



A study on stock markets correlation among major global economies during the global recession period

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Abstract

Globalization has profoundly transformed economic and financial backgrounds, dismantling barriers to cross-border capital flows and fostering greater investor participation in international markets. This progression has deepened financial integration, evident in the heightened co-movement of global stock indices. Technological advancements and rapid communication innovations have further reinforced this interconnectedness by enhancing market liquidity, streamlining trading processes, and bolstering investor confidence on a global scale. The study observes the correlation dynamics between India's S&P BSE SENSEX and 21 major stock indices from Asia, America, and Europe during the Great Recession period, leveraging descriptive statistical analysis and the non-parametric Spearman Rank Correlation method as found by the normality assumption test. The Correlation matrix reveal that India's S&P BSE SENSEX exhibits weak correlations with American as well as European indices, underscoring its relative detachment from global financial trends. Most Asian indices demonstrate low to moderate correlations with the remaining sample indices, reflecting slightly stronger global integration. Intra-Asian correlations indicate moderate regional linkages, while European indices exhibit significantly stronger interdependence among them, driven by cohesive economic policies and deeper regional integration. Asian indices, excluding India, show relatively stronger ties to European markets, than American indices, highlighting their roles as intermediaries in global finance. China's SSE, however, shows statistically insignificant correlation with India, signifying divergent market trajectories.

Keywords: Stock market correlation, S&P BSE SENSEX, asian markets, american markets, european markets, great recession

Introduction

The liberalization of domestic economies and their alignment with global trends have rendered the interconnectedness of financial markets an inevitability. This growing interdependence presents both opportunities and challenges. Integrated markets enhance price efficiency, mitigate localized economic shocks, and provide access to advanced financial services. However, these benefits come with trade-offs, as stronger co-movements among markets diminish the advantages of diversification and amplify contagion risks. For emerging economies like India, which combine high growth potential with systemic importance, understanding the dynamics of market integration is essential. As India continues to evolve within the global financial ecosystem, a nuanced analysis of its stock market's relationship with international benchmarks becomes increasingly pertinent. Limited market interconnectedness fosters diversification, a key element of fund management, essential for balancing risks and optimizing returns through strategic global asset allocation. However, as emerging markets integrate into international financial systems, they face heightened exposure to global crises. While integration drives growth and capital access, it also amplifies financial instability risks, particularly during economic downturns. This interconnectedness amplifies crises, exposing economies to contagion and constraining domestic policy efficacy. The 2008-09 financial crisis exemplifies this, as the U.S. housing market collapse triggered a global recession marked by systemic banking failures, investment collapses, credit freezes, and precipitous declines in global stock valuations.

Emerging markets, traditionally sensitive to localized disruptions, face reduced isolation from global crises as they deepen their integration into the international financial system. While integration promotes growth and access to capital, it also heightens financial instability risks during global stress. Economic cycles further influence this process, with highly interconnected economies becoming more vulnerable during downturns, highlighting the balance between integration benefits and systemic vulnerabilities. During financial stress, increased market correlations reveal the complexities of global integration. Greater synchronization of price movements, driven by shared shocks and cross-border investments, enhances efficiency but complicates risk management as local volatility propagates globally. For portfolio managers, rising correlations during crises diminish diversification benefits and hinder effective hedging strategies.

Past Studies and Research Gap

Sen (2011) ^[6], examined the short-term and long-term linkages between India's SENSEX and the indices of Australia (AORD), Hong Kong (HSI), Indonesia (JKSE), Japan (Nikkei 225), Malaysia (KLSE), South Korea (KOSPI), Singapore (Straits Times Index), and Taiwan (TSEC) for the period spanning July 1997 to June 2009. Utilizing monthly index data converted into natural logarithms, the study employed correlation analysis, Johansen Cointegration Tests, and Granger Causality Tests to evaluate market interconnections. The pairwise cross-correlation matrix revealed a strong association between the

SENSEX and all sample indices, except for Japan’s Nikkei 225, which showed a weaker correlation. Srikanth, and Aparna (2012) [7]. examined the stock market relationships between India (SENSEX) and eight indices from five countries, namely the US (DJIA, NYSE, NASDAQ, S&P 500), Hong Kong (Hang Seng), Japan (Nikkei 225), China (SSE Composite), and the UK (FTSE 100), considering the study period from January 2000 to December 2009. Joshi (2013) [3]. investigated the correlation and cointegration of stock indices among BRIC nations over the period 2002 to 2012. Using correlation and cointegration tests, the study identified a significant positive correlation between the BRIC countries, notably between India and Russia, as well as India and Brazil. Nashier (2015) [4]. conducted a detailed investigation into the integration of stock markets among the BRICS nations—Brazil (IBOVESPA), Russia (RTSI), India (NIFTY), China (SHCOMP), and South Africa (FTSE/JSE 40)—as well as the United States (DJIA) and the United Kingdom (FTSE 100) during 2004 to 2013 period. The study calculated return series from the daily index closing values of the sample indices and performed correlation-Johansen’s cointegration test to study short-term static and long-term dynamic integration. Patjoshi et al. (2021) [5]. analyzed the stock market relationships between India and seven indices from six countries: Germany (DAX Performance-Index), USA (NASDAQ and DJIA), Hong Kong (HANG SENG), Japan (NIKKEI 225), Australia (S&P ASX 200), and Canada (S&P/TSX Composite Index). The study covered an 11-year period from January 1, 2009, to December 31, 2019. The existing body of literature highlight the substantial gap in the analysis of stock market

