# A STUDY ON EXISTENCE OF CO-INTEGRATION BETWEEN SHARE PRICE VOLATILITY AND SELECTED MACROECONOMIC VARIABLES

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**ABSTRACT**

This paper checks the descriptive statistics for the selected macroeconomic variables and the volatility of the Indian stock market of BSE Sensex and NSE Nifty thorough first half and second half time constraint by using the most widely used framework for finding out the co-integration among variables was Asset Pricing Theory.

The study also focuses to see the impact on stock market volatility after the liberalization of Indian economy , simple percentage was  also used to calculate the rate of return in the Indian stock market and select foreign markets, The level of significant was  identified with the selected variables of BSE Sensex , NSE Nifty,FII ,WPI, money supply, Foreign exchange and gold rate.

We have listed that the benefit of increased liquidity is available at a volatility level, The government should maintain effective checks to control volatility in any such sector so as this excessive volatility is not transmitted to the economy. The suggestions are recommended to make the functioning of Indian stock market more effective.

**Keywords**: Volatility, Indian economy, liquidity, Derivatives.

## 1. INTRODUCTION

The Financial system of a country implies financial markets, financial instruments/ assets and financial intermediaries. Financial markets are further classified as money market and capital market. Money market deals with the assets of short-term nature, generally less than a year. The main participants in money market in our country are the RBI and the banks. The capital market is however for long-term funds and has two interdependent and inseparable segments i.e. primary/new Issue market and secondary market/ stock exchanges.

Primary market or new issue market deals in new securities i.e. the securities which have not been offered to the public earlier and allows issue of these securities through public issue, rights issue and through private placement while, the secondary market is a market for old/existing securities i.e. those securities which are already issued and are granted stock exchange quotation/listing. The secondary market or stock exchange provides liquidity to the investors and constitutes an organized market for securities issued by central government, state governments, public bodies and joint stock companies.

**SECONDARY/STOCK MARKET/EXCHANGE:**

Secondary market is a market for old /existing securities i.e. those already issued and granted stock exchange quotation/listing. It plays only indirect role in industrial financing by providing liquidity to investments already made. It has a physical existence and is located in a particular geographical area. In India the secondary market consists of recognized stock exchanges operating under rules, by-laws and regulations duly approved by the government.

These stock exchanges constitute an organized market for securities issued by central government, state government, public bodies and joint stock companies. A stock exchange is defined under section 2(3) of the Securities Contracts (Regulation) Act, 1956, as "Anybody of individuals, whether incorporated or not, constituted for purpose of assisting, regulating or controlling the business of buying, selling in securities."

**Major Indicators of Indian Stock Market**

| ITEMS | 2013-14 | 2014-15 | 2013-14 | 3014-15 |
|---|---|---|---|---|
| A. Indices | | | | |
| BSE SENSEX | | | | |
| Year-end | 22,386 | 27,957 | 18.8 | 24.9 |
| Average | 20,120 | 26,557 | 10.5 | 32.0 |
| CNX-NIFTY | | | | |
| Year-end | 6,704 | 8,491 | 18 | 26.7 |
| Average | 6,010 | 7,967 | 8.9 | 32.6 |
| **B. Annualised Volatility (percent** | | | | |
| BSE SENSEX | 17.5 | 13.5 | 39.6 | 22.6 |
| CNX-NIFTY | 18.1 | 13.5 | -40.3 | -25.4 |
| **C. Total Turnover(Rs. Crore)** | | | | |
| Cash Segment (All-India) | 33,41,337 | 51,84,500 | 2.6 | 55.2 |
| **BSE** | 5,21,664 | 8,54,845 | 4.9 | 63.9 |
| **NSE** | 28,08,488 | 43,29,655 | 3.7 | 54.2 |
| **MSEI** | 11,185 | Na | 33.793* | Na |
| **Equity Derivatives segment** | 4,75,75,571 | 7,59,69,290 | 22.9 | 59.7 |
| **BSE** | 92,19,434 | 2,03,62,741 | 28.7 | 120.9 |
| **NSE** | 3,82,11,408 | 5,56,06,453 | 21.2 | 45.5 |
| **MSEI** | 1,44,729 | 95 | 1.698* | 99.9 |
| **Current Derivatives Segment** | 69,80,855 | 50,33,096 | 19.9 | 27.9 |
| **BSE** | 2,44,312 | 13,07,077 | Na | 435.0 |

| | | | | |
|---|---|---|---|---|
| NSE | 40,12,513 | 30,23,908 | 23.9 | 24.6 |
| MSEI | 24,22,410 | 6,49,925 | 26.7 | 73.2 |
| USE | 3,01,620 | 52,186 | 127.0 | 82.7 |
| Interest Rate Derivatives Segment | 39,944 | 4,73,783 | Na | 1060.3 |
| BSE | 7,191 | 41,913 | Na | 482.9 |
| NSE | 30,173 | 4,21558 | Na | 1,297.1 |
| MSEI | 2,580 | 10,312 | Na | 299.7 |
| **D Market Capitalisation (Rs, Crore)** | | | | |
| BSE | 74,15,296 | 1,01,49,290 | 16.1 | 36.9 |
| NSE | 72,77,720 | 99,30,122 | 16.6 | 36.4 |
| **E No of Listed companies** | | | | |
| BSE | 5,336 | 5,624 | 2.4 | 2.4 |
| NSE | 1,688 | 1,733 | 1.3 | 1.3 |
| **F.P/E Ratio** | | | | |
| BSE Sensex | 18.3 | 19.5 | 8.3 | 6.6 |
| CNX Nifty | 18.9 | 22.7 | 7.4 | 20.1 |

The national stock exchange has its own set of indices, namely, CNX Nifty, CNX Nifty Junior and CNX Midcap 200. Most important of all CNX Nifty also called the Nifty 50 or Nifty is the benchmark stock market index of the National stock exchange. CNX in the name stands for CRISIL National Stock Exchange Index and it comprises of 50 stocks listed on the NSE. It covers 22 sectors of Indian Economy.

