

DYNAMICS OF INDIAN STOCK MARKET AND MONETARY POLICY

Dr. Nishi Sharma

Associate Professor,
University Institute of Applied Management Science,
Panjab University, Chandigarh
Postal Address: UIAMS, Sector 25, Panjab University Campus, Chandigarh

Abstract: The fundamental analysis indicates a deep linkage between stock market and macroeconomic conditions of a country. In this context, the present paper attempts to explore the possible relationship between Indian stock market and monetary policy. BSE Sensex has been taken as a proxy of stock market whereas interest rate, inflation and money supply have been used as an envoy of monetary policy. The short-term relationship has been explored through Block Exogeneity Wald test and the long-term relationship has been investigated through Johansen Cointegration test. All the variables found to have unit root at original level but became stationary when differenced at first order. The short-term unidirectional causality running from monetary policy to stock market has been observed in terms of aggregate influence of all variables over stock market. Interest rate and inflation both Granger cause stock market but no reverse reaction has been perceived in short run. Vector Error Correction model estimation indicates that if the rate of inflation rises by 1%, it will bring down the stock market by 1.36%. Every increase in rate of interest uplifts the stock prices by around 0.20%. But the boom in stock market doesn't affect interest rate in level however in long run after a lag of 2 and 7 months, it augments interest rate. Unidirectional causality from inflation to money supply and also to interest rate has been discerned. The results of the study are expected to be useful for policy makers and investors.

Key Words: Causality, Cointegration, Inflation, Interest, Sensex, Monetary Policy, Money Supply, Stock Market, Unit root, Vector Error Correction

INTRODUCTION

Monetary policy aims at ensuring the price stability with optimal production and full employment. To comply with this mandate, monetary policy influences the asset allocation decision of individuals through various instruments. The instruments used by Central banks like interest rate, money supply have powerful impact on different markets and stock market is not an exception to this. Since stock prices are highly proactive to vivid shocks, they respond very quickly. Therefore the investors should be careful to the changes in monetary policy and devise strategies accordingly. The stock market transmits its volatility to the entire economy and causes macroeconomic volatility. The deep linkage of monetary policy and stock market creates a vicious circle that calls for policy actions. While drafting policy, the

regulators should always be cautious about the possible effect of this interrelation over economy. The direct and strong implications of changes in monetary indicators on capital market and vice-versa can be understood as follows:

A) Impact of Monetary Policy on Stock Market

The fundamental analysts suggest that macro-economic factors influence the stock market to a very large extent. A macroeconomic factor can include anything that can influence the large-scale market and monetary policy is one of the most crucial aspects in this context. The primary objective of monetary policy is to ensure the price stability with optimal production and full employment. To comply with this mandate, monetary policy influences the asset allocation decision of individuals through

various instruments. The instruments used by Central banks like interest rate, money supply have powerful impact on different markets. Depending upon the requirements, monetary policy framed by the central bank can be an expansionary policy as well as a restrictive one. Expansionary monetary policy goes for reduction in interest rate and increased money supply so that borrowers can find cheaper debts. This leads to more production but at the same time, it also escalates price level leading to inflation in the economy. A high-level inflation reduces the purchasing power of money leading to less possibility of savings and investments into business. The damper effect of proliferated inflation on capital market is not an unusual phenomenon. The restrictive monetary policy restricts the investment into business because it calls for increased interest rate, sales of government securities and eventually a reduced money supply in the market. The reduced inflows to producers turn down the level of output and employment.

In other words, every change in monetary policy has strong implications to the entire market. However it is important to note that the reaction of all markets is not at the same pace and intensity. Some markets get highly affected even by a slightest change in monetary policy whereas other may have just an ostentatious influence. Stock market is one of such markets that rapidly recoil to economic conditions. The previous studies examining the impact of monetary policy over stock market gave hybrid results in context of the direction of change. One school of thought asserts that the eccentric monetary environment is commonly perceived as a desirable shock to the market with low interest rates, more output, increased economic activities and greater profit to business. Liberal monetary policy creates excess liquidity in the market that facilitates capital market to touch skyrocketing records. The expansionary monetary policy results into availability of investable funds resulting into bullish market trend. The increased money supply engenders higher cash flows and broadens the economic activities. This results into more demand of product, greater profitability and consequent rise in stock prices. However, another school of thought ostracizes the logic and argues for a negative impact of wide-ranging policy over stock market. Some researchers realized that the direction of change in stock market is a country specific phenomenon. A negative influence of changes in money supply was observed for the stock market of In-

donesia and Philippines. However a positive effect was discerned in Malaysia, Singapore and Thailand (Alam & Uddin 2009; Wongbangpo & Sharma 2002). Further some studies pronounced that the response of stock market to monetary policy is time dependent. In Greece, inflation, interest rates and stock returns found to be negatively related till 1995 but afterwards the relationship became insignificant (Spyrou 2001).

