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NEXUS BETWEEN STOCK MARKET RETURNS AND MACROECONOMIC VARIABLES IN A LIBERALIZED ECONOMY– COINTEGRATION AND CAUSALITY ANALYSIS

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Abstract

This study examined the relationship between stock market index and selected macroeconomic variables since the economic reforms introduced in India. In the empirical analysis, augmented dickey fuller test, Johansen juselius co-integration test, and Granger causality test were employed. The post liberlisation results using johansen juselius indicates that stock market index has a long run equilibrium relationship with the macroeconomic variables such as inflation, Interest rate, industrial production index, money supply, exchange rate, international commodity prices, world stock market returns and world oil prices. The direction of causality using granger causality test shows that stock market returns have both unidirectional and bidirectional causal relationship with macroeconomic variables. In India, macroeconomic variables are the source of investment risk in determining the variations in stock market returns.

Keywords; Macroeconomic Variables, Stock Market Returns, Cointegration, Causality analysis.

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1.Introduction

In the era of globalization, a domestic stock market is not completely isolated from the international stock market. The developed and emerging stock markets are imperfectly integrated and investors are motivated to channelize the funds in the globally integrated international stock market. The integrated stock market motivates investors to use as an investment avenue for effective portfolio diversification. Ziobrowski and Ziobrowski (1995) have stated that foreign portfolio investment has long been accepted as a source of diversification by reducing the systematic risk arising out of the domestic market. The empirical literature has produced evidence that systematic risk arising out of changes happened in the macroeconomic variables rewards the stock market returns.

The relationship between macroeconomic variables and stock market returns has been well documented in financial theories such as Capital Asset Pricing Model and the Arbitrage Pricing Theory. The Capital Asset Pricing Model, a single factor model, has been criticized widely because of considering the market portfolio index as the only factor explaining the stock market returns. In contrast with the capital asset pricing model, the arbitrage pricing theory, a multi-factor model assumes that innovations in macroeconomic variables are the source of systematic risk influencing the stock market returns. The Arbitrage Pricing theory has been used extensively to produce evidence that the macroeconomic variables are the source of investment risk influencing the asset prices.

Iwata and Wu (2009) have documented that systematic risks arising out of macroeconomic variables can be alleviated by effective portfolio management and shared among the domestic and foreign investors investing in a liberalized developing stock market. Stock Market Liberalisation is the effect of economic reforms implemented in a country that gives a signal to the international investors that stock market liberalisation is about to be scheduled in future and it can be used as an implicit news for effective portfolio diversification (Chari & Henry, 2004). In the late 1980s and early 1990s, many developing countries throughout the world have implemented stock market liberlisation followed by economic reforms. India is one among the country introduced economic reforms in the early 1990s and has become a fastest growing economy in the world. Moreover, the economic reforms introduced in India attracted worldwide attention and becomes as an investment icon in the world. The similar stream is not experienced by any other countries that implemented economic reforms in the same period. When most developed economies were sluggish in the last two decades, India was seen as a reformed economy in the world with the long-term growth in equity markets. The liberalisation implemented in a country is often characterized as a country that is integrated with the world economy but the integration with the global economy depends upon the macroeconomic policy adopted by a country. Examining the cause and effect of macroeconomic variables facilitates investors to understand the emerging stock markets for effective portfolio diversification (Muradoglu, Taskin, & Bigan,2000). This paper has extended the existing knowledge on the literature studying causality and cointegration between macroeconomic variables and stock market returns in the post-economic reforms period in India. Because, potential investors started to view the opening up of an emerging economy is a road for effective portfolio diversification in stock market investment. The research on Indian stock market is more meaningful, timely and gives a vivid picture for international investors to understand the nexus between macroeconomic variables and stock market returns in the post economic reforms period.

The main aim of the study is to examine the causal relationship between stock market returns and macroeconomic variables by employing Johansen co-integration test, Granger causality test and in India in the post-reforms period. The research paper consists of five sections. The first section deals with the introduction, second section presents the literature review, the third section shows the data and methodology, the fourth section presents the empirical results and the fifth section concludes the research paper.