**Exchange-wise Cash Segment Turnover (in crores)**

| STOCK EXCHANGE | 2013-14 | 2014-15 | Percentage Share |
|---|---|---|---|
| Ahmadabad | Na | Na | Na |
| BSE | 5,21,664 | 8,54,845 | 16.50 |
| Calcutta | 79 | Na | Na |
| Madras | Na | Na | Na |
| MSEI | 11185 | Na | Na |
| MPSE | Na | Na | Na |
| NSE | 28,08,488 | 43,29,655 | 83.50 |
| PUNE | Na | Na | Na |
| UPSE | Na | Na | Na |
| Vadodara | Na | Na | Na |
| **TOTAL** | **33,41,416** | **51,84,500** | **100.00** |

Source: Annual Report, SEBI

## 2. REVIEW OF LITERATURE

The review of literature related to the present investigation is of the prime importance in conducting further research work. The review of past research studies helps in becoming conversant with the subject matter of the research and gives an insight for selecting appropriate methodology. Review of literature also helps in avoiding duplication of research work thus reducing the wastage of resources. Keeping the importance of earlier research studies in mind, this chapter has been developed by sourcing the research works from various journals, internet sites etc.

**Raj and Dhal** (2008) investigated the financial integration of Indian stock market with global and major regional markets. BSE-200 scrip all index was used as a proxy for the Indian stock market; global markets selected were the United States, the United Kingdom and Japan, while the regional markets were the stock markets of Singapore and Hong Kong. Daily and weekly data were used for the period between March 1993 and January 2008. Financial integration was visualized in two phases i.e. 1993-2002 and 2003-2007. It was found that during the period of Asian crisis Indian stock market showed inverse co-movement with global stock markets but positive correlation with regional stock markets.

Correlation of daily stock returns showed that the correlation of Indian market with other markets had strengthened since 2003 as compared to the earlier period but this correlation is lower than that of other regional markets with global markets. The co integration analysis also revealed that the Indian market was more dependent upon the global markets than the regional markets.

**Chinzara and Aziakpono** (2009) in their study analyzed returns and volatility linkages between South African Equity market and the world major equity markets using daily data for the period 1999-2007. Results showed that both returns and volatility linkages exist between South Africa and the major world stock markets, for example with Australia, China and US showing most influence on South Africa returns and volatility. Volatility was found to be inherently asymmetric but reasonably stable over time in all the stock markets studied, and no significant evidence was found for the risk-premium hypothesis.

**Kumar and Gupta** (2009) investigated the behavior of stock prices in Indian stock market. They used four different ways to test the normality of returns e.g. Jarque-Bera, K-S test and Q-Q plot etc. the data was used for 25 shares in BSE Sensex and their daily adjusted closing prices from January 2000 to December 2006 were taken for the purpose of analysis. All the four ways of testing normality provided strong evidence against Gaussian hypothesis of normality and it was concluded from all the methods that the return distributions observed had "fat-tails".

**Siddiqui** (2009)conducted a study to examine the association of CNX Nifty with the Asian and U.S. stock markets. He used daily closing prices from 1999-2009 for the study. He divided the time period of ten years into period-I i.e. 1999-2004 and period-II i.e. 2004-2009. The analysis of the data revealed that the volatility had gone down in the period-II and the correlations between the selected stock markets were improved in period-II though the influence of US stock markets on the Asian stock markets had eroded over the period of time.

**Sharma and Mahendru** (2010) analyzed the long-term impact of various macro- economic variables on BSE. Weekly data was used from January 2008 to January 2009 for the selected variables i.e. gold price, foreign exchange reserve, inflation rate and change in exchange rate. Multiple regression equation was used to determine the relationship and the results showed high correlation of exchange rate and gold price with BSE stock price, while foreign exchange reserve and inflation were found to have low level of correlation with BSE stock prices.

**Singh Dharmendra** (2010) attempted to explore the causal relationship between stock market index i.e. BSE Sensex and three key macro-economic variables of Indian economy by using correlation, unit root stationery test and granger causality test. Monthly data from April 1995 to March 2009 was used for this purpose. The macroeconomic variables selected for the study were WPI, IIP and Exchange Rate. The results showed that the Stock Market Index, IIP, WPI and Exchange rate contained a unit root and were integrated of order one. Granger causality test indicated that IIP is the only variable having bilateral causal relationship with BSE Sensex. WPI is having strong correlation with Sensex but it is unilateral.

**Gupta and Aggarwal** (2011) found the correlation of Indian stock market with five other Asian Economies, Japan, Hong Kong, Indonesia, Malaysia and Korea. The results reveal a weak correlation and conclude that the Indian Stock market offers diversification benefits to institutional and international investors. The paper also found non-normality feature in the stock return distribution of the six economies of Asia including India. The Indian markets showed features of platykurtic distribution, the volatility of weekly returns in India was similar to the volatility of Asian counterparts. The negative skewness of returns in India reveals concentration of returns is towards the higher sides, thus revealing good opportunity for investment.

**Mukhopadhyay and Sarkar** (2011) conducted an empirical study on the co-integration of stock price index and macro and financial variables in Indian stock market. The indices chosen for this purpose were BSE SENSEX, BSE 100 and NIFTY. The study showed that there exist co integrating relations between stock index and domestic industrial production, consumer price index, nominal exchange rate, foreign direct investment and long-term interest rate. Further, the all the three indices showed co integrating relations with same set of macroeconomic variables. None of the financial variables showed any co integrating relations with the stock indices.

**Panda and Acharya** (2011) examined the price linkages and interdependence of Indian stock market with some of the world markets i.e., US, UK, Japan, Singapore, Hong Kong, Malaysia, South Korea, Taiwan and China using daily closing prices for the period covering January 2, 2001 to November 28, 2008. It was observed that the Indian stock market has co-integrating relationship with US financial market. The co-integration was also found with Hong Kong in the pre- crisis period which breaks in the post-crisis, period while In case of China, a co-integrating relationship is found after Crisis. But relationship with other financial markets was not well established.