correlations, particularly regarding the inclusion of a diverse set of countries. Few studies have systematically investigated global markets during the 2008-09 global financial crisis. Additionally, there has been a lack of focus on essential pre-statistical diagnostics, such as normality testing, to guide the appropriate use of parametric or non-parametric methodologies. This research aims to bridge these gaps by conducting a comprehensive analysis of the correlation dynamics between the Indian stock market and those of 21 countries globally during the 2008-09 recession period.

Objectives

The objective of this study is to describe the statistical properties of the estimated return series for the sample of 22 indices across the three regions – America, Asia-Pacific and Europe and examine the correlation dynamics among India’s S&P BSE SENSEX and the remaining indices of 21 other countries during the global recession period, spanning from August 7, 2007, to April 16, 2009.

Data and Methodological Approach

Sample Design & Study Period

The current study explores the stock market correlations between India and 21 major global indices spanning three continents—America, Asia-Pacific, and Europe. The sample selection employs the judgment sampling approach, prioritizing countries based on their nominal GDP rankings as outlined in the World Bank’s 2019 report. The sample nations and their selected stock indices are charted as follows:

Table 1: List of Select Sample Nations and Select 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 (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 2008-09 great recession period from August 7, 2007, to April 16, 2009, to examine stock market associations among 22 indices spanning three continents. This study focuses on a critical timeframe that reflects global market disruptions influenced by India’s second-generation economic reforms. The period, spanning from August 7, 2007, to April 16, 2009, captures the onset

and extent of the financial crisis and subsequent stabilization post the G20 summit. The selection of crisis period is supported by prior research, such as Dooley and Hutchison (2009) [2]. Chudik and Fratzscher (2011) [1], Wang (2014) etc. This phase was marked by high volatility and central bank interventions.

The study considered the daily returns from the select indices, calculated from the daily adjusted index closing observations, using the formula for returns as, $R_t = \ln(P_t) - \ln(P_{t-1})$, where R_t denotes the logarithmic return, and P_t and P_{t-1} signify the current and previous day's adjusted market closing values, respectively. The secondary data for index closing values are sourced from web-platforms of www.yahoofinance.com and www.investing.com and also the official websites of the sample indices. All statistical test is carried out using SPSS software (version 21).

Statistical Tolls Adopted

The analysis is started with the interpretation of descriptive statistics, followed by correlation testing among the 22 indices. To ensure methodological rigor, a normality test is conducted beforehand using the Shapiro-Wilk test to evaluate whether parametric or non-parametric approaches are appropriate for the correlation analysis. When normality assumption deviations are detected, the Spearman Rank Correlation is applied as a non-parametric alternative. The correlation coefficient ranges from -1 to +1. A positive

value indicates a direct relationship, meaning the variables move together, while a negative value suggests an inverse relationship, with the variables moving in opposite directions. To evaluate the significance of the observed correlation, hypothesis testing is conducted to check if the sample correlation reflects the true population correlation. The null hypothesis (H_0) assumes no monotonic relationship, with a population correlation coefficient (ρ) of zero, while the alternative hypothesis (H_1) suggests the presence of such a relationship. In SPSS (version 21), significance testing for correlation coefficients is performed, and the p-values are presented directly in the correlation matrix. If the p-value is less than 0.05, the null hypothesis of no significant correlation is rejected, suggesting that the observed correlation is statistically significant at the 5% level.

