International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Contagion Effect Between Bombay Stock Exchange (BSE), National Stock Exchange (NSE) and Nasdaq

Mansha Rafiq

Student, International Islamic University Malaysia

Abstract

This comprehensive study investigates the contagion effect and relationships among three major stock exchanges—specifically, the two largest stock exchanges in India, BSE (Bombay Stock Exchange) and NSE (National Stock Exchange), and the globally renowned NASDAQ—spanning an extensive eight-year period on a daily basis. Employing a robust analytical framework in E-views, the study conducts a suite of tests, including Unit Root tests, Granger causality analysis, Johansen's Cointegration test, Vector Error Correction Models (VECM), and Dynamic Ordinary Least Squares (DOLS).The results of our investigation reveal a significant cointegration among BSE, NSE, and NASDAQ, indicating a long-term relationship between these stock exchanges. Notably, the study establishes that BSE Granger causes NSE, given their shared national context. Moreover, in an international context, NASDAQ emerges as a Granger cause for both BSE and NSE, while NSE Granger causes NASDAQ. This nuanced understanding of Granger causality relationships has profound implications for investors seeking to optimize their portfolios. Importantly, our findings suggest a viable strategy for portfolio diversification, emphasizing the potential benefits of allocating investments across stock exchanges with limited correlation. Specifically, investors can strategically diversify their portfolios by considering exchanges that do not exhibit Granger causality relationships with each other. This insight provides a practical guide for investors looking to capitalize on opportunities in markets with distinct and uncorrelated movements, thereby enhancing the effectiveness of international portfolio diversification. In essence, this study underscores the feasibility of diversification between exchanges with no observed Granger causality relationships, shedding light on the nuanced dynamics of inter-market dependencies. Investors can leverage these findings to make informed decisions, mitigating risks, and capitalizing on diverse opportunities across global financial markets.

Keywords: Unit root test, Granger Causality, Johansons Cointegration, VECM, Dynamic OLS

1. Introduction

It is obvious in this era that the investors always measure the return they get and the risk they are exposed to and then only invest. The contagion effect, in the context of financial markets, refers to the rapid spread of financial distress or market turbulence from one market to others. It often involves the transmission of shocks, such as economic downturns, currency crises, or major financial disruptions, across different markets. Researchers have extensively studied the contagion effect between various stock markets, revealing several key insights:

- **Global Interconnectedness:**
  Researchers emphasize that financial markets are globally interconnected. Events in one market can quickly transmit to others, especially in an era of increased globalization and interdependence.
- **Common Shocks and Systemic Risks:** The contagion effect is often associated with common shocks and systemic risks. When a major event impacts a particular market or a group of markets, the interconnectedness of financial systems can lead to a cascading effect, affecting other markets.
- **Financial Crises:** Contagion is frequently observed during financial crises. For example, the global financial crisis of 2008 demonstrated how problems originating in the U.S. housing market quickly spread to financial markets worldwide, leading to a synchronized downturn.
- **Transmission Channels:** Researchers identify various transmission channels for contagion, including trade linkages, financial linkages, and investor behavior. Changes in economic fundamentals, investor sentiment, or policy decisions can propagate shocks across borders.
- **Cross-Border Capital Flows:** The movement of capital across borders, driven by globalization, plays a significant role in contagion. Capital flows can amplify the transmission of shocks, and sudden reversals in these flows can trigger contagion.
- **Quantitative Measures:** Researchers use quantitative measures to assess the extent of contagion. These measures include correlation analysis, volatility spillovers, and co-movement of stock prices. High correlations and increased volatility among markets are indicative of contagion.
- **Role of Information and Expectations:**Information asymmetry and changes in investor expectations contribute to the contagion effect. Negative news or uncertainty in one market can lead to a reassessment of risk across multiple markets.
- **Policy Responses**: Contagion often prompts coordinated policy responses. Central banks and policymakers may implement measures to stabilize financial markets and prevent the spread of contagion. International collaboration becomes crucial in addressing contagion risks.
- **Regional and Global Contagion:** Contagion can occur at both regional and global levels. Regional economic or financial stress can spill over to neighboring markets, and in some cases, it can escalate to a global contagion if the conditions are severe.
- **Portfolio Diversification**: Contagion risk underscores the importance of portfolio diversification. Investors are encouraged to diversify their portfolios across different asset classes and geographic regions to reduce vulnerability to the contagion effect.

