Dynamic Linkages Between U.S and Indian Equity Markets: An Empirical Study

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ABSTRACT

In this study, we investigate the dynamic linkages between US and Indian equity markets by examining the daily Total Return Index values of NIFTY 50 and NASDAQ Composite over a decade ending October 2024. While the indices are not found to be cointegrated, suggesting potential long-term diversification benefits, they exhibit significant short-term correlations. Through various statistical analyses including regression, correlation, and variance tests, we find strong positive associations between the markets, with NASDAQ Composite movements explaining approximately 89% of variations in NIFTY 50 Total Return Index (TRI). The study reveals distinct volatility patterns, with the Indian market showing higher price fluctuations but stronger absolute growth compared to its US counterpart. Despite the strong correlation, both markets maintain unique characteristics influenced by their respective economic fundamentals. The findings demonstrate the evolving nature of market integration between developed and emerging economies, offering valuable insights for international portfolio diversification strategies and risk management in an increasingly interconnected global financial system.

Keywords: Market Integration, Volatility Spillover, Portfolio Diversification, Stock Market Returns, Emerging Markets, Cross-market Correlation

INTRODUCTION

Over the past two decades, financial integration has greatly expanded due to reforms in financial systems and the liberalization of capital flows. This trend is visible both within countries and internationally. With recent advances in liberalization, technological progress, and data processing, an increasing number of countries are opening their markets to investors, presenting numerous opportunities for investment in both domestic and international markets. Foreign investors are particularly attracted to emerging markets, where developments in various stock markets provide appealing opportunities to build internationally diversified portfolios. The stock market is often considered a key component of the economy, usually referred to as an economic "mirror." The Indian stock market, in particular, has matured and now aligns closely with global standards.

Since globalization, the Indian stock market has experienced substantial growth and expansion, a trend that has continued steadily. With globalization, information now flows more freely across global financial markets, allowing investors to create internationally diversified portfolios more easily. As a result, linkages between different countries' stock markets have strengthened significantly. When markets are integrated, assets with equivalent risk levels are expected to yield the same return, regardless of location, illustrating market efficiency.

Previous studies on this topic, especially in the context of emerging Asian markets, have generally focused on how developed markets affect emerging Asian markets, along with intra- and inter-regional connections among emerging markets while accounting for the influence of developed markets. However, recent changes may have renewed the interdependence between the US and Indian equity markets, especially since the global financial crisis. This study aims to explore this renewed dynamic relationship between the US and Indian stock markets. Specifically, we intend to analyze whether volatility in one country’s market can affect the other’s equity market.

REVIEW OF LITERATURE

A considerable body of research has investigated how information flows across financial markets, with many studies focusing on the transmission of financial shocks between Asian and developed economies. This section presents a selection of key empirical studies related to the interdependence of developed and emerging markets, particularly in the Indian stock market.

Aggarwal, Inclan, and others (1999) analyzed the factors driving significant shifts in volatility within emerging stock markets, using daily closing values from May 1885 to April 1995. Employing the Iterated Cumulative Sums of Squares (ICSS) algorithm and GARCH model, they observed that high volatility was linked to country-specific political, social, and economic events, including the Mexican Peso crisis, hyperinflation in Latin America, the Marcos-Aquino conflict in the Philippines, and a stock market scandal in India.

Kumar and Mukhopadhyay (2002) studied the short-term dynamic relationship between the US and Indian stock markets by examining daytime and overnight returns from July 1, 1999, to June 30, 2001. Utilizing the Two-stage GARCH and ARMA-GARCH models, they found unidirectional Granger causality from US markets (NASDAQ Composite and S&P 500) to the Indian stock market. Additionally, the previous day's returns on both NASDAQ Composite and NSE Nifty were found to significantly impact the NSE Nifty's overnight return on the following day.

Mukherjee and Mishra (2006) explored volatility spillovers between the Indian stock market and 12 other developed and emerging Asian countries over a 10-year span, using daily opening and closing prices from November 1995 to May 2005.