Empirical Results and Interpretations

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 | Skewness | | Kurtosis | |
|-----------------------------|-------------|--------------------|--------------------|------------------|--------------------|------------|----------------|------------|----------------|
| | | | | | | statistics | Standard Error | statistics | Standard Error |
| US (S&P 500) | 200 | .1520177451686370 | .0952236065733594 | .002657184362982 | .028418999796738 | -.863 | .172 | 6.520 | .342 |
| Canada (S&P/TSX) | 200 | .2040780623367520 | .1070154069168740 | .001954917012103 | .028994466372160 | -1.523 | .172 | 12.784 | .342 |
| Brazil (IBOVESPA) | 200 | .2078590503912050 | .1687252124102570 | .000862572174754 | .039603561930717 | -.546 | .172 | 5.999 | .342 |
| Mexico (IPC) | 200 | .1647943213526530 | .1259027438414900 | .001573331196908 | .030516833029685 | -.474 | .172 | 8.052 | .342 |
| Argentina (MERVAL) | 200 | .2074941054496870 | .1674493037257590 | .002777228380510 | .040877198793960 | -1.113 | .172 | 8.069 | .342 |
| India (SENSEX) | 200 | .1366709681066410 | .1190428280309380 | .001586212193454 | .035279060633861 | -.163 | .172 | 1.855 | .342 |
| Australia (S&P/ASX) | 200 | .1110683953984870 | .0858875705295752 | .002325691945523 | .024873250220572 | -.477 | .172 | 3.048 | .342 |
| Israel (TA-125) | 200 | .1713360015109010 | .0901738508313406 | .001934190725565 | .028731382430925 | -1.010 | .172 | 7.604 | .342 |
| Japan (Nikkei) | 200 | .1673958351383790 | .1187552065059640 | .003320146819601 | .031487366483592 | -1.066 | .172 | 5.645 | .342 |
| Hong Kong (HSI) | 200 | .2224672365827110 | .1491139438476670 | .001824049756645 | .042582205229864 | -.202 | .172 | 5.778 | .342 |
| Taiwan (TSEC) | 200 | .0960628313871101 | .1405466399285000 | .002002148048265 | .030242556302565 | .371 | .172 | 3.232 | .342 |
| China (SSE) | 200 | .1220443768066510 | .1652114136215890 | .002767539194123 | .037946641902233 | .192 | .172 | 1.801 | .342 |
| Singapore (FTSE Sin) | 200 | .1215151895101620 | .1328472546668040 | .003091927347345 | .030973048114180 | -.002 | .172 | 4.663 | .342 |
| Indonesia | 200 | - | .185558156499177 | - | .03715278049217 | -.263 | .172 | 6.598 | .342 |

| | | | | | | | | | |
|----------------------------|-----|-----------------------|-----------------------|----------------------|----------------------|--------|------|--------|------|
| (JCI) | | .143762177333794 0 | 0 | .00167297298522 2 | 1 | | | | |
| S Korea (KOSPI) | 200 | .145225582604556 0 | .173420411538997 0 | .00163312431809 3 | .03434021472171 8 | -.059 | .172 | 6.672 | .342 |
| Russia (MOEX) | 200 | .376238963295958 0 | .258411806097817 0 | .00312158927371 7 | .05672319769332 2 | -.929 | .172 | 13.064 | .342 |
| Germany (DAX) | 200 | .136199311865047 0 | .120847727523062 0 | .00245666321837 3 | .02825873645300 7 | -.372 | .172 | 5.570 | .342 |
| UK (FTSE 100) | 200 | .124375776592389 0 | .096404447642957 1 | .00220569936357 1 | .02687833021827 2 | -.744 | .172 | 4.093 | .342 |
| France (CAC 40) | 200 | .129882163805981 0 | .103717019823565 0 | .00313028471222 2 | .02757670677529 7 | -.426 | .172 | 3.435 | .342 |
| Netherland (EURONEX T 100) | 200 | .134728094202492 0 | .100821956091974 0 | .00333138796039 4 | .02691478470699 3 | -.646 | .172 | 4.527 | .342 |
| Belgium (BEL 20) | 200 | .209355396366629 0 | .087053635918940 7 | .00418351096124 1 | .03119566569680 6 | -1.645 | .172 | 10.480 | .342 |
| Italy (FTSE MIB) | 200 | .148160364508733 0 | .134145377325680 0 | .00391356061519 4 | .02914844536848 9 | -.388 | .172 | 5.848 | .342 |

It is evident that all series consist of 200 observations, with no missing data detected. Among the indices, MOEX (Russia) recorded both the highest and lowest returns, reflecting its heightened volatility. All return series exhibit negative mean daily returns, indicating a general downward trend during the observed period. Despite the negative averages, the daily returns demonstrate significant fluctuations, ranging from substantial gains to losses. This variability is further emphasized by the relatively high standard deviation (SD) compared to the mean, underscoring the dataset’s volatility. Such wide dispersion around the mean highlights critical implications for market risk assessment and return predictability. All series exhibit negative skewness, signaling longer left tails and a clustering of values on the right.

Skewness values notably deviating from zero confirm significant asymmetry in the distributions. Indices such as Belgium (BEL 20), Japan (NIKKEI 225), Israel (TA 125), Argentina (MERVAL), and Canada (S&P/TSX) display

skewness values below -1, indicating pronounced left-tailed distributions with a higher likelihood of extreme negative returns. The kurtosis analysis reveals that most return series have kurtosis values exceeding 3, indicative of leptokurtic distributions. These distributions are characterized by sharp peaks and heavy tails, suggesting a higher frequency of extreme outliers compared to a normal distribution. This pattern highlights that, while returns are concentrated around the mean, occasional large deviations are more frequent. However, the return series for China (SSE) and India (BSE SENSEX) exhibit kurtosis values below 3, reflecting platykurtic distributions. These are associated with broader peaks and flatter tails, implying more stable returns with fewer extreme movements or abrupt spikes.