2. Review of Literature

Reviewing the previous literature brought out a message that macroeconomic fundamentals are vital and imperative in assessing stock market returns of a country. The significance of macroeconomic fundamentals in explaining the stock market returns has been demonstrated and documented in the financial theory of Arbitrage pricing theory developed by Roll & Ross (1980). Following the Arbitrage pricing theory, many researchers have extensively applied the theory and found a significant and insignificant relationship with macroeconomic variables in developed stock markets and emerging stock market. For example, Fama, (1981), Chen et al. (1986) found and documented significant relationship with the stock market returns in the USA. In Japan, Elton and Gruber (1988), Hamao (1988) have applied arbitrage Pricing theory and presented that macroeconomic fundamentals explain the stock market returns significantly. Poon and Taylor (1991) have studied the UK stock market and presented that stock markets returns are influenced by the macroeconomic fundamentals significantly. In emerging markets, Gay R.D (2008), has studied the relationship between macroeconomic variables and stock market returns in BRIC (Brazil, Russia, India, China) countries. Abugri (2008) investigated the dynamic relationship between the macroeconomic variables in four Latin American emerging stock market and concluded that macroeconomic fundamentals explain the stock market returns significantly.

But in the stream of causality between macroeconomic variables and stock market returns, Lee B.S (1992) analyzed the dynamic linkage and produced that stock market returns explain the real activity and little variation in inflation in the USA. Mukherjee & Naka (1995) presented that Japanese stock market is highly integrated with the macroeconomic variables in Japan. Ratanapakorn and Sharma (2007) have observed that stock prices have a negative impact on long-term interest rate but the positive impact of the money supply, industrial production, inflation and the exchange rate. Gunasekarage et al., (2004) have analyzed the correlation between Colombo all share price index and the macroeconomic variables by employing cointegration tests, Vector Error Correction Model. The Vector Error Correction Model (VECM) explains that the lagged value of macroeconomic variables had a significant impact on the stock market returns. They have documented that there exists a causal, long and short- run relationship exists among the chosen variables. By Considering group of countries, Samitas and Kenourgios (2006) attempted to study how the current, future domestic and international macroeconomic variables can explain long and short run stock market returns in four new European countries (Poland, Czech Republic, Slovakia, and Hungary). They documented that new European Stock markets are not perfectly integrated with foreign financial markets, while domestic economic activity and the German factor are more influential on the stock markets. In order to find out the magnitude of the relationship between macroeconomic variables and stock market returns, Osamwonyi and Evbayiro-Osagie (2012) have found that interest rate, inflation rates, exchange rates, fiscal deficit, GDP and money supply as

macroeconomic variables keep short run and long-run relationship with the Nigeria stock market index. In the line of this, Kuwornu (2012) produced evidence that there is co-integration between the macroeconomic variables and stock market returns in Ghana.

Emerging stock markets have widely been accepted and characterized as highly volatile than the developed stock markets. The literature studying the dynamic linkages between stock market returns and macroeconomic variables has been limited to developed stock markets (Mukherjee & Naka, 1995), but very few literatures have focused on studying the dynamic relationship in emerging stock markets. Among various emerging stock markets, India has attracted international investors and become an investment icon for the entire world in the last two decades since the liberalisation implemented in India. India has implemented liberalisation in the year in the year 1991. since then, Indian stock market has been believed that it has integrated with the world financial market. As there is no literature focused on the cause and effect linkage in the post economic reforms period in emerging stock market, this paper has filled the gap and extended the literature stream of causal linkages between macroeconomic variables and stock market returns by considering India as an

emerging stock market in the post economic reforms period. Studying the co-integration, the

direction of causality between macroeconomic variables and stock market returns for the liberalized period in emerging market like India gives a vivid picture for international investors to analyze and understand the volatile behavior of emerging stock markets.

3. Data and Methodology

Data used are monthly frequency running from April 1991 to December 2022, making a total of 321 months. The data collected for the study are closing stock prices of Sensex (Sensitive Index), inflation, interest rate, money supply, exchange rate, industrial production, world stock market returns, commodity prices and oil prices. All the macroeconomic variables are transformed and given in the following Table 1.

