.774** (0.000)	.906** (0.000)	.913** (0.000)	.753** (0.000)	.842** (0.000)
UK (FTSE 100)	.270** (0.000)	.391** (0.000)	.290** (0.000)	.378** (0.000)	.388** (0.000)	.293** (0.000)	0.069 (0.104)	.431** (0.000)	.243** (0.000)	.346** (0.000)	.404** (0.000)	.774** (0.000)	1	.852** (0.000)	.858** (0.000)	.753** (0.000)	.796** (0.000)
France (CAC 40)	.306** (0.000)	.384** (0.000)	.359** (0.000)	.431** (0.000)	.418** (0.000)	.340** (0.000)	0.049 (0.249)	.450** (0.000)	.244** (0.000)	.411** (0.000)	.394** (0.000)	.906** (0.000)	.852** (0.000)	1	.987** (0.000)	.817** (0.000)	.866(0.000)
Netherland (EURONEXT 100)	.320** (0.000)	.401** (0.000)	.359** (0.000)	.443** (0.000)	.429** (0.000)	.361** (0.000)	0.061 (0.147)	.469** (0.000)	.263** (0.000)	.428** (0.000)	.403** (0.000)	.913** (0.000)	.858** (0.000)	.987** (0.000)	1	.840** (0.000)	.865** (0.000)
Belgium (BEL 20)	.275** (0.000)	.354** (0.000)	.304** (0.000)	.374** (0.000)	.400** (0.000)	.338** (0.000)	0.076 (0.071)	.464** (0.000)	.270** (0.000)	.388** (0.000)	.395** (0.000)	.753** (0.000)	.753** (0.000)	.817** (0.000)	.840** (0.000)	1	.753** (0.000)
Italy (FTSE MIB)	.271** (0.000)	.358** (0.000)	.316** (0.000)	.356** (0.000)	.385** (0.000)	.292** (0.000)	0.031 (0.458)	.411** (0.000)	.211** (0.000)	.338** (0.000)	.367** (0.000)	.842** (0.000)	.796(0.000)	.866** (0.000)	.865** (0.000)	.753** (0.000)	1

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

Conclusion

The correlation analysis highlights varied financial integration across Asian, American, and European markets, shaped by regional dynamics and global interdependencies. India's S&P BSE SENSEX shows weak correlations with both American and European indices, with coefficients below 0.3, underscoring limited co-movement. While most Asian indices also demonstrate low correlations with American markets, moderate associations (0.5–0.6) are observed in Japan's Nikkei 225, Hong Kong's HSI, Taiwan's TSEC, Singapore's FTSE ST, Indonesia's JCI, and South Korea's KOSPI, reflecting slightly stronger global ties. Within Asia, inter-market correlations suggest robust regional economic connections, with the highest linkage between Hong Kong's HSI and Singapore's FTSE. European indices exhibit stronger interdependence, reflecting deeper regional integration due to shared economic policies. Asian indices, excluding India, show relatively stronger ties to European markets, highlighting intermediary roles in global finance. Conversely, China's SSE exhibits no significant correlation with either American or European indices, emphasizing its limited integration. Among transcontinental pairs, Mexico's IPC and the Netherlands' EURONEXT 100 show the strongest correlation, while Argentina's MERVAL and Germany's DAX exhibit the weakest. Statistically significant relationships, confirmed by p-values below 0.01, underscore the robustness of these findings. The results emphasize India's distinct market dynamics and relative insulation within the global financial ecosystem.

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