Understanding the contagion effect between various stock markets is essential for investors, policymakers, and financial institutions to anticipate and manage risks in an interconnected global financial system. Research in this area continues to evolve as market dynamics and global economic conditions change over time. As one of the main characteristic of investment is the risk which is divided into two parts, the systematic risk that cannot be avoided and the unsystematic risk. Investing in stocks in different markets can help investors to diversify their investment, but if there is correlation among the stock markets, diversification through different stock markets might become inefficient and worthless. Thus, it is very crucial for international investors who mostly rely on diversification to identify the correlation between different stock markets. Therefore this study tries to determine whether there exists cointegration between two stock exchanges in India and one based in U.S to determine the long run relationship and if there exists co integration, and to understand the direction with the use of Granger causality.

BSE is the Bombay Stock Exchange located in Maharashtra, India is the 10th largest stock market in the world with Nifty as of May 2014. Being the oldest and leading stock exchange in India BSE was established in 1875, it is also one of Asia's first stock exchanges, and provided corporate sector for raising capital efficiently. With a market capitalization of USD $1.7 trillion, it mainly deals in equity, debt instrument, derivatives and mutual funds. It calculates the amount in total market capitalization basis. BSE best popular equity index is S&P BSE SENSEX. More than 5000 companies are listed in the BSE making it one of the world's fastest stock exchange, with a speed of 200 microseconds and one of the leading exchange groups and the oldest stock exchange in South Asia region.

NSE, the National Stock Exchange of India Ltd. is another leading stock exchange of India located in Mumbai, and established in 1992 as the first demutualized electronic exchange in the country. It was the first ever exchange in the country that provides a modern, fully automated screen based electronic trading system which offers easy trading facility to investors spread across the whole nation. With a market capitalization of USD 1.65 trillion, it is the world's 12th largest stock exchange set up by a group of leading Indian financial institutions at the behest of Government of India to bring transparency to the Indian Capital Market. By introducing electronic trading facility NSE offers trading, clearing and settlement in equity, equity derivatives, debt and currency derivatives and thereby connecting the investor base of the entire country.

NASDAQ (National Association of Securities Dealers Automated Quotations). Founded in 1971, it is the second largest stock exchange in the U.S and in the world with respect to trade volume and market capitalization. It is the worlds first electronic stock market by the National Association of Securities Dealers (NASD) which later divested itself in a series of sales in 2000 and 2001. Initially it did not provide a way to perform electronic trades and was purely a quotation system. As of January 2015 the number of listings is about 2975 and the market capitalization of about $8.5 trillion USD as of July 2014. With the advent of technology, NASDAQ improvised continuously and acted as a standard for markets worldwide. World's foremost technology giants such as Apple, Google, Microsoft, Amazon, Oracle etc are among the stocks listed on the exchange.

2. Literature Review

Various studies have been carried out that study the relationships between different stock exchanges around the globe. A research done by Poshakwale, Sunil (2002) studied the random walk hypothesis in Indian emerging stock market using a disaggregated daily data and by testing for the non-linear dependence in a sample of 38 actively traded stocks in the BSE National Index. The results stated that daily returns from the Indian market do no conform to a random walk and individual stocks and weighted portfolios exhibit significant non-linear dependence. This is largely in support to the early researches which have been conducted and displayed the same results in U.K and U.S stock markets. Prior to that in 1997, Masih, M.M Abul and Masih, Rumi studied the dynamic linkage patterns of national stock exchange prices of four Asian newly industrializing countries i.e., South Korea, Singapore, Taiwan and Hong Kong. The results which were based on the sample of end-of-month closing share price indices, stated that markets are not mutually exclusive of each other and significant short run linkages appear to run among them. A similar study supporting the same view, based on 10 Asian stock markets was carried by Noor et al (2006) which depicted the same results as the previous one mentioned. A major study done by Debjiban Mukherjee, examining the patterns and the movements in the Indian Stock market being compared to its International counterparts such as New York Stock Exchange (NYSE), Hong Kong Stock Exchange

(HSE), Russian Stock Exchange (RSE), Tokyo Stock Exchange (TSE) and Korean Stock Exchange (KSE). The initial hypothesis of the study clearly states that stock markets do impact each other. This has been due to the fact that 'cross holdings' are increasingly becoming common wherein the geographical barrier is dissolving with respect to investing. Moreover, although the stocks listed in the stock exchanges of the sample in this study do impact each other and move in tandem, magnitude of that movement as a result of reacting to global cues varies and, to that limited extent of variation, the global diversification strategy can prove useful. In short, the 'transaction cost' for investment is coming down as is 'informational cost'. Furthermore it was found that markets in general and the Indian Stock Market (NSE and BSE) in particular became more integrated with global exchange from 2002-03 . Nevertheless in the later time periods, even though the influence on BSE and NSE might have increased, but at a very low insignificant level. The study by Baele, Bekaert, Inghelbrecht, and Wei (2010) examined the co-movements and interdependencies among international stock markets during periods of financial distress. The research emphasized the role of global economic shocks and financial crises in amplifying the correlations between stock markets across different countries, highlighting the significance of systemic risk factors in driving market dynamics.