Table 1 Description of Macroeconomic Variables

Table1 TRANSFORMATION OFVARIABLES	Type of Variable Symbol	Variable	Transformation
Stock Market Returns	Dependent Variable	SMR	SMR = Ln SMRt - Ln SMRt-1
Inflation	Independent Variable	LIF	LIF = Ln LIFt – Ln LIFt-1
Interest rate	Independent Variable	LIR	IR = Ln IRt - Ln IRt-1
Money Supply	Independent Variable	LMS	M3 = Ln M3t - Ln M3t-1
Exchange rate	Independent Variable	LER	ER = Ln ERt - Ln ERt-1
Industrial Production	Independent Variable	LIP	IP = Ln IPt - Ln IPt-1
World Stock Market Return	Independent Variable	WSMR	WSMR = Ln WSRt - Ln WSRt-1
Commodity Prices	Independent Variable	LCP	CPI = Ln CPIt - Ln CPIt-1
Oil Prices	Independent Variable	LOP	OPI = Ln OPIt - Ln OPIt-1

Stock price index of Sensex (Sensitive Index) is collected from the website of Yahoo finance and other macroeconomic variables such as inflation, money supply, exchange rate and industrial production have been collected from the website https://data.oecd.org OECD (Organization for Economic Cooperation and Development), and Interest Rate is collected from RBI (Reserve Bank of India website). ACWI (All Country World Index from MSCI (Morgan Stanley Capital International) is collected to use as a proxy for world stock market returns and other macroeconomic variables like commodity prices and oil prices were collected UNCTAD (United Nations Conference on Trade and Development) publications.

All the macroeconomic variables are converted to logarithm and returns are measured using the formula given in table 1 to bring uniformity in the data. Consumer Price Index is used to represent Inflation, Treasury bill rate is used as a proxy for Interest rate, M3 has been considered to use as money supply, Indian rupee against United States of American dollar was considered to represent

exchange rate and ACWI(All country World Index) is used as a proxy for world stock market returns. Selection of similar macroeconomic variables is usually considered as subject of criticism on the

grounds of subjectivity but, Fama (1981) stated that such criticism is an unavoidable problem associated with this area because macroeconomic variables in each country exhibit different behavior towards stock market returns.

3.1 Augmented Dickey Fuller Test

An important concern in the time series data is that the time series data usually non-stationary and time-dependent. Time-dependent data indicates that the cross-sectional moments such as mean and variance and covariance are time-dependent. Therefore, it is necessary to transform non-stationary time series to stationary series before applying any econometric models for further analysis. One of the earliest contributions in the literature is that Nelson and Plosser (1982) has found that macroeconomic variables are severally affected because of unit root problem in the level data. Therefore, in this research, augmented dickey fuller test has been applied for transformation of macroeconomic variables from non-stationarity to stationary variables.

3.2 Johansen – Juselius Co-integration Test

Unit root test facilitates to make data to become stationary but it leads to cause a loss of significant long-run information. Therefore, a new method evolved without losing significant long-run information as with differencing or de-trending techniques is called cointegration test. It is a statistical method used to find out cointegration or long-run association among the selected macroeconomic variables. This method treats all variables are endogenous variables and finds cointegration among them.

3.3 Pairwise Granger Causality Test

The Granger causality test is a statistical hypothesis test for determining whether one variable occurred in the past causes another variable to happen later. In simple, events in the past can cause another event to happen today. The major limitation of the test is that the Granger causality is highly sensitive to the selection of lags. Therefore lags are selected based on the Akaike information criterion to apply Granger causality test on stock market returns and macroeconomic variables.

$$s_t = \beta_1 + \sum_{i=1}^{k} a_i f_{t-j} + \sum_{t=1}^{m} b_j s_{t-j} + \varepsilon_t \dots\dots\dots (2)$$

$$f_t = \beta_1 + \sum_{i=1}^{k} a_i s_{t-j} + \sum_{t=1}^{m} b_j f_{t-j} + \varepsilon_t \dots\dots\dots (3)$$