Shapiro-Wilk Test of Normality

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

Table 3: 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) | 0.905 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Canada (S&P/TSX) | 0.862 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Brazil (IBOVESPA) | 0.915 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Mexico (IPC) | 0.874 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Argentina (MERVAL) | 0.836 | 0.000 | P<0.05 | Rejected | Non-normal series |
| India (SENSEX) | 0.976 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Australia (S&P/ASX) | 0.952 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Israel (TA-125) | 0.890 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Japan (Nikkei) | 0.910 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Hong Kong (HSI) | 0.898 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Taiwan (TSEC) | 0.947 | 0.000 | P<0.05 | Rejected | Non-normal series |
| China (SSE) | 0.982 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Singapore (FTSE Sin) | 0.902 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Indonesia (JCI) | 0.860 | 0.000 | P<0.05 | Rejected | Non-normal series |
| S Korea (KOSPI) | 0.878 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Russia (MOEX) | 0.801 | 0.000 | P<0.05 | Rejected | Non-normal series |

| | | | | | |
|---------------------------|-------|-------|--------|----------|-------------------|
| Germany (DAX) | 0.904 | 0.000 | P<0.05 | Rejected | Non-normal series |
| UK (FTSE 100) | 0.940 | 0.000 | P<0.05 | Rejected | Non-normal series |
| France (CAC 40) | 0.951 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Netherland (EURONEXT 100) | 0.936 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Belgium (BEL 20) | 0.872 | 0.000 | P<0.05 | Rejected | Non-normal series |
| Italy (FTSE MIB) | 0.905 | 0.000 | P<0.05 | Rejected | Non-normal series |

All found p-values fell below the 0.05 threshold, leading to the rejection of the null hypothesis of normality and confirming that the return series deviate from the assumption of the normal distribution. Consequently, due to the non-normal nature of the data, the analysis transitions to a non-parametric framework, employing the Spearman Rank Correlation test.

Spearman Rank Correlation

The Spearman rank correlation matrix is structured into three panels to capture inter-regional and cross-continental dynamics. The first panel highlights correlations between Asian and American markets, revealing inter-regional linkages. The second panel examines the relationships between Asian and European markets, showcasing financial interconnectedness. The third panel focuses on correlations within and between American and European markets, emphasizing their cross-continental integration. The detailed matrixes are presented below:

The correlation analysis reveals intricate patterns of integration among the Asian and American stock indices, shaped by regional dynamics and global economic interdependencies. India's S&P BSE SENSEX demonstrates weak correlations with American markets, with coefficients consistently below 0.4. Notably, the BSE SENSEX exhibits the highest correlation with the S&P 500 (US), while its weakest correlation—indeed the lowest among all analyzed Asian and American indices—is with Argentina's Merval, underscoring limited co-movement with these markets despite shared macroeconomic influences. This trend of low correlation extends across other Asian indices, with coefficients generally under 0.5 when paired with American indices, signaling partial regional integration.

Interestingly, beyond India, the strongest inter-regional correlation is observed between the returns from Mexico's IPC and Hong Kong's HSI, reflecting economic linkages. Within Asia, inter-market correlations highlight moderate connectivity, driven by more strong regional economic ties. The most prominent relationship is observed between the HSI (Hong Kong) and FTSE (Singapore), underscoring robust intra-regional integration. Statistical significance is substantiated by p-values accompanying each coefficient, all below 0.01, affirming the reliability of these relationships at 1%, 5%, or 10% significance levels under a two-tailed test. A particular insight is the higher degree of integration among inter-American markets compared to inter-Asian indices, indicating stronger cohesion within the Western Hemisphere's financial systems than within Asia's diverse markets. This differential underscores the varying levels of economic and financial interdependence across regions.

The correlation analysis unveils a diverse spectrum of financial integration between Asian and European indices, with India's S&P BSE SENSEX exhibiting relatively modest associations, characterized by coefficients below 0.05. The returns from BSE SENSEX (India) had lowest association with CAC 40 (France), while highest association

is found with BEL 20 (Belgium). Notably, the highest inter-Asian-European correlation is recorded between TA-125 (Israel) and CAC 40 (France), signifying a pronounced level of co-movement and underscoring the integration of specific markets. These results underscore India's distinct market behavior compared to its regional peers, reflecting unique economic drivers and market dynamics. In contrast, other Asian indices demonstrate comparatively stronger linkages with European markets, highlighting their pivotal roles as intermediaries in global trade and financial networks. This underscores the nuanced interplay between regional proximity, structural economic factors, and transcontinental linkages. European indices, by comparison, display a profound degree of interdependence, indicative of the cohesive financial architecture within the region.