**Aliyu** (2012)the study assessed the impact of inflation on stock market returns and volatility using monthly time series data from the two west African countries, that is, Nigeria and Ghana. Results for Nigeria show weak support for the hypothesis that bad news exert more adverse effect on stock market volatility than good news of the same magnitude, while a strong opposite case holds good for Ghana. Furthermore, inflation rate and its three months average were found to have significant effect on stock market volatility in the two countries. It was suggested that if measures are employed towards restraining inflation in the two countries, it would certainly reduce stock market volatility and boost investors' confidence.

**Desai and Trivedi** (2012) examined the day of the month effect in the world stock markets. Z-statistics was used to test the significance of the results. In total 310 hypotheses were tested in the study. The results confirmed that the month of the day anomaly existed for all the selected stock markets. Further turn of the month effect was also found in the stock markets. Regarding day of the month effect it was suggested that the investors could benefit if they avoid the days with negative bias.

**Falkberg** (2012)analyzed the impact of macroeconomic variables on the volatility and returns of S&P 500 index. The data used for the analysis was on monthly basis and ranged from 1957 and 2011. The empirical outcomes were obtained by employing VAR, Granger causality and other econometric techniques. The seven macroeconomic variables used were default spread, inflation, and industrial production, slope of the yield curve, implied volatility and 3 months treasury bills. The results showed the presence of seasonal patterns and asymmetric volatility. The results also showed that no relationship was found between the macroeconomic variables and stock market volatility.

**Trivedi and Behera** (2012) revisited the issue of examining the inter-linkages between equity share prices of BSE Sensex and selected macroeconomic variables in India. They used the data from September1997 to March 2011 and tried to investigate the long-run and short-run relationship of equity prices with macroeconomic variables, namely, IIP, WPI, FII, interest rate, money supply as well as Morgan Stanley Capital International world Index. It was concluded for the co integration tests that equity prices are significantly related to all macroeconomic variables considered in the study. The estimation of VECM further confirms the existence of long-run stable equilibrium among the variables in the model.

**Vashishtha et.al.** (2012) analyzed the prices of the Tata Motors Ltd. and Eicher Motors Ltd. for the financial year 2010-11 to measure the volatility. The data were analyzed with the help of mean, standard deviation and t-statistics. The volatility in the prices was found to be of gyrated nature. The volatility for the open to open and close to close prices was found to be significant at five percent level of significance. A comparison of the open to open and close to close volatility showed that the volatility for the selected units was the same.

**Bhowmik (**2013) studied various dimensions of stock market volatility and the impact of volatility with the help of the literature. He concluded that the political instability and the depressions catapulted the stock market volatility which dwindled the growth of the country having a negative spillover of volatility from other countries on growth rate. The relationship between international trade and volatility revealed that volatility reduced volume of trade and increased both current and capital account deficits.

**Deepak and Sandeep** (2013) conducted a study for five major world indices namely BSE 30,NSE CNX NIFTY, HANG SENG index, S&P500 and KLSE COMPOSITE for finding out the intensity of stock market integration. From the study it was observed that the correlation between returns of the indices has increased over the period of time. All the indices considered were found to be co-integrated thus suggesting the existence of a long-term relationship which might be seen as first indication of increased interdependency among the selected stock markets. It was also found that the impact of US markets on Indian stock markets is fading away and the impact of Hong Kong market on Indian stock market is increasing.

**Jayasrees** (2013) conducted a study on stocks forming part of the BSE index to find out the correlation of disclosures and volatility of stock prices. Regression method was used to see the impact of various selected variables on the index. The study proved that among all the studied variables disclosures have significant impact on volatility. The regression model had shown that disclosure had highest intercept value. The slope values for disclosure were also negative thus indicating that better disclosures reduce volatility.

**Chandrasekara and Tilakratnesss** (2014) aimed at finding out the distribution of return at the Colombo stock exchange. The study period consisted of five years daily data from 2007 to 2012. The results revealed that the distribution of returns for the Colombo stock exchange could not be modeled

using normal distribution and t-distribution. KS test was used to study the suitability of the fitted distribution and it was found that the test was insignificant at five percent level of significance.

**Jha and Singh** (2014) examined the effect of macroeconomic factors on the Indian stock market and used monthly data from January 2000 till December 2008. ARCH method was used to find out the short-run and long-run equilibrium relationship between the variables. The authors found co-movements between macroeconomic variables and Indian stock index in the long-run. In the short-run it was found that the stocks prices are affected by the variation in own prices rather than the changes in the macroeconomic variables.

**Srivastava** (2014) conducted a study to know the volatility of the Indian stock market after the recession taking BSE and NSE as proxies of the Indian stock market. The daily data for the period between 2008 and 2013 was used for the purpose of the study. The results of the study revealed that close to close volatility for both the indices was highest in the year 2008-09. The volatility decreased after 2008-09. It was also concluded that stock market reacts negatively to the recessions and financial crises thus increasing the volatility of the stock market.

**Hussain et. al.** (2015) examined the relationship between macroeconomic variables and stock returns volatility in the Pakistan stock market. The study used the monthly observations between 2001 and 2011. Auto Regressive Distributed Lag method was employed to study the relationship. The results revealed that macroeconomic variables are responsible factors in explaining stock returns volatility. Inflation, real exchange rate and oil prices are the factors increasing stock volatility. While industrial sector output and real supply of money are related to the volatility negatively.

**Joshi and Giri** (2015) studied how fiscal deficit affects the behavior of stock prices in Indian stock market. Annual data from 1988 till 2012 was used for studying the relationship. Auto Regressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) were used for testing the short-run and long-run dynamic relationship. The findings suggest that the series are integrated and reveal that the long-term negative relationship exists between fiscal deficit and stock prices in India but does not show any significant relationship in the short-term.