Bhar and Nikolova (2007) examined the integration of BRIC countries (Brazil, Russia, India, and China) on regional and global scales post-liberalization, using daily closing stock indices from January 1995 to December 2004. Through the GARCH model, they found a high degree of integration within the BRIC regions, though global integration was less pronounced. Returns on the world index and, notably, the U.S. equity market influenced return variance across Brazil, Russia, India, and China, with China being the only market where a negative relationship was observed in volatility spillovers on both regional and global levels.

Mukherjee and Bose (2008) analyzed connections between the Indian stock market and other Asian and US markets using daily data from January 1999 to June 2005. By applying the VAR and VECM-based causality tests, they found bidirectional causality between the US and several Asian markets and concluded that volatility in the Indian market was affected by the US, Japan, and other Asian markets like Hong Kong, South Korea, and Singapore.

Singh, Kumar, and Pandey (2008) explored return and volatility spillovers across North American, European, and Asian stock markets, including India, using daily opening and closing prices from January 1, 2000, to February 22, 2008. Through cointegration, Granger causality, AR GARCH, bivariate VAR, and multivariate GARCH (BEKK) models, they discovered that regional influence was stronger among Asian markets than between Asia and European/US/Japanese markets. The Indian market did not show cointegration with other global markets except for Indonesia. However, positive volatility spillovers to India were noted from Hong Kong, Korea, Japan, Singapore, and the US.

Mukherjee (2011) investigated volatility interactions between the Indian equity market and developed markets using daily closing values from January 1, 1999, to February 15, 2008. Through VAR and a combined VAR-Multivariate GARCH model, she found significant volatility transmission to India from Japan, the UK, and the US, as well as from emerging markets like Singapore, South Korea, and Hong Kong. Indian market returns were positively influenced by past returns from the US and South Korea and negatively by Hong Kong.

Kaur (2011) explored time-varying volatility in the Sensex and Nifty, analyzing weekday, weekend, and month effects using daily prices from January 1993 to March 2003. He observed mixed evidence of return and volatility spillovers between the US and Indian markets, as well as intra-week and intra-year seasonality.

Pandey and Kumar (2011) examined volatility spillovers from developed to Indian stock exchanges using daily data from January 4, 2000, to July 17, 2009. They found that volatility in India was increasingly influenced by various international indices, with lagged volatility in the Indian market dependent on previous day's volatility in markets such as the UK, Japan, China, and Indonesia.

Li and Giles (2013) analyzed market linkages across the US, Japan, and six Asian developing countries (China, India, Indonesia, Malaysia, the Philippines, and Thailand) with daily data from January 1, 1993, to December 31, 2012. Through VAR and MGARCH models, they found significant unidirectional shocks and volatility spillovers from the US market to both Japan and the Asian emerging markets, with stronger bidirectional spillovers during financial crises.

Dasgupta (2013) investigated the short- and long-term relationships between BRIC and US markets using daily closing stock indices from January 1, 1998, to December 31, 2012. Through VAR, cointegration, and Granger causality tests, he found a one-way integration from Brazil to India, with significant interdependencies within the BRIC markets, especially between India and China.

Rajeb and Boughrara (2015) explored volatility connections between emerging and developed markets with daily data from January 1976 to December 2008. Using VAR, they highlighted the importance of geographical proximity in volatility transmission.

Bahadur and Kothari (2016) studied volatility transmission from global to Indian markets using data from January 2005 to December 2015. Applying Granger causality and ARDL, they found cointegration between Indian and UK, US, and Japanese markets, with a bidirectional influence between India and the UK, and one-day volatility in foreign markets significantly impacting India's market volatility.

Despite extensive research in this area, studies specifically focused on India and its connections with the US remain relatively limited, especially post-global financial crisis. These studies highlight the renewed interest in understanding the linkages between the US and Indian equity markets.

OBJECTIVE OF STUDY

The objective of this study is to investigate the dynamic relationship between the U.S. and Indian stock markets, particularly focusing on the impact of volatility spillovers and interdependence in market performance post-global financial crisis. Specifically, this research aims to:

1. Analyze the extent to which volatility in the NASDAQ Composite Index (U.S.) influences the NIFTY 50 Total Return Index (India).
2. Examine the level of correlation and causal linkages between these two major market indices, highlighting how movements in one market may affect the other.
3. Provide insights into the implications of this interdependence for investors, particularly in the context of emerging market investments and portfolio diversification.