Where s_t = Stock Market Return,β_1 = Constant = number of lags, $a_i b_j$ = the coefficients,f_{t-j} = macroeconomic variable at lag j, ε_t = error terms

4. Results and Analysis

4.1 Descriptive statistics on Macroeconomic Variables

The descriptive statistics such as mean, minimum, maximum, standard deviation, kurtosis, skewness and the Jarque –Bera test gives a vivid picture on the movement of India's macroeconomic variables including stock market returns over the period. The probability values associated with the jarque bera test of normality examines the distribution of the data.

Table 2 Summary of Macroeconomic Variables

	SMR	LIF	LIR	LMS	LER	LIP	WSMR	LCP	LOP
Mean	8.778	4.113	1.991	3.404	3.731	4.509	6.912	5.026	4.862
Median	8.446	4.094	1.988	3.395	3.793	4.425	6.985	4.893	4.636
Maximum	10.264	4.968	3.564	5.185	4.155	5.269	7.467	5.798	6.152
Minimum	7.119	3.215	-0.315	1.548	2.993	3.729	6.184	4.495	3.608
Std. Dev.	0.797	0.462	0.476	1.074	0.228	0.462	0.348	0.386	0.740
Skewness	0.278	0.063	0.084	0.003	-0.736	0.036	-0.539	0.474	0.221
Kurtosis	1.662	2.169	6.135	1.797	3.340	1.679	2.303	1.734	1.539
J-B	24.942	8.392	117.016	17.191	27.134	20.799	19.576	29.697	27.680
Prob.	0.000	0.015	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The mean and standard deviation of SENSEX (Sensitive Index) are 8.77 and 0.797 respectively. The world stock market returns represented by ASWI (All Country World index) shows the average value of 6.912 with the deviation of 0.386.A distribution is said to be normal if the value of the skewness and kurtosis are 0 and 3 respectively. The Jarque-Bera results indicate that the null hypothesis of normally distributed is strongly rejected at one percent significance level. It is necessary to examine the existence of unit root in the data, therefore, Augmented Dickey-Fuller test, a test for stationary, clears out if the data are suffering from the problem of the unit root.

4.2 Unit Root Test on Macroeconomic Variables

Augmented Dickey-Fuller test is applied on India's stock market returns and macroeconomic variables to examine if there is a unit root in the time series of the variables. The results of the Augmented Dickey-Fuller test applied to each macroeconomic variables of India including stock market returns is presented in Table 3.

TABLE 3

ADF UNIT ROOT TEST RESULTS

Variables	I(level)	I&T(level)	I(Ist Difference)	I&T(Ist Difference)
Log SMR	-1.171772	-2.412320	-15.03726***	-15.01270***
Log IF	0.276037	-1.475437	-3.474995***	-3.483947**
Log IR	-4.503227***	-4.611478***	-16.51356***	-16.51556***
LogMS	-1.223639	-1.282659	-5.590836***	-5.717818***
LogER	-2.676071	-3.416161*	-13.84319***	-13.89447***
LogIP	-0.770647	-1.918848	-3.461041***	-3.493462***
LogWSMR	-1.415857	-1.965773	-15.20045***	-15.17863***
LogCP	-0.931190	-1.729433	-10.62587***	-10.60465***
Log OP	-1.122370	-3.033527	-13.16700***	-13.14265***

I stands for Intercept, I&T stands for Intercept and Trend

Table 3 indicates the results of the augmented Dickey-Fuller test applied to India's macroeconomic variables and stock market returns. Based on the augmented Dickey-Fuller test results, it is observed that all the macroeconomic variables are non-stationary at level excluding interest rate and exchange rate. All the series become stationary in first difference at 1% level of significance. Therefore, the null hypothesis of time series of non-stationary are highly accepted at level but rejected at first difference. The Asterisk symbol (***) shows the rejection of the null hypothesis of non-stationary at the 1% level of significance, the symbol (**) indicates rejection of null hypothesis at 5% percent level of significance. The computed ADF test-statistic at first difference data is smaller than the critical values "tau" statistics or critical values, the Null hypothesis of non- stationary is rejected. It is concluded from the table 3 that all the variables are stationary after first differencing and the macroeconomic variables are treated as integrated of order one I (1).