**Gupta et al.** (2016) explained week from efficiency of Indian capital market. The four indices i.e. BSE100 and SENSEX of Bombay stock exchange, s& p CNX NIFTY and S&P CNX500 of national stock exchange were used in the study to present the market. The whole period was divided into three parts equally to see the impact of different short time periods. The different statistical tools like unit root test, runs, test and kolrilogorov-smirnovtest (k-S test) we are used to analyze the data. The results revealed the present situation of Indian capital market. It was noticed that Indian stock market did not actually move in random which has the incompletion of dependency on past prices. The study proved that Indian stock market had the tendency of not completely adjusting the information and happenings into present stock prices during the period of study. It gives the indication that market did not move anadem and it is still not weak from efficiency.

**Palamalai srinivasan and vasudevan** (2017) examined in their research that the linkage between the changes in implied volatility index and the underlying stock index return in the Indian stock market. The empirical results revealed that the contemporaneous return was the most important factor that determined the changes in the current India implied volatility. Besides, the empirical evidences confirmed the negative asymmetry volatility- return relation, supporting the behavioral explanations rather than financial leverage hypothesis.

## 3. RESEARCH DESIGN

**SCOPE OF THE STUDY:**

The new policy led to a number of financial reforms and the capital market was rebuilt in the process. The process of reforms was carried out in different phases, the first phase starting in 1991 and ending in 1996. The major reforms brought about in this phase were statutory status to Securities Exchange Board of India as regulator of the securities market in January 1992, free pricing of equity issues, permission to foreign institutional investors to operate in primary and secondary market in September 1992, and Introduction of electronic trading with the setting up of National Stock Exchange in 1994.

The second phase of reforms started in the year 1996. National Security Depository Limited was set up in the same year to hold securities in dematerialized form. Screen based trading was introduced in all exchanges in India so that transparency can be increased. Rolling settlement was introduced and settlement period was reduced to T+5 in July 2001. Equity issues by Indian companies in the foreign market were allowed through ADR's and GDR's and compulsory credit rating was also introduced.

As a result of various reforms the market capitalization and trading volume of the BSE and NSE increased many fold. Stock market index also reached the magic figure of 10000 in the second phase of reforms. The present study covers the time period from 1995 till 2015. This study period is divided into two time periods i.e. April1995-March 2005 and April 2005-March 2015. The period between April1995 and March 2005 is considered as first half of the study and the period of April 2005 to March 2015 as second half of the study.

Further, the study is confined to Bombay Stock Exchange (BSE Sensex) and National Stock Exchange (Nifty). The two stock exchanges dominate the stock market in India. Bombay stock exchange is the oldest stock exchange in India and is the leading stock exchange with regard to the number of companies listed and market capitalization. It has the largest number of listed companies in the world whereas; National stock exchange is the 16th largest stock exchange in the world and largest in India in terms of daily turnover and the number of trades. The study is mainly focused to see the impact on stock market volatility after the liberalization of Indian economy.

## OBJECTIVES OF THE STUDY:

1. To study the change in open-to-open share price return and volatility during the period of the study.
2. To study the change in close-to-close share price return and volatility.
3. To examine the existence of co-integration between share price volatility and select macroeconomic variables.
4. To analyse whether there is co-integration between Indian stock market and select foreign stock markets.
5. To analyse the distribution of stock price returns in Indian stock market and select foreign stock markets.

## HYPOTHESES:

In the light of overall objectives the following hypotheses have been developed for the purpose of testing:

1. There is no significant change in open-to-open stock market return and volatility during period of the study.
2. There is no significant change in close-to-close stock market return and volatility during period of the study.
3. There is no co-integration between the stock market volatility and select macroeconomic variables.
4. There is no co-integration between Indian stock market and select foreign markets.
5. There is no change in the co-integration of Indian stock market with the select macroeconomic variables during period of the study.
6. The Distributions of stock price returns for Indian stock market and select foreign markets are normally distributed.
7. There is no change in the co-integration of Indian stock market with the select foreign stock markets during the two periods of the study.

## RESEARCH METHODOLOGY:

## SOURCE OF DATA:

The above objectives are studied through the use of secondary data. Data is gathered from various sources, namely SEBI Annual Reports, BSE Annual Reports, Bombay Stock Exchange Monthly Reviews, NSE Annual Reports, BSE website, NSE website, RBI website, SEBI, etc.

## ACCOUNTING TOOLS:

The present study uses the ratio analysis to study market size and market liquidity. A ratio measures the relationship of one number to the other and is one of the most powerful tools of analysis. Ratio analysis may be defined as the indicated quotient of two mathematical expressions. The various ratios used to measure stock market size and liquidity is as below:

Market Capitalisation Ratio
Value Traded Ratio
Turnover Ratio
Arithmetic Mean
Standard Deviation
Coefficient Of Variation

## LIMITATIONS OF THE STUDY:

1. The accurate and reliable data are available from the databases on payment of a fee. The study has not covered all the aspects of stock price movements and therefore it is not appropriate to say that the decrease/increase in volatility is due to liberalization process or market capitalization has increased due to increased liquidity.

2. Sometimes sectoral volatility or the shocks generated in any sector might be transmitted to the market index, making it more volatile and vice versa. Both these aspects are not covered in the present study. Therefore, it is not possible to say whether the sectoral volatility is transmitted to the indices or volatility of indices is having an impact on sectoral volatility.

3. Every study takes a particular span of time to complete. Changes are bound to occur during the intervening period as the regulators in their effort to promote stock market make certain changes from time to time. The SEBI and government of India might have taken steps to strengthen the market, the changes so made have not been covered in this study.