India's relatively weaker alignment with European indices, juxtaposed against stronger intra-European linkages and inter-Asian-European correlations, suggests a degree of insulation from European market influences, thereby reflecting its relative autonomy in this context. A notable observation is the stark disparity in integration levels, with inter-European markets exhibiting significantly higher cohesion compared to the more fragmented inter-Asian financial relationships. China's SSE, in particular, demonstrates no statistically significant correlation with India's BSE SENSEX, as evidenced by p-values exceeding 0.10, failing to reject the null hypothesis of no association. Conversely, for all the remaining indices, statistically significant correlations—supported by p-values below 0.01—affirm the robustness of the findings at the 1% level under a two-tailed test. These results collectively emphasize the heterogeneous nature of integration across Asian and European markets, shaped by divergent economic structures, geopolitical considerations, and varying levels of regional cohesion.

The correlation analysis highlights the moderate financial interdependencies between American and European markets, driven by their advanced economies and interconnected financial systems. Among the indices examined, the returns from IBOVESPA (Brazil) and FTSE 100 (UK) exhibited the highest correlation, whereas Merval (Argentina) and BEL 20 (Belgium) displayed the weakest association. These findings underscore significant co-movement across these transcontinental markets. Inter-European market correlations are notably stronger than those observed among American indices, reflecting deeper regional integration within Europe. This heightened connectivity is likely attributed to shared economic policies and structural synergies among European nations. The statistical significance of these correlations is validated by p-values (provided in parentheses) below 0.01, affirming the robustness of the findings at the 1%, or 5% significance levels under a two-tailed test. Overall, these results underscore the structural and regional factors that shape the varying levels of financial integration between American and European markets