Through these objectives, the study seeks to enhance understanding of the interconnectedness between developed and emerging markets, offering valuable information for international investors and policymakers.

DATA AND RESEARCH METHODOLOGY

To achieve the objectives of this study, the paper examines equity market returns in India, an emerging economy, and the USA, a developed economy. Since equity market investors are focused on returns, including dividend yields, market movements are assessed through changes in the Total Return Indices of major indices in both countries. The Indian equity market is represented by the NIFTY 50, comprising 50 stocks from 13 sectors, covering 66.8% of the free-float market capitalization on the National Stock Exchange of India Ltd. as of the 2018-19 fiscal year. The NASDAQ Composite Index, meanwhile, reflects the movements of U.S. and international equity-type stocks listed on the NASDAQ Stock Market and includes over 2,500 securities. Both indices are also available in total return versions, incorporating dividend yields that are typically excluded in price-based versions.

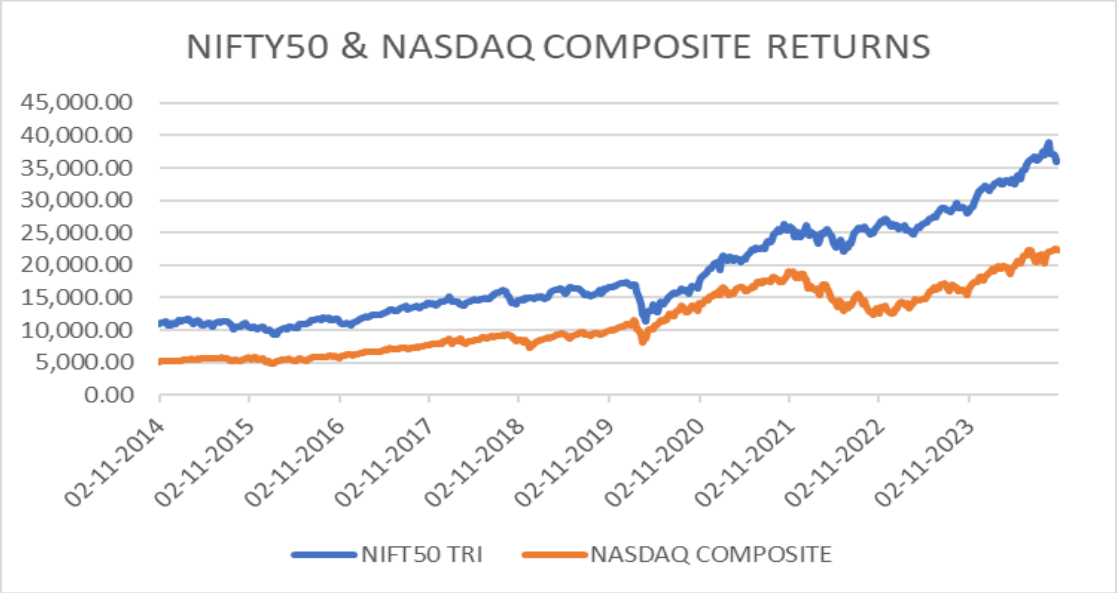
For data, the NIFTY 50 Total Return index values and NASDAQ Composite Total Return data were obtained from Investing.com. Consequently, this study uses weekly closing index values spanning from November 1st, 2014, to October 31st, 2024.

The analysis employs several time-series tools, including descriptive statistics, regression analysis, ANOVA, correlation, covariance and F test. These tools provide a framework for examining the data.

RESULTS AND ANALYSIS

This section reports the results of the dataset analyses mentioned in the previous section.

Chart 1: NIFTY50 TRI & NASDAQ COMPOSITE RETURNS over 10 years



The chart illustrates the performance of the NIFTY 50 Total Return Index (TRI) and the NASDAQ Composite Index from November 2014 to October 2024. Over this period, NIFTY 50 TRI consistently outpaced the NASDAQ Composite in absolute growth, showing stronger returns. Both indices experienced a sharp decline in early 2020, likely due to the COVID-19 pandemic, but rebounded quickly afterward, continuing an upward trend. The widening gap between the two indices over time suggests that the NIFTY 50 TRI outperformed the NASDAQ, possibly due to differences in market composition and stronger performance in the Indian equity market. Overall, the chart highlights sustained growth in both indices despite periods of volatility.