4. Prices of the index vary several times in a day. This intra-day fluctuation of the indices has not been covered in the study as the prices considered in the study are opening and closing prices of the BSE Sensex and Nifty.`

## Stock market volatility and Selected macroeconomic variables

The stock market acts as a center where buyers and sellers meet and enter into transactions. It helps in mobilizing the capital leading to growth of industry and commerce in emerging and developed economies. The stock market represents the heath of the economy as a whole. The investors while investing in the stock market expect return on the investments and get signals from many factors regarding their expectations. Emerging markets like India have been identified as being at least partially segmented from global stock markets. It is therefore argued that the variation in stock prices in these markets is more due to the local risk factors rather than the global risk factors.

The macroeconomic variables selected for the study are: exchange rate, foreign institutional investors (FIIs), foreign exchange reserves, gold prices, money supply and wholesale price index (WPI) and BSE Sensex and CNX Nifty are taken as proxy of Indian stock market.

EXCHANGE RATE
FOREIGN INSTITUTIONAL INVESTORS (FII):
FOREIGN EXCHANGE RESERVES:
GOLD PRICES:
MONEY SUPPLY:

## 4. ANALYSIS AND INTERPRETATION

## DESCRIPTIVE STATISTICS FOR THE SELECT MACROECONOMIC VARIABLES AND VOLATILITY OF THE INDIAN STOCK MARKET:

The current section analyses the descriptive statistics for the select macroeconomic variables and the volatility of the Indian stock market. The descriptive statistics for the first half have been presented in table 4.1. The results of the descriptive statistics during first half of the study period reveal that the mean values for volatility of BSE Sensex and Nifty are 1.467 percent and 1.458 percent respectively. The maximum volatility witnessed on the indices is revealed by the maximum value which is 3.718 percent for the Sensex and 4.111 percent for the Nifty.

The inflation as indicated by wholesale price index reveals the mean value of 80.508 percent and foreign institutional investors depicting the net investments in Indian capital market has the mean value of 1125.893 crores rupees. The maximum net investments made by foreign institutional investors has been 8811.800 crores rupee whereas, the minimum investment is 498.965 crores rupee. The maximum money supply during the first half of the study period has been 2251449 crores while, the minimum value is 1139133.5 crores rupee. The gold price indicates the price of gold in Mumbai for every 10 grams and has the mean value of 4928.335 rupees. The highest price of the gold during this period is 6553.830 rupees and the lowest price has been 4788.515 rupees. The values of skewness is positive for all the variables except exchange rate, indicating that only exchange rate has the majority of values above its average value and all the other variables have majority values below its average value.

**Descriptive Statistics of Volatility of Indian Stock Market and Macroeconomic Variables: First Half**

| | BSE | NSE | WPI% | FII Rupees | Money Supply | Foreign Exchange Reserves | Exchange Rate | Gold Prices |
|---|---|---|---|---|---|---|---|---|
| Mean | 1.467 | 1.458 | 80.508 | 1125.893 | 1218617.842 | 50789.800 | 42.414 | 4928.335 |
| Median | 1.357 | 1.361 | 80.021 | 498.965 | 1139133.500 | 35528.500 | 43.626 | 4788.515 |
| Maximum | 3.718 | 4.111 | 101.500 | 8811.800 | 2251449.000 | 141514.000 | 48.997 | 6550.830 |
| Minimum | 0.652 | 0.554 | 63.390 | 3151.290 | 524864.000 | 20652.000 | 31.379 | 3995.000 |
| Std.Dev | 0.614 | 0.628 | 11.064 | 1882.241 | 513000.174 | 33043.309 | 5.117 | 637.946 |
| Skewness | 1.359 | 1.609 | 0.218 | 1.991 | 0.381 | 1.298 | 0.644 | 0.669 |
| Kurtosis | 2.283 | 3.289 | 1.055 | 4.841 | 1.087 | 0.436 | 0.883 | 0.410 |

Source: RBI Handbook of Statistics

The descriptive statistics for indices and select macroeconomic variables during second half of the study period has been presented in table.The average volatility on BSE Sensex is 1.403 percent and for Nifty, the average is 1.420 percent. The highest volatility during this period has been 10.097 percent for Sensex and 10.035 percent for Nifty. The average of wholesale price index is 141.518 percent. foreign exchange reserves showing total of SDRs, Gold and foreign currency assets has the mean value of 262147.092 crores rupee, while the exchange rate depicting the average rate of Indian rupee exchanged for one US Dollar has the mean value of 49.272 rupees. The highest exchange rate of US Dollar during this period is 63.752 rupees while, lowest value of Indian rupee for US Dollar has been 46.567 rupees. The value of skewness has been positive for all the variables except for foreign exchange reserves.

**Descriptive Statistics of Volatility of Indian Stock Market and Macroeconomic Variables: Second Half**

| | BSE | NSE | WPI% | FII Rupees | Money Supply | Foreign Exchange Reserves | Exchange Rate | Gold Prices |
|---|---|---|---|---|---|---|---|---|
| Mean | 1.467 | 1.458 | 80.508 | 1125.893 | 1218617.842 | 50789.800 | 42.414 | 4928.335 |
| Median | 1.357 | 1.361 | 80.021 | 498.965 | 1139133.500 | 35528.500 | 43.626 | 4788.515 |
| Maximum | 3.718 | 4.111 | 101.500 | 8811.800 | 2251449.000 | 141514.000 | 48.997 | 6550.830 |
| Minimum | 0.652 | 0.554 | 63.390 | 3151.290 | 524864.000 | 20652.000 | 31.379 | 3995.000 |
| Std.Dev | 0.614 | 0.628 | 11.064 | 1882.241 | 513000.174 | 33043.309 | 5.117 | 637.946 |
| Skewness | 1.359 | 1.609 | 0.218 | 1.991 | 0.381 | 1.298 | 0.644 | 0.669 |
| Kurtosis | 2.283 | 3.289 | 1.055 | 4.841 | 1.087 | 0.436 | 0.883 | 0.410 |

## COINTEGRATION OF VOLATILITY IN INDIAN STOCK MARKET AND SELECT MACROECONOMIC VARIABLES:

Until recently, the most widely used framework for finding out the co-integration among variables was Asset Pricing Theory. APT holds that expected returns of a financial asset can be modeled as a linear function of various macroeconomic factors or theoretical market indices, where sensitivity to changes in each factor is represented by a factor-specific beta coefficient.