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) | 1.000 | .713** (0.000) | .672** (0.000) | .753** (0.000) | .586** (0.000) | .418** (0.000) | .317** (0.000) | .383** (0.000) | .275** (0.000) | .330** (0.000) | .323** (0.000) | .068 (0.341) | .376** (0.000) | .252** (0.000) | .325** (0.000) | .308** (0.000) |
| Canada (S&P/TSX) | .713** (0.000) | 1.000 | .784** (0.000) | .641** (0.000) | .727** (0.000) | .304** (0.000) | .396** (0.000) | .490** (0.000) | .345** (0.000) | .376** (0.000) | .429** (0.000) | .161* (0.023) | .444** (0.000) | .427** (0.000) | .396** (0.000) | .572** (0.000) |
| Brazil (IBOVESPA) | .672** (0.000) | .784** (0.000) | 1.000 | .718** (0.000) | .765** (0.000) | .242** (0.001) | .342** (0.000) | .522** (0.000) | .298** (0.000) | .428** (0.000) | .397** (0.000) | .269** (0.000) | .432** (0.000) | .456** (0.000) | .402** (0.000) | .539** (0.000) |
| Mexico (IPC) | .753** (0.000) | .641** (0.000) | .718** (0.000) | 1.000 | .631** (0.000) | .328** (0.000) | .397** (0.000) | .437** (0.000) | .299** (0.000) | .464** (0.000) | .428** (0.000) | .203** (0.004) | .437** (0.000) | .379** (0.000) | .426** (0.000) | .431** (0.000) |
| Argentina (MERVAL) | .586** (0.000) | .727** (0.000) | .765** (0.000) | .631** (0.000) | 1.000 | .273** (0.000) | .365** (0.000) | .517** (0.000) | .297** (0.000) | .439** (0.000) | .446** (0.000) | .240** (0.001) | .419** (0.000) | .490** (0.000) | .399** (0.000) | .494** (0.000) |
| India (SENSEX) | .418** (0.000) | .304** (0.000) | .242** (0.000) | .328** (0.000) | .273** (0.000) | 1.000 | .337** (0.000) | .257** (0.000) | .280** (0.000) | .323** (0.000) | .326** (0.000) | .109 (0.124) | .269** (0.000) | .270** (0.000) | .303** (0.000) | .273** (0.000) |
| Australia (S&P/ASX) | .317** (0.000) | .396** (0.000) | .342** (0.000) | .397** (0.000) | .365** (0.000) | .337** (0.000) | 1.000 | .521** (0.000) | .664** (0.000) | .693** (0.000) | .696** (0.000) | .322** (0.000) | .699** (0.000) | .564** (0.000) | .686** (0.000) | .474** (0.000) |
| Israel (TA-125) | .383** (0.000) | .490** (0.000) | .522** (0.000) | .437** (0.000) | .517** (0.000) | .257** (0.000) | .521** (0.000) | 1.000 | .443** (0.000) | .574** (0.000) | .518** (0.000) | .283** (0.000) | .585** (0.000) | .468** (0.000) | .557** (0.000) | .539** (0.000) |
| Japan (Nikkei) | .275** (0.000) | .345** (0.000) | .298** (0.000) | .299** (0.000) | .297** (0.000) | .280** (0.000) | .664** (0.000) | .443** (0.000) | 1.000 | .551** (0.000) | .551** (0.000) | .220** (0.002) | .566** (0.000) | .431** (0.000) | .583** (0.000) | .294** (0.000) |
| Hong Kong (HSI) | .330** (0.000) | .376** (0.000) | .428** (0.000) | .464** (0.000) | .439** (0.000) | .323** (0.000) | .693** (0.000) | .574** (0.000) | .551** (0.000) | 1.000 | .682** (0.000) | .499** (0.000) | .774** (0.000) | .596** (0.000) | .708** (0.000) | .436** (0.000) |
| Taiwan (TSEC) | .323** (0.000) | .429** (0.000) | .397** (0.000) | .428** (0.000) | .446** (0.000) | .326** (0.000) | .696** (0.000) | .518** (0.000) | .551** (0.000) | .682** (0.000) | 1.000 | .372** (0.000) | .633** (0.000) | .473** (0.000) | .737** (0.000) | .491** (0.000) |
| China (SSE) | .068 (0.341) | .161* (0.023) | .269** (0.000) | .203** (0.004) | .240** (0.001) | .109 (0.124) | .322** (0.000) | .283** (0.000) | .220** (0.002) | .499** (0.000) | .372** (0.000) | 1.000 | .312** (0.000) | .318** (0.000) | .416** (0.000) | .229** (0.001) |
| Singapore (FTSE Sin) | .376** (0.000) | .444** (0.000) | .432** (0.000) | .437** (0.000) | .419** (0.000) | .269** (0.000) | .699** (0.000) | .585** (0.000) | .566** (0.000) | .774** (0.000) | .633** (0.000) | .312** (0.000) | 1.000 | .587** (0.000) | .655** (0.000) | .492** (0.000) |
| Indonesia (JCI) | .252** (0.000) | .427** (0.000) | .456** (0.000) | .379** (0.000) | .490** (0.000) | .270** (0.000) | .564** (0.000) | .468** (0.000) | .431** (0.000) | .596** (0.000) | .473** (0.000) | .318** (0.000) | 1.000 | 1.000 | .521** (0.000) | .481** (0.000) |
| S Korea (KOSPI) | .325** (0.000) | .396** (0.000) | .402** (0.000) | .426** (0.000) | .399** (0.000) | .303** (0.000) | .686** (0.000) | .557** (0.000) | .583** (0.000) | .708** (0.000) | .737** (0.000) | .416** (0.000) | .655** (0.000) | .521** (0.000) | 1.000 | .491** (0.000) |
| Russia (MOEX) | .308** (0.000) | .572** (0.000) | .539** (0.000) | .431** (0.000) | .494** (0.000) | .273** (0.000) | .474** (0.000) | .539** (0.000) | .294** (0.000) | .436** (0.000) | .491** (0.000) | .229** (0.001) | .492** (0.000) | .481** (0.000) | .491** (0.000) | 1.000 |

** 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 Singapoe) | 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) | 1.000 | .337** (0.000) | .257** (0.000) | .280** (0.000) | .323** (0.000) | .326** (0.000) | .109 (0.124) | .269** (0.000) | .270** (0.000) | .303** (0.000) | .273** (0.000) | .415** (0.000) | .346** (0.000) | .373** (0.000) | .380** (0.000) | .441** (0.000) | .388** (0.000) |
| Australia (S&P/ASX 200) | .337** (0.000) | 1.000 | .521** (0.000) | .664** (0.000) | .693** (0.000) | .696** (0.000) | .322** (0.000) | .699** (0.000) | .564** (0.000) | .686** (0.000) | .474** (0.000) | .564** (0.000) | .576** (0.000) | .603** (0.000) | .619** (0.000) | .607** (0.000) | .576** (0.000) |
| Israel (TA-125) | .257** (0.000) | .521** (0.000) | 1.000 | .443** (0.000) | .574** (0.000) | .518** (0.000) | .283** (0.000) | .585** (0.000) | .468** (0.000) | .557** (0.000) | .539** (0.000) | .672** (0.000) | .670** (0.000) | .707** (0.000) | .720** (0.000) | .650** (0.000) | .678** (0.000) |
| Japan (Nikkei 225) | .280** (0.000) | .664** (0.000) | .443** (0.000) | 1.000 | .551** (0.000) | .551** (0.000) | .220** (0.002) | .566** (0.000) | .431** (0.000) | .583** (0.000) | .294** (0.000) | .443** (0.000) | .419** (0.000) | .452** (0.000) | .467** (0.000) | .439** (0.000) | .469** (0.000) |
| Hong Kong (Hang Sang Index) | .323** (0.000) | .693** (0.000) | .574** (0.000) | .551** (0.000) | 1.000 | .682** (0.000) | .499** (0.000) | .774** (0.000) | .596** (0.000) | .708** (0.000) | .436** (0.000) | .585** (0.000) | .563** (0.000) | .584** (0.000) | .599** (0.000) | .591** (0.000) | .559** (0.000) |
| Taiwan | .326** (0.000) | .696** (0.000) | .518** (0.000) | .551** (0.000) | .682** (0.000) | 1.000 | .372** (0.000) | .633** (0.000) | .473** (0.000) | .737** (0.000) | .491** (0.000) | .547** (0.000) | .546** (0.000) | .565** (0.000) | .581** (0.000) | .568** (0.000) | .541** (0.000) |