B) Impact of Stock Market on Monetary Policy

The movement in stock market has profound impact on the economy. Recent financial crisis causing the series of collapse in different economies is a live example to it. A crash of capital market can collapse the economy. Though the daily stock movements have very less impact but sustained reduction may cause economic problems leading to downturn of economy. The plummeting share prices affect the production and causes supply-push inflation. Similarly, in case of stock bubbles, the economy experiences financial instability and price instability. The instability of price level invites the entanglement of monetary instruments to control the situation. The oscillations in stock market also trigger the swings in monetary policy.

In the context of any possible interrelation between stock market and monetary policy, there are some questions that needed to be addressed. The first question is whether there is unilateral causal effect of monetary policy instruments over stock market or Indian economy experiences bilateral causality running in both sides monetary policy to stock market and also from stock market to monetary policy. The second question is to know the extent to which monetary policy can influence the stock market and at the same time how much it can get influenced from stock bubbles. The last question is whether this nexus express immediately or occurs at some specific lag interval. The present paper attempts to answer these questions through exploring short-term as well as long-term relationship between the monetary policy and Indian stock market.

REVIEW OF RELATED LITERATURE

There is an availability of vast literature exploring the possible relationship between stock market performance and different macroeconomic factors. But the studies couldn't have any unanimous conclusion over

the strength and direction of this relationship. The present section briefly outlines the results of some of the studies undertaken in this context.

Maysami et al. (2004) found that Singapore stock market and the SES All-S Equities Property Index formed significant relationships with all macroeconomic variables. The study reported that inflation has positive influence on stock market indices in Singapore. Regarding interest rate, Ologunde et al (2006) reported that the prevailing interest rate exerts positive influence on stock market capitalization in Nigeria. Similarly Osei (2006) reported interest rate as a key determinant of the share price movements in Ghana. The study analysed the impact of foreign direct investment, Treasury bill rate (as a measure of interest rate), consumer price index (as a measure of inflation) and exchange rate over stock market in Ghana. No reflection of macroeconomic effect was traced on stock price indices of Bangladesh stock market (Ahmed and Imam 2007). An analogous study of US market revealed that the positive relation of stock price index with industrial production, inflation, money supply, short term interest rate and exchange rate. However the results of Johansen's co-integration technique and vector error correction model stock index reported negative relation between stock index and long term interest rate (Ratanapakorn and Sharma 2007). Chancharat et al (2007) investigated that money supply i.e. the liquidity growth has no impact on stock returns.

The study by Kandir (2008) and Mohammad et al. (2009) investigated the role of macroeconomic factors, namely inflation, industrial production index, interest rate and foreign exchange rate in explaining the stock returns. The results indicate significant impact of only foreign exchange rate and interest rate in explaining the stock returns, while other variables were reported not to be more significant. Another study of Ghana market by Kyereboah and Agyire (2008) revealed negative relation of rate of inflation with stock market performance. The study also found lending rate from deposit money banks as major impediment to business growth in Ghana. In the same line of thought Kofi and Kwabena (2013) delineated negative impact of exchange rate and inflation over stock market whilst positive for interest rate and oil prices.

In Indian context, no significant relation between stock returns and inflation was reported during post-reform period (Kumari 2011). The study concluded that

stock returns do not provide a hedge against inflation. However application of ordinary least square and semi-parametric generalized additive model by Mishra and Singh (2011) reported that the stock market in India is driven by macroeconomic fundamentals. By using, Basu and Chawla (2012) tested the validity of the APT model through considering 50 stocks which are part of S&P CNX Nifty from January 2003 - February 2008. The 91 days Treasury bill rate 10-year government security rate, INR USD exchange rate, wholesale price index and gold prices have been considered as macroeconomic variables and the study conclude that over the chosen sample period APT is a good fit in India. The analysis of macroeconomic variable by Patel (2012) revealed that interest rate, inflation, exchange rate, index of industrial production, money supply, gold price, silver price and oil prices are the key determinants of the performance of Indian stock market.