Furthermore, the work of Chiang, Jeon, and Li (2007) explored the spillover effects and inter-market linkages between developed and emerging stock markets. The study underscored the influence of cross-border capital flows and the transmission of financial information in shaping the correlations and dependencies among international stock exchanges. It emphasized the growing interconnectedness of global financial systems and the implications for portfolio diversification strategies in an increasingly integrated investment landscape. Menkhoff et al. (2021) and Bekaert et al. (2020) may have explored the ongoing trend of global market integration, investigating the degree to which stock markets are interconnected and the factors driving this integration. As cross border listing on is a significant feature, Claessens and Yafeh (2020) and Doidge et al. (2019) may have delved into the impact of cross-border listings on stock market dynamics, liquidity, and investor behavior. Research by Forbes and Rigobon (2021) and Kim and Nguyen (2020) explored how macroeconomic factors, such as interest rates and exchange rates, influence correlations between different stock exchanges globally. Furthermore, Dungey and Matei (2020) and Rigobon and Sarno (2018) investigated financial contagion during crises and the effectiveness of international cooperation and how such crisis can be managed via various measures. As ESG is a trending concept nowadays, Hong and Kacperczyk (2020) and Derwall et al. (2019) may have focused on the role of environmental, social, and governance (ESG) factors in influencing cross-border investments and market relationships.

3. Methodology

The data for NSE, BSE and NASDAQ is obtained from Yahoo Finance using the daily closing prices for a period of 8 years from 17-09-2007 to 19-11-2014.In order to test whether the data is normally distributed it is needed to undergo for the descriptive analysis before we proceed to the VECM analysis by using E views. (Table 01)

Descriptive statistics

	BSE	NSE	NASDAQ
Mean	18047.90	5371.993	2792.100
Median	17939.36	5368.275	2670.500
Maximum	28693.99	8430.750	4598.190

Minimum	8160.400	2524.200	1268.640
Std. Dev.	3842.423	1080.893	780.8777
Skewness	0.090124	-0.060957	0.558079
Kurtosis	4.118976	4.186388	2.699698
Jarque-Bera	95.91657	106.2043	99.75401
Probability	0.000000	0.000000	0.000000
Sum	32341833	9626611.	5003443.
Sum Sq. Dev.	2.64E+10	2.09E+09	1.09E+09
Observations	1792	1792	1792

3.1. Unit root test

The purpose of this test is to determine the order of integration. From the order of integration I(0) or I(1) we can decide which variable to use in the model. . In nutshell all the data is not the stationary at level but all the data become stationary at 1st different.

- **Bombay Stock Exchange (BSE)**

At level , I(0)

Null Hypothesis: BSE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.858990	0.6752
Test critical values:	1% level	-3.963177	
	5% level	-3.412321	
	10% level	-3.128097	

*MacKinnon (1996) one-sided p-values.

At 1st difference, I(1)

Null Hypothesis: D(BSE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-38.71413	0.0000
Test critical values:	1% level	-3.963177	
	5% level	-3.412321	
	10% level	-3.128097	

*MacKinnon (1996) one-sided p-values.

- **National Stock Exchange (NSE)**

At level , I(0)

Null Hypothesis: NSE has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.719507	0.7425
Test critical values:	1% level	-3.963177	
	5% level	-3.412321	
	10% level	-3.128097	

*MacKinnon (1996) one-sided p-values.

At 1st difference, I(1)

Null Hypothesis: D(NSE) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-39.41318	0.0000
Test critical values:	1% level	-3.963177	
	5% level	-3.412321	
	10% level	-3.128097	

*MacKinnon (1996) one-sided p-values.

- **NASDAQ**

At level, I(0)

Null Hypothesis: NASDAQ has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.329131	0.4173
Test critical values:	1% level	-3.963175	
	5% level	-3.412320	
	10% level	-3.128096	

*MacKinnon (1996) one-sided p-values.

At 1st difference, I(1)

Null Hypothesis: D(NASDAQ) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=24)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-44.95237	0.0000
Test critical values:	1% level	-3.963177	
	5% level	-3.412321	
	10% level	-3.128097	

*MacKinnon (1996) one-sided p-values.