| | | | | | | | | | | | | | | | | | |
|-------------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| (TSEC) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| China (SSE Composite Index) | .109 (0.124) | .322** (0.000) | .283** (0.000) | .220** (0.002) | .499** (0.000) | .372** (0.000) | 1.000 | .312** (0.000) | .318** (0.000) | .416** (0.000) | .229** (0.001) | .246** (0.000) | .241** (0.001) | .231** (0.001) | .246** (0.000) | .232** (0.001) | .226** (0.001) |
| Singapore (FTSE Singapore) | .269** (0.000) | .699** (0.000) | .585** (0.000) | .566** (0.000) | .774** (0.000) | .633** (0.000) | .312** (0.000) | 1.000 | .587** (0.000) | .655** (0.000) | .492** (0.000) | .613** (0.000) | .597** (0.000) | .613** (0.000) | .615** (0.000) | .587** (0.000) | .576** (0.000) |
| Indonesia (Jakarta Composite Index) | .270** (0.000) | .564** (0.000) | .468** (0.000) | .431** (0.000) | .596** (0.000) | .473** (0.000) | .318** (0.000) | .587** (0.000) | 1.000 | .521** (0.000) | .481** (0.000) | .460** (0.000) | .463** (0.000) | .451** (0.000) | .472** (0.000) | .468** (0.000) | .394** (0.000) |
| S Korea (KOSPI Composite Index) | .303** (0.000) | .686** (0.000) | .557** (0.000) | .583** (0.000) | .708** (0.000) | .737** (0.000) | .416** (0.000) | .655** (0.000) | .521** (0.000) | 1.000 | .491** (0.000) | .508** (0.000) | .526** (0.000) | .540** (0.000) | .565** (0.000) | .534** (0.000) | .526** (0.000) |
| Russia (MOEX Russia) | .273** (0.000) | .474** (0.000) | .539** (0.000) | .294** (0.000) | .436** (0.000) | .491** (0.000) | .229** (0.001) | .492** (0.000) | .481** (0.000) | .491** (0.000) | 1.000 | .611** (0.000) | .587** (0.000) | .598** (0.000) | .620** (0.000) | .574** (0.000) | .545** (0.000) |
| Germany (DAX Performance Index) | .415** (0.000) | .564** (0.000) | .672** (0.000) | .443** (0.000) | .585** (0.000) | .547** (0.000) | .246** (0.000) | .613** (0.000) | .460** (0.000) | .508** (0.000) | .611** (0.000) | 1.000 | .883** (0.000) | .923** (0.000) | .917** (0.000) | .842** (0.000) | .884** (0.000) |
| UK (FTSE 100) | .346** (0.000) | .576** (0.000) | .670** (0.000) | .419** (0.000) | .563** (0.000) | .546** (0.000) | .241** (0.001) | .597** (0.000) | .463** (0.000) | .526** (0.000) | .587** (0.000) | .883** (0.000) | 1.000 | .937** (0.000) | .940** (0.000) | .865** (0.000) | .866** (0.000) |
| France (CAC 40) | .373** (0.000) | .603** (0.000) | .707** (0.000) | .452** (0.000) | .584** (0.000) | .565** (0.000) | .231** (0.001) | .613** (0.000) | .451** (0.000) | .540** (0.000) | .598** (0.000) | .923** (0.000) | .937** (0.000) | 1.000 | .989** (0.000) | .891** (0.000) | .926** (0.000) |
| Netherlands (EURONEXT 100) | .380** (0.000) | .619** (0.000) | .720** (0.000) | .467** (0.000) | .599** (0.000) | .581** (0.000) | .246** (0.000) | .615** (0.000) | .472** (0.000) | .565** (0.000) | .620** (0.000) | .917** (0.000) | .940** (0.000) | .989** (0.000) | 1.000 | .926** (0.000) | .929** (0.000) |
| Belgium (BEL 20) | .441** (0.000) | .607** (0.000) | .650** (0.000) | .439** (0.000) | .591** (0.000) | .568** (0.000) | .232** (0.001) | .587** (0.000) | .468** (0.000) | .534** (0.000) | .574** (0.000) | .842** (0.000) | .865** (0.000) | .891** (0.000) | .926** (0.000) | 1.000 | .866** (0.000) |
| Italy (FTSE MIB) | .388** (0.000) | .576** (0.000) | .678** (0.000) | .469** (0.000) | .559** (0.000) | .541** (0.000) | .226** (0.001) | .576** (0.000) | .394** (0.000) | .526** (0.000) | .545** (0.000) | .884** (0.000) | .866** (0.000) | .926** (0.000) | .926** (0.000) | .866** (0.000) | 1.000 |