The model derive rate of return will then be used to price the asset correctly- the asset price should equal the expected end of period price discounted at the rate implied by the model. If the price diverges, arbitrage should bring it back into line. However, the development of the co-integration analysis has allowed another approach to examine the relationship between macroeconomic variables and stock prices. Mukherjee and Naka (1995) employed Johansen co-integration test and found that the Japanese stock market was integrated with six macroeconomic variables. Similarly, the co-integration analysis was used by Mayasmai and Koh (2000) in the Singaporean stock exchange to find out the relationship between stock prices and macroeconomic variables.

## VARIANCE DECOMPOSITION FOR VOLATILITY OF INDIAN STOCK MARKET:

The co-integration analysis only helps in determining the long run relationship between the variables and does not provide information on the responses of the variables due to shocks in other variables, though the results of the co-integration analysis help in determining the VAR model to be used in estimation of adjustment and short-run coefficients. This section presents the responses of the Indian stock market due to variations in select macroeconomic variables.

**Bombay Stock Exchange:**

Table presents the variance decomposition of the Sensex during first half of the study period. The analysis shows that the variance created by different macroeconomic variables in the volatility of Sensex is very small in the short-run. After lapse of two periods, the variance accounted for by own values of Sensex is 96.314 percent and foreign exchange reserves lead to only 1.148 percent change in the value of Sensex.

**Variance Decomposition of BSE Sensex: First Half of the Study Period**

|  | BSE Sensex | Nifty | Exchange Rate | FIIs | Foreign Exchange Reserve | Gold Prices | Money Supply | WPI |
|---|---|---|---|---|---|---|---|---|
| BSE Sensex | 1 |  |  |  |  |  |  |  |
| Nifty | 0.991 | 1 |  |  |  |  |  |  |
| Exchange Rate | 0.008 | 0.01 | 1 |  |  |  |  |  |
| FIIs | 0.555* | 0.564* | 0.228 | 1 |  |  |  |  |
| Foreign Exchange Reserve | 0.183 | 0.159 | 0.441* | 0.162* | 1 |  |  |  |
| Gold Prices | 0.081 | 0.007 | 0.809** | 0.293* | 0.746* | 1 |  |  |
| Money Supply | 0.063 | 0.052 | 0.876* | 0.29* | 0.772* | 0.948* | 1 |  |
| WPI | 0.085 | 0.074 | 0.861 * | 0.276* | 0.767 | 0.97* | 0.99* | 1 |

The influence of gold prices seems to be the least i.e. .078 percent only. Though, the variance accounted for by own volatility of the Sensex has decreased over the period of time and it is 70.186 percent after the expiration of ten periods. Amongst all the macroeconomic variables, the influence of foreign exchange is highest and is 9.731 percent while, FIIs lead to 7.776 percent change in the volatility of the Sensex. The money supply seems to be having least influence on the volatility of Sensex.

**Variance Decomposition of BSE Sensex: Second Half of the Study Period**

| | BSE Sensex | Nifty | Exchange Rate | FIIs | Foreign Exchange Rescdssserve | Gold Prices | Money Supply | WPI |
|---|---|---|---|---|---|---|---|---|
| BSE Sensex | 1 | | | | | | | |
| Nifty | 0.985 | 1 | | | | | | |
| Exchange Rate | 0.002 | 0.021 | 1 | | | | | |
| FIIs | 0.312* | 0.315* | 0.162 | 1 | | | | |
| Foreign Exchange Reserve | 0.102 | 0.102 | 0.536* | 0.631* | 1 | | | |
| Gold Prices | 0.106 | 0.098 | 0.182** | 0.581* | 0.818* | 1 | | |
| Money Supply | 0.074 | 0.081 | 0.794* | 0.518* | 0.935* | 0.669* | 1 | |
| WPI | 0.058 | 0.066 | 0.826* | 0.498* | 0.91* | 0.613* | 0.993* | 1 |

The variance decomposition analysis of the Sensex during the second half of the study period has been presented in table 4.14. The results in the initial period reveal the endogenous behavior of the volatility of the Sensex as none of the macroeconomic variables leads to any variation in the volatility in the first period. The endogenous behavior of the volatility has started disappearing after this and after lapse of only five periods, the variation accounted for by the own values is 60.563 percent. The variation caused by foreign institutional investors is highest during this period followed by the variation of wholesale price index and money supply. As the time passes, the variance accounted for by own values decreases further and is only 49.445 percent in the tenth period the foreign institutional investors appear to be the largest determinants of the volatility in the Sensex and explain 22.134 percent variation in the Sensex followed by wholesale price index with 11.684 percent variation.

**National Stock exchange:**
The analysis of the variance decomposition of Sensex during first half of the study period reveals that most of the variance in the volatility of Nifty is explained by its own values and the influence of all the macroeconomic variables is very little.