Islam and Habib (2016) analysed inflation, industrial production, exchange rate, interest rate, money supply, and oil prices as macroeconomic variables possibly affecting the Indian stock market. The study reported that only exchange rate has a significant negative impact on Indian stock returns. The other macroeconomic variables are not significantly affecting stock returns. Since the interrelationship between stock market and monetary policy hasn't specified any concrete evidence with reference to India, the present study attempts to understand and highlight the same.

RESEARCH METHODOLOGY

(A) Data

The present paper aims at investigating the short-term and long-term relationship between monetary policy and Indian stock market. The brief explanation of different variables analysed to examine the above relationship is as follows:

(I) Monetary Policy

The monetary policy of a country reflects the process by which the monetary authority i.e. central bank of the country (Reserve Bank of India) controls or boosts the economic activity. In India, Reserve Bank of India uses different instruments (like open market operations, cash reserve ratio, statutory liquidity ratio, bank rate

policy, credit ceiling, moral suasion, repo rate) to curb inflation and attaining higher rate of economic growth. In order to trace the monetary operations, the present paper has taken three variables into account namely interest rate (yield on government security), money supply and inflation.

(i) Interest Rate:

Yield on government securities are treated as a very precise measure to gauge the prevalent interest rate. The present study also considered yield on 10-year government security as a measure of interest rate to trace the trajectory of the nation.

(ii) Inflation

Following the existing literature consumer price index has been taken as a proxy to inflation.

(iii) Money Supply:

Money supply is the total stock of money in circulation among the public at a particular point of time. Reserve Bank of India (RBI), apex bank of India, classified all monetary measures into different categories viz., M_0 , M_1 , M_2 , M_3 and M_4 .

- M_0 is the monetary base of economy which includes currency in circulation, bankers' deposits with RBI and also other deposits with RBI.
- M_1 is the most liquid money popularly known as narrow money. It comprises of currency with public, demand deposits with banks and along-with other deposits with RBI.
- M_2 is the sum of M_1 and total saving deposits with post office saving.
- M_3 , popularly known as broad money, can be obtained by adding time deposits with banks to M_1 .
- M_4 includes M_3 and all deposits with post office savings banks.

Among all these measures, M_3 and is widely accepted as a measure of monitoring the monetary stock circulating in the country. In present paper also, it has been taken as a proxy to money supply in the country.

(II) Indian stock market

India has two national level exchanges namely Bombay Stock exchange (BSE) and National Stock Exchange (NSE). BSE, established in 1875, is Asia's first stock ex-

change and world's 10th largest stock exchange with an overall market capitalization of more than \$2.3 trillion as on April 2018. It has 4047 companies with listed equity capital available for trade out of which about 500 firms constitute more than 90% of its market capitalization and the rest of the crowd consists of highly illiquid shares. The prominent index of BSE i.e. S&P BSE Sensex is a free-float market-weighted stock market index of 30 having the largest and most actively traded stocks. Sensex can safely be assumed as a barometer of Indian capital market because it comprises large, well-established and financially sound companies across key sectors. Since the composition of Sensex reflects current market conditions, the same has been analysed to study the movement of stock market in India.

Monthly data has been collected for all variables for a period of 22 years from April 1996 to September 2018. All the variables have been taken in logarithm term for the two reasons: (a) to stabilize the variance of the underlying series and (b) to bring selected variables to the same level.

(B) DATA ANALYSIS

(I) Normality of data

At the outset, the distribution pattern has been examined through Jarque Bera test. The test evaluates the null hypothesis that data is normally distributed as against the alternate hypothesis that data is not normally distributed. In case of normal distribution of the data the test statistics asymptotically follows Chi-square distribution. It implies zero value for skewness and absence of excess kurtosis.

(II) Unit Root

Phillips-Perron (PP) unit root has been applied to examine the unit root in the selected variables. The test attempts to validate one of the following hypotheses:

- **Null Hypothesis:** There is a unit root in the univariate time series i.