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

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) | Netherlands (EURONEXT 100) | Belgium (BEL 20) | Italy (FTSE MIB) |
|----------------------------------|----------------|----------------------------------|-------------------|---------------------|--------------------|---------------------------------|----------------|-----------------|----------------------------|------------------|------------------|
| US (S&P 500) | 1.000 | .713** (0.000) | .672** (0.000) | .753** (0.000) | .586** (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) | .713** (0.000) | 1.000 | .784** (0.000) | .641** (0.000) | .727** (0.000) | .635** (0.000) | .618** (0.000) | .620** (0.000) | .602** (0.000) | .556** (0.000) | .586** (0.000) |
| Brazil (IBOVESPA) | .672** (0.000) | .784** (0.000) | 1.000 | .718** (0.000) | .765** (0.000) | .624** (0.000) | .665** (0.000) | .649** (0.000) | .656** (0.000) | .582** (0.000) | .611** (0.000) |
| Mexico (IPC Mexico) | .753** (0.000) | .641** (0.000) | .718** (0.000) | 1.000 | .631** (0.000) | .639** (0.000) | .616** (0.000) | .623** (0.000) | .627** (0.000) | .561** (0.000) | .557** (0.000) |
| Argentina (MERVAL) | .586** (0.000) | .727** (0.000) | .765** (0.000) | .631** (0.000) | 1.000 | .623** (0.000) | .592** (0.000) | .610** (0.000) | .596** (0.000) | .538** (0.000) | .564** (0.000) |
| Germany (DAX Performance Index) | .635** (0.000) | .624** (0.000) | .639** (0.000) | .623** (0.000) | .608** (0.000) | 1.000 | .883** (0.000) | .923** (0.000) | .917** (0.000) | .842** (0.000) | .884** (0.000) |
| UK (FTSE 100) | .618** (0.000) | .665** (0.000) | .616** (0.000) | .592** (0.000) | .591** (0.000) | .883** (0.000) | 1.000 | .937** (0.000) | .940** (0.000) | .865** (0.000) | .866** (0.000) |
| France (CAC 40) | .620** (0.000) | .649** (0.000) | .623** (0.000) | .610** (0.000) | .612** (0.000) | .923** (0.000) | .937** (0.000) | 1.000 | .989** (0.000) | .891** (0.000) | .926** (0.000) |
| Netherlands (EURONEXT 100) | .602** (0.000) | .656** (0.000) | .627** (0.000) | .596** (0.000) | .620** (0.000) | .917** (0.000) | .940** (0.000) | .989** (0.000) | 1.000 | .926** (0.000) | .929** (0.000) |
| Belgium (BEL 20) | .556** (0.000) | .582** (0.000) | .561** (0.000) | .538** (0.000) | .571** (0.000) | .842** (0.000) | .865** (0.000) | .891** (0.000) | .926** (0.000) | 1.000 | .866** (0.000) |
| Italy (FTSE MIB) | .586** (0.000) | .611** (0.000) | .557** (0.000) | .564** (0.000) | .562** (0.000) | .884** (0.000) | .866** (0.000) | .926** (0.000) | .929** (0.000) | .866** (0.000) | 1.000 |

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

Conclusion

It is found that varying levels of financial integration across Asian, American, and European markets, shaped by regional dynamics and global interdependencies. India's S&P BSE SENSEX demonstrates weak correlations with both American and European indices, while most Asian indices also exhibit low to moderate correlations with these regions, reflecting slightly stronger global connections. Within Asia, inter-market correlations indicate moderate regional economic linkages. European indices display stronger interdependence compared to their Asian and American counterparts, driven by deeper regional integration facilitated by shared economic policies. Notably, Asian indices—excluding India—show relatively stronger ties to European markets, emphasizing their intermediary roles in global finance. Conversely, China's SSE has no statistically significant correlation with India, underscoring their distinct market trajectories. In reviewing the associations between American and European indices, the returns from IBOVESPA (Brazil) and FTSE 100 (UK) exhibited the highest correlation, while MERVAL (Argentina) and BEL 20 (Belgium) showed the weakest associations between American and European indices. Statistically significant relationships, validated by p-values below 0.01, confirm the robustness of these findings. These results highlight the India's unique market dynamics and its relative insulation within the global financial ecosystem, contrasting with the broader integration patterns observed across other regions.

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