**Variance Decomposition of Nifty: First Half of the Study Period**

| Period | BSE Sensex | Nifty | Exchange Rate | FIIs | Foreign Exchange Reserve | Gold Prices | Money Supply | WPI |
|---|---|---|---|---|---|---|---|---|
| 1 | 0.627 | 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 2 | 0.65 | 95.338 | 1.5295 | 0.153 | 1.343 | 0.037 | 0.74 | 0.791 |
| 3 | 0.678 | 89.098 | 2.051 | 5.18 | 2.077 | 0.171 | 0.679 | 0.741 |
| 4 | 0.732 | 81.805 | 6.427 | 5.903 | 2.648 | 1.575 | 0.595 | 1.042 |
| 5 | 0.65 | 95.338 | 1.5295 | 0.153 | 1.343 | 0.037 | 0.74 | 0.791 |
| 6 | 0.627 | 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 0.816 | 70.836 | 6.709 | 7.249 | 9.989 | 3.009 | 0.582 | 1.624 |
| 8 | 0.829 | 70.216 | 6.795 | 7.455 | 10.187 | 2.94 | 0.582 | 1.821 |
| 9 | 0.85 | 68.677 | 6.802 | 7.944 | 10.538 | 2.893 | 1.106 | 2.037 |
| 10 | 0.872 | 68.472 | 7.376 | 7.563 | 10.447 | 2.776 | 1.052 | 2.311 |

Though, the influence of select macroeconomic variables increases in the long run, after ten periods the variation created by own values of volatility is only 68.472 percent and the remaining variation i.e. 31.528 percent is explained by macroeconomic variables. Table 4.16 presents the analysis of variance decomposition of Nifty during second half of the study period. The results reveal that the Nifty behaves

more endogenously during second half of the study period as most of the variance is accounted for by the own values of volatility of the index.

**Variance Decomposition of Nifty: Second Half of the Study Period**

| Period | BSE Sensex | Nifty | Exchange Rate | FIIs | Foreign Exchange Reserve | Gold Prices | Money Supply | WPI |
|--------|-----------|--------|--------------|------|--------------------------|-------------|--------------|------|
| 1 | 1.147 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2 | 1.179 | 96.729 | 1.255 | 1.117 | 0.61 | 0.175 | 0.107 | 0.002 |
| 3 | 1.224 | 92.199 | 4.898 | 1.368 | 0.788 | 0.233 | 0.114 | 0.397 |
| 4 | 1.301 | 89.842 | 4.76 | 1.24 | 0.944 | 2.661 | 0.192 | 0.358 |
| 5 | 0.65 | 95.338 | 1.5295 | 0.153 | 1.343 | 0.037 | 0.74 | 0.791 |
| 6 | 0.627 | 100 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 7 | 0.816 | 70.836 | 6.709 | 7.249 | 9.989 | 3.009 | 0.582 | 1.624 |
| 8 | 0.829 | 70.216 | 6.795 | 7.455 | 10.187 | 2.94 | 0.582 | 1.821 |
| 9 | 1.525 | 84.782 | 4.583 | 3.603 | 2.177 | 2.044 | 0.774 | 2.034 |
| 10 | 1.575 | 84.537 | 4.659 | 3.643 | 2.245 | 1.936 | 0.792 | 2.184 |

The variance explained by its own values is 84.537 percent and the variance created by exchange rate is 4.659 percent and is highest variance created by any of the macroeconomic variables during second half of the study period. The foreign institutional investors lead to 3.643 percent variation whereas the variation created by foreign exchange reserves is only 2.245 percent. The behavior of Nifty is thus different from the Sensex which initially reveals endogenous behavior but later becomes exogenous whereas the own values of Nifty account for majority variations even in the tenth period.

## 4. GRANGER CAUSALITY BETWEEN MACROECONOMIC VARIABLES AND STOCK MARKET VOLATILITY:

In order to determine the lead- lag relationship between volatility in the Indian stock market and select macroeconomic variables, the granger causality test has been used. This test helps in determining whether the past values of one variable can be used to predict the changes in the value of another variable. Literature suggests the existence of causal relationship between the stock markets and the macroeconomic variables.

Table above presents the summary of granger causality relationship between volatility of BSE Sensex and select macroeconomic variables. The results reveal that during first half of the study period, volatility of Sensex is caused by foreign institutional investors and money supply is granger caused by volatility. Foreign institutional investors are also granger caused by foreign exchange reserves, gold prices and money supply. There is one bi-directional relationship between money supply and wholesale price index during first half of the study period.

During second half of the study period, it has been observed that volatility on Sensex is caused by prevailing exchange rate and money supply and the Sensex granger causes wholesale price in India. The relationship between money supply and wholesale price index which has existed during first half of the study period is not seen during second half of the study period.

The results for volatility on Nifty and select macroeconomic variables reveal that Nifty is not granger caused by any of the variables during first half of the study rather it seems to be causing money supply, the relationship between money supply and stock market movements has also been verified in the studies of Bhattacharya (2001) and Macmillan (2007). It has also been observed that foreign exchange reserves are caused by money supply and wholesale price index while, foreign institutional investors are caused by foreign exchange reserves, gold prices and money supply. The volatility of Nifty is not caused by any of the variables during second half of the study period. The significant relationships exist between wholesale price index and exchange rate, wholesale price index and gold prices and wholesale price index and money supply. No bi-directional causality has been reported during this period.

An attempt has been made to analyse the relationship between the Indian stock market volatility and select macroeconomic variables. The analysis reveals that the relationship of volatility with the select macroeconomic variables has strengthened during the second half of the study period. Analysis of the long-run relationship reveals that there are two co-integrating equations among volatility and select macroeconomic variables during the second half of the study period signaling an increase in the co-integration among stock market volatility and the macroeconomic variables.

## 5.  RESULTS AND CONCLUSION

The mathematical tool used in the study is simple percentage and is used to calculate the rate of return in the Indian stock market and select foreign markets. The further analysis has been conducted with the help of arithmetic mean, standard deviation, coefficient of variation, skewness, kurtosis, correlation and regression. The normality of the distribution of stock returns has been tested with the help of Jarque-Bera a test and Shapiro-Wilk test.

1. An analysis of the stock market growth size shows that there has been continuous increase in the number of listed companies in both the indices i.e. BSE Sensex and CNX Nifty, the number of listed companies in 2014-15 were 5624 and 1733 in BSE and CNX respectively.

2. The liquidity situation as presented by value traded ratio and turnover ratio shows that the Indian stock market has the highest value traded ratio in the year 2000-01 for BSE and 2007-08 for the CNX Nifty. The highest turnover ratio was recorded in the year 200001 for both the indices. This year had the turnover ratio of 174.97 percent for BSE Sensex and 203.62 percent for the Nifty. Thereafter both the ratios show mixed trends.