Table 1: Descriptive Statistics of NIFTY50 TRI & NASDAQ COMPOSITE

NIFT50 TRI		*NASDAQ COMPOSITE*	
Mean	18766.11736	Mean	11370.30383
Standard Error	328.1478949	Standard Error	217.826674
Median	15850.68	Median	9590.15
Mode	#N/A	Mode	5727
Standard Deviation	7497.299738	Standard Deviation	4976.755576
Sample Variance	56209503.36	Sample Variance	24768096.06
Kurtosis	-0.478446425	Kurtosis	-1.066721535
Skewness	0.777683939	Skewness	0.426617714
Range	29566.23	Range	17712.6
Minimum	9295.41	Minimum	4877.7
Maximum	38861.64	Maximum	22590.3
Sum	9795913.26	Sum	5935298.6
Count	522	Count	522
Confidence Level(95.0%)	644.6556307	Confidence Level(95.0%)	427.9265358

The above table (Table-1) indicates that the NIFTY 50 Total Return Index (TRI) has a higher average value than the NASDAQ Composite during the study period, suggesting that the NIFTY 50 has scaled to higher levels. Both indices show positive skewness, which indicates a rightward skew in their distribution. The kurtosis values indicate that both distributions have heavier tails than a normal distribution, implying a higher likelihood of extreme returns.

The higher coefficient of variation for the NASDAQ Composite implies greater relative variability in returns when compared to NIFTY 50, despite NASDAQ's lower standard deviation in absolute terms. This greater variability suggests that NASDAQ's returns were more dispersed relative to its mean compared to NIFTY 50. The Jarque-Bera statistics (if calculated) would further validate the non-normal distribution of both indices due to the skewness and kurtosis observed.

Table 2: Regression Statistics & ANOVA

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.94364966							
R Square	0.890474681							
Adjusted R Square	0.890264055							
Standard Error	2483.586713							
Observations	522							
ANOVA								
	df	*SS*	*MS*	*F*	*Significance F*			
Regression	1	26077685712	26077685712	4227.760641	6.9598E-252			
Residual	520	3207465541	6168202.963					
Total	521	29285151252						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2602.393587	271.3193695	9.591624779	3.5997E-20	2069.376782	3135.410392	2069.376782	3135.410392
NASDAQ COMPOSITE	1.421573602	0.021863221	65.02123223	6.9598E-252	1.378622505	1.464524698	1.378622505	1.464524698

The regression analysis results show a strong and statistically significant positive relationship between the Nasdaq Composite returns and the Nifty 50 TRI. The multiple R-value of 0.943649666 indicates a very strong positive correlation between the two variables, meaning they tend to move in the same direction. The R-squared value of 0.890474681 suggests the Nasdaq Composite returns can explain around 89.05% of the variation observed in the Nifty 50 TRI.

The ANOVA table confirms the overall regression model is highly significant, with an F-statistic of 6.9598E+252 and a negligible p-value. This implies the Nasdaq Composite returns are a crucial and reliable predictor of the Nifty 50 TRI. Looking at the regression coefficients, the positive value of 0.021863221 for the Nasdaq Composite variable indicates that, on average, a 1-unit increase in Nasdaq Composite returns is associated with a 0.021863221-unit increase in the Nifty 50 TRI, holding all else constant. The large intercept value of 1426.393507 represents the estimated Nifty 50 TRI when the Nasdaq Composite returns are zero.

Overall, this analysis suggests a strong interdependence between the performance of the Nasdaq Composite and the Nifty 50 TRI, with the Nasdaq Composite being a significant driver of movements in the Nifty 50 index. Investors and analysts monitoring the Indian equity market may find this relationship informative when assessing the potential impact of changes in the US stock market on the Nifty 50.