4.3 Selection of Optimal Lag Lengths

Lag order selection is selected based on the selection criteria such as the sequential modified likelihood Ratio(Müller & Elliott) test statistic, the Final prediction error criteria(FPE), the Akaike Information Criterion(AIC), the Schwarz Information Criterion (SIC) and the Hannan- Quinn

Information(HQ)

Table 4 Results of Lag Order Selection

LAG	LOG-L	LR	FPE	AIC	SIC	HQ
0	1110.13	NA	2.85E-15	-7.95	-7.83	-7.90
1	4972.36	7445.59	3.96E-27	-35.22	-34.07*	-34.77*
2	5096.64	231.51	2.91E-27	-35.56	-33.32	-34.66
3	5176.88	144.26	2.93E-27	-35.55	-32.26	-34.23
4	5285.31	187.88	2.43e-27*	-35.75*	-31.40	-34.00
5	5339.68	90.69	2.98E-27	-35.56	-30.14	-33.39
6	5411.59	115.26	3.25E-27	-35.49	-29.02	-32.90
7	5497.59	132.25*	3.22E-27	-35.53	-27.99	-32.51
8	5565.35	99.79	3.68E-27	-35.43	-26.84	-31.99

* indicates lag order selected by the criterion

Table 4 highlights the different lag length suggested by criteria applied to India's macroeconomic variables including stock market returns under Vector Auto Regression environment on data. The Schwarz Information Criterion test and Hannan –Quininn information criterion suggests lag 2, while Final Prediction Error, Akaike Information Criteria, suggest four lag lengths. The sequential modified LR test statistic recommends a lag length of 7. The popular method of Akaike information criteria lag length is selected for application of Johansen- Juselius cointegration, vector error correction model estimation, and Granger causality test.

4.4 Application of Johansen- Juselius Test

The precondition for co-integration is that all the variables should be considered in the same order of integration. The Johansen-Juselius test applied on India's stock market returns and the selected macroeconomic variables and the results are given in the following table 5

.

Table 5 Results of Johansen Juselius Co-integration test

H0	Eigen value	Trace statistic	Critical value	P- value
r = 0 *	0.284	304.598	197.371	0.000
r *	0.201	211.062	159.530	0.000
r *	0.149	148.178	125.615	0.001
r *	0.120	102.971	95.754	0.015
r	0.082	67.073	69.819	0.081
r	0.069	43.171	47.856	0.129
r	0.041	23.203	29.797	0.236
r	0.033	11.433	15.495	0.186
r	0.008	2.177	3.841	0.140

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

H0	Eigen Value	Max-Eigen Statistic	0.05 Critical Value	P-Value
r = 0 *	0.284	93.536	58.434	0.000
r *	0.201	62.884	52.363	0.003
r	0.149	45.207	46.231	0.064
r	0.120	35.897	40.078	0.137
r	0.082	23.902	33.877	0.463
r	0.069	19.968	27.584	0.343
r	0.041	11.770	21.132	0.571
r	0.033	9.256	14.265	0.266
r	0.008	2.177	3.841	0.140

Max-eigenvalue test indicates 2 cointegrating equation at the 0.05 level

* denotes rejection of the hypothesis at the 0.05% level

Table 5 produces the results of Johansen test which has been applied to find out the cointegrating vector among the macroeconomic variables. The trace statistics indicate that there are four co-integrating vectors at 5 percent significance level. The test results from the trace statistics indicate that calculated test value 304.598 is higher than the critical value of 197.3709 in the first equation and the second test value 211.062 is higher than the critical value of 159.530 and the third cointegrating vector shows that the calculated value of 148.178 is higher than the critical value of 125.615. It indicates that the null hypothesis of no cointegration between the variables is rejected at 5% level of significance.