3. The Turnover ratio declines to 8.42 percent for the BSE Sensex and 43.60 percent for the CNX Nifty in 2014-15, whereas the value traded ratio was 7.40 percent for BSE and 37.49 percent for the CNX Nifty in the same year. This reveals the liquidity is better provided to the investors by the CNX Nifty as compared to BSE Sensex.

4. An analysis of the relationship of the Indian stock market volatility with the select macroeconomic variables has been conducted with the help of correlation analysis. The results reveal that during the first half of the study period, volatility of the BSE Sensex is negatively related with select macroeconomic variables.

5. The relationship of FIIs and gold prices with the volatility is significant at one percent level and with the money supply and foreign exchange reserves at five percent level of significance. The second half of the study period reveals that volatility of BSE Sensex has significant relationship with FIIs, WPI, money supply, and exchange rate and gold prices at one and five percent level of significances.

6. The co-integration analysis has been used to find out whether the volatility of Indian stock market is co-integrated with its macroeconomic variables or not. The results of the unit-root test on the stock market volatility and the select macroeconomic variables reveal that some of the variables are non-stationary in the level form and become stationary after first difference and therefore co-integration test is applied on the variables.

7. The results of the trace test for the first half of the study period reveals that the null hypothesis of no co-integration between the stock market volatility and macroeconomic variables is rejected at five percent level of significance for both BSE Sensex and CNX Nifty.

8. The results of trace test depict that there are three co-integrating equations between the stock market volatility and select macroeconomic variables, while the second test of co-integration analysis i.e. maximum Eigen value test indicates that there exists only one co-integrating equation between the select macroeconomic variables and stock market volatility in the first half of the study period.

9. The results of unit root test for second half of the study period reveals that all the variables are not stationary in the level form and are therefore differenced. The variables become stationary after first difference. The trace test of co-integration analysis reveals that in case of BSE Sensex, there exist three co-integrating relationships between the stock market volatility and the select macroeconomic variables.

10. The results for CNX Nifty are little different from the results of BSE Sensex as the trace test and maximum eigenvalue test for Nifty signal existence of only two  co-integrating equations between

volatility and select macroeconomic variables. Though the maximum Eigen value test depicts increase in the co-integration as compared to the first half of the study period, the trace test shows only two co-integrating equations as against three for the first half of the study period.

11. The variance decomposition analysis of the volatility of BSE Sensex during first half of the study period reveals that volatility is influenced by its own past values. Amongst macroeconomic variables, foreign exchange reserves lead to maximum variance in the volatility on the Sensex. But the situation changes during the second half of the study period, the variation created by own values of volatility is reduced to less than fifty percent and the major contributors to the variance in Sensex are foreign institutional investors and wholesale price index. Thus, it can be concluded that the majority variations are explained by select macroeconomic variables in the long-run.

12. As far as Nifty is concerned, it has been observed that the volatility is behaving endogenously and has been influenced by its past values. As the time passes, the influence of macroeconomic variables is seen and it is revealed that the foreign exchange reserves, foreign institutional investors and exchange rate explain more than 25 percent variation in the volatility of the Nifty. The influence of these macroeconomic variables has declined during the second half of the study period and the three variables lead to only 10-11 percent variation in the Volatility. Thus, it can be said that the Nifty is behaving endogenously in the long-run.

13. Granger causality test for the BSE Sensex and select macroeconomic variables reveal that during first half of the study period, there is uni-directional causality running from foreign institutional investors to BSE Sensex while, the index granger causes money supply. And during second half of the study period, the Sensex is ganger caused by money supply and exchange rate and the Sensex granger causes wholesale price index.

14. As far as the CNX Nifty is concerned, it is not ganger caused by any of the variables in the first half of the study period. The CNX Nifty is not granger caused by select macroeconomic variables and fails to granger cause any of the select variables during the entire study period.
15. FIIs show one- directional causality with foreign exchange reserves, gold prices and money supply during first half of the study period, while in second half of the study period, exchange rate seems to granger cause money supply only.

**SUGGESTIONS:**
From the above findings, following suggestions are recommended to make the functioning of Indian stock market more effective:
1. The size of the Indian stock market has increased. The number of companies getting listed on the stock exchange is rising. In order to protect the interest of investors, the regulating agencies should make adequate provisions regarding listing of the companies and subsequent disclosures by these companies.
2. The study reveals that Indian stock market is able to provide better liquidity to the investors after liberalization. The benefit of increased liquidity is available at a volatility level which is almost the same as earlier. Therefore, need is felt to adopt more liberalized measures to attract both domestic and international investors so that more liquidity can be ensured in the Indian stock market.
3. The volatility is a measure of risk but the volatility is sometimes misunderstood by the investors. They must realize that the volatility is not something unwanted. The investors equate higher volatility with higher risk, though the excessive volatility caused by irrational behavior of investors and trading mechanism imperfections is not desirable and may threaten the functioning of the stock markets.
4. Volatility of returns is maximum in the month of March. This could be due to the most significant event in the economy i.e. presentation of the union Budget on the last day of February. The investors should therefore consider investing around the presentation of the union Budget, if they are ready to bear the increased risk.
5. Investors using technical analysis must predict the future trend by integrating stock price and volume. This can provide more useful prediction regarding future as it is indicated by the study that price and volume go together, meaning thereby that increased price indicates increased volume and indicates a bull run and vice-versa.

6. The study is focused on one financial market, there are other financial markets, such as money market, bond market and foreign exchange market and all these markets offer opportunities for diversification and therefore, help in the financial stability of the economy. It is therefore suggested that similar studies should also be taken for such markets so that the financial stability can be improved.

7. In an economy, the volatility of one sector has impact on the other sectors also as it gets transmitted to other sectors also. The government should therefore maintain effective checks to control volatility in any such sector so as this excessive volatility is not transmitted to the economy.

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