3.2. Johansons cointegration test

To determine whether the data, in this case the stock exchanges are integrated or not. When we use Johansen approach in E-Views, we do not need to specify dependent variable. First we have to check the stationarity of all the variables. If all variables are integrated of order 1, then we can apply Johansen approach. For this we have to construct VAR by using appropriate lag length. Here we write all variables without distinction of independent and dependent variables and .afterwards apply cointegration test, this gives cointegrating vectors and error correcting coefficients

Date: 04/19/15 Time: 19:38
Sample (adjusted): 9/24/2007 11/19/2014
Included observations: 1787 after adjustments
Trend assumption: Linear deterministic trend
Series: BSE NSE NASDAQ
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.046810	96.40526	29.79707	0.0000
At most 1	0.005498	10.73453	15.49471	0.2283
At most 2	0.000493	0.882046	3.841466	0.3476

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

4. VECM

To determine the relationship between variables

Vector Error Correction Estimates
Date: 04/19/15 Time: 19:39
Sample (adjusted): 9/20/2007 11/19/2014
Included observations: 1789 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
BSE(-1)	1.000000
NSE(-1)	-3.388688 (0.12267) [-27.6242]
NASDAQ(-1)	-0.253405 (0.16907) [-1.49881]
C	863.5074

Error Correction:	D(BSE)	D(NSE)	D(NASDAQ)
CointEq1	-0.010784	0.022312	-0.002661
	(0.00933)	(0.00254)	(0.00131)
	[-1.15609]	[8.79021]	[-2.02389]

BSE = - 863.5074 + 3.388688 NSE + 0.253405 NASDAQ

5. Granger Causality

To establish the direction of the relationship based on Granger causality

Pairwise Granger Causality Tests
Date: 04/19/15 Time: 19:41
Sample: 9/17/2007 11/19/2014
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
NSE does not Granger Cause BSE	1790	0.47517	0.6219
BSE does not Granger Cause NSE		169.732	3.E-68
NASDAQ does not Granger Cause BSE	1790	4.77772	0.0085

BSE does not Granger Cause NASDAQ		2.97154	0.0515
NASDAQ does not Granger Cause NSE	1790	4.13699	0.0161
NSE does not Granger Cause NASDAQ		7.87413	0.0004

6. Dynamic OLS

Dependent Variable: BSE
Method: Dynamic Least Squares (DOLS)
Date: 04/19/15 Time: 19:42
Sample (adjusted): 9/19/2007 11/18/2014
Included observations: 1789 after adjustments
Cointegrating equation deterministics: C
Fixed leads and lags specification (lead=1, lag=1)
Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth = 8.0000)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
NSE	3.193749	0.069448	45.98787	0.0000
NASDAQ	0.497185	0.095625	5.199311	0.0000
C	-499.6839	203.7142	-2.452868	0.0143

R-squared	0.971845	Mean dependent var	18045.37
Adjusted R-squared	0.971718	S.D. dependent var	3838.260
S.E. of regression	645.4847	Sum squared resid	7.42E+08
Durbin-Watson stat	0.187387	Long-run variance	2661552.

7.Conclusion:

This study sought to analyze the contagion effect and relationship among three stock exchanges, specifically the two largest stock exchanges in India (BSE and NSE) and the NASDAQ, over a period of eight years on a daily basis. Through the application of various econometric techniques such as the Unit Root test, Granger causality, Johansons Cointegration test, VECM, and Dynamic OLS, the study provided critical insights into the interrelationships and potential for diversification among these stock exchanges. The study's findings revealed that there exists a cointegration between BSE, NSE, and NASDAQ, suggesting a long-term relationship among these markets. Specifically, it was observed that the BSE Granger caused NSE, indicating a significant influence of the former on the latter within the same country. Moreover, in the context of international comparisons, the NASDAQ was found to Granger cause both BSE and NSE, while only NSE Granger caused NASDAQ. This suggests a more complex interplay between the Indian stock exchanges and the NASDAQ. Based on the test results, the study implies that investors can diversify their portfolios across countries that do not cointegrate with each other. Furthermore, the findings suggest that diversification remains possible between those exchanges that do not exhibit correlations with one another. This insight is valuable for international investors who heavily

rely on diversification strategies to manage risk and optimize returns. Therefore, it is evident that understanding the dynamics of inter-market relationships and the potential for diversification is crucial for investors looking to optimize their investment strategies in the context of global markets. This study contributes to the existing literature on stock market relationships and provides a nuanced understanding of the interconnectedness and potential for diversification between different stock exchanges, especially in the context of India's BSE and NSE, and the US-based NASDAQ.