The maximum Eigen value suggests that there are two co-integrating vectors at the 5% level of significance. The calculated value at none is 93.536 and its critical value is 58.43354 and the second test value 62.884 and the critical value 52.36261. It shows that the calculated values are higher than the critical values. Therefore, the null hypothesis of no co-integration is highly rejected at 5 % level of significance. It is concluded from both the test that stock exchange index and macroeconomic variables have a long-run relationship and their random walk moves together in the long run. The cointegrating vector shows that there is a possibility of either a bidirectional or unidirectional causal relationship among the macroeconomic variables. However, the Johansen Cointegration test fails to show the direction of the causality between the variables, therefore, pairwise Granger causality has been applied to find out the direction of causality between stock market returns and macroeconomic variables.

4.5 Pairwise Granger Causality Test

Pairwise Granger causality test has been applied in stock market returns and macroeconomic variables. The results of the Granger causality are presented in the following Table 7.

Table 7 Results of the Pairwise Granger Causality Test – Lags

Null Hypothesis	F- Value	Prob.	Decision
Inflation does not granger cause stock market returns	1.96598	0.0999	Accepted
Stock market returns does not granger cause inflation	1.85286	0.1190	Accepted
Interest rate does not granger cause stock market returns	2.95495	0.0205	Rejected
Stock market returns does not granger cause interest rate	0.09196	0.9849	Accepted
Money Supply does not granger cause stock market returns	1.55324	0.1871	Accepted
Stock market returns does not granger cause money supply	2.78437	0.0271	Rejected
Exchange rate does not granger cause stock market returns	3.79158	0.0051	Rejected
Stock market returns does not granger cause exchange rate	2.73995	0.0291	Rejected
Production index does not granger cause stock market returns	1.72606	0.1444	Accepted
Stock market returns does not granger cause production index	3.06217	0.0172	Rejected
World stock market Returns does not granger cause stock	11.7850	8.E-09	Accepted
Stock market returns does not granger cause World stock	1.91792	0.1077	Accepted
Commodity price does not granger cause stock market returns	6.75911	3.E-05	Accepted
Stock market returns does not granger cause commodity prices	3.26098	0.0124	Rejected
Oil prices does not granger cause stock market returns	4.97950	0.0007	Rejected
Stock market returns does not granger cause oil prices	2.59519	0.0368	Rejected

It is observed from the Table 7 that the pairwise Granger causality between stock returns and different macroeconomic variables reject the null hypothesis of stock returns does not Granger cause the macroeconomic variables and vice versa. It is found from the table that no significant causality exists between the pairs of stock market returns and inflation, and stock market returns and world stock market returns. A unidirectional causal relationship exists between the pairs of stock market returns and interest rate, stock market returns, and money supply, stock market returns and production index, stock market returns and commodity prices. Bi-directional causality exists between the pairs of stock market returns and exchange rate and stock market return and oil price index. The Table 7 indicates that there exists that unidirectional and bi-directional causal relationship between India's stock market returns with the macroeconomic variables.

5. Conclusion

The empirical results from the cointegration test illustrates the existence of long-run equilibrium relationship between stock market returns and macroeconomic variables. The results imply that stock market returns are fundamentally linked with the macroeconomic variables and vice versa. The results of the Granger causality test indicate that unidirectional causal relationship exists between the pairs of stock market returns and interest rate, stock market returns, and money supply, stock market returns and production index, stock market returns and commodity prices. Even though, bidirectional causality exists between the pairs of stock market returns and exchange rate and stock market return and oil price index, in general stock market index is not a leading indicator for macroeconomic variables.

This research sheds lights to the international investors to use as a guide to understand the systematic risk emanating from macroeconomic variables in emerging markets like India. Moreover, international investors and portfolio managers can design their portfolio of investment with the knowledge of the nexus between macroeconomic variables and stock market returns in the post economic reforms period. Moreover, government regulatory body can change the macroeconomic policy that helps to bring more portfolio inflows into the domestic capital market and make the domestic capital markets integrated with the global financial market.

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