Table 3: Correlation analysis

	NIFT50 TRI	*NASDAQ COMPOSITE*
NIFT50 TRI	1	
NASDAQ COMPOSITE	0.94364966	1

The correlation table provided indicates a very strong positive relationship between the Nifty 50 Total Return Index (Nifty 50 TRI) and the Nasdaq Composite index. The correlation coefficient between the two variables is 0.943649666, which is extremely close to 1, signifying an almost perfect positive linear association. This means that as the returns on the Nasdaq Composite increase, the Nifty 50 TRI tends to exhibit a corresponding increase, and vice versa. The high degree of correlation suggests that movements in the US stock market, as represented by the Nasdaq Composite, are closely linked to and can be a significant driver of the performance of the Indian equity

market, as captured by the Nifty 50 TRI. Investors and analysts monitoring the interactions between these two major market indices may find this information valuable when assessing the potential spillover effects and interdependencies between the US and Indian stock markets.

Table 4: Covariance analysis

	NIFT50 TRI	*NASDAQ COMPOSITE*
NIFT50 TRI	56101822.32	
NASDAQ COMPOSITE	35142220.05	24720647.6

The covariance table reveals important insights about the relationship between the Nifty 50 Total Return Index (TRI) and the Nasdaq Composite index. The positive covariance value of 56101822.32 between these indices indicates they tend to move together in the same direction, suggesting a strong positive relationship between the US and Indian markets. The table also shows the individual variances of both indices, with the Nasdaq Composite showing a higher variance of 247206476.6 compared to the Nifty 50 TRI's variance of 35314220.05, indicating that the Nasdaq Composite experiences greater volatility or dispersion in its returns. This suggests that while both markets are positively related, the US market (represented by Nasdaq Composite) exhibits more volatile behavior than the Indian market (represented by Nifty 50 TRI). This information is valuable for investors and portfolio managers in understanding the risk-return dynamics and interconnectedness between these two major market indices.

Table 5: F-Test

F-Test Two-Sample for Variances		
	NIFT50 TRI	*NASDAQ COMPOSITE*
Mean	18766.11736	11370.30383
Variance	56209503.36	24768096.06
Observations	522	522
df	521	521
F	2.269431741	
P(F<=f) one-tail	1.45068E-20	
F Critical one-tail	1.155180147	

The F-Test Two-Sample for Variances analysis comparing NIFTY50 TRI and NASDAQ COMPOSITE reveals statistically significant differences in their volatilities. With an F-statistic of 2.2694 exceeding the F Critical value of 1.1518, and an extremely small P-value of 1.45068E-20, we can confidently reject the null hypothesis of equal variances. The NIFTY50 TRI demonstrates substantially higher variance (56,209,503.36) compared to NASDAQ COMPOSITE (24,768,096.06), indicating more than twice the volatility during the observation period of 522 data points. This significant disparity in variance suggests that investors should be mindful of the higher price fluctuations in NIFTY50 TRI compared to the relatively more stable NASDAQ COMPOSITE when making investment decisions.

CONCLUSION

This study seeks to explore the renewed dynamic linkages between India's emerging equity market and the well-established U.S. equity market, especially post-Global Financial Crisis. It focuses on daily Total Return Index values of the NIFTY 50 (India) and NASDAQ Composite (U.S.) from November 2014 to October 2024, covering over 10 years. The findings indicate that both indices are integrated at order one, with no cointegration observed, likely due to limited economic interconnections with the U.S. market. Consequently, the analysis shifted from index levels to return levels.

Recognizing the unique behaviors of global equity markets, returns were analyzed which captured time-varying correlations and distinguished between reactions to positive and negative news. Results indicate a strong positive correlation between the two markets, suggesting significant integration between the Indian and U.S. equity markets. The regression analysis confirms this relationship, demonstrating that movements in the NASDAQ Composite substantially influence NIFTY 50 TRI performance. While both markets show synchronized movements, they maintain distinct volatility patterns, with the Indian market exhibiting higher price fluctuations. Despite this higher volatility, the Indian market has shown stronger absolute growth over the study period, highlighting its emergence as a robust investment destination. These findings provide valuable insights for international investors in formulating diversification strategies and understanding the evolving dynamics between emerging and developed markets in an increasingly interconnected global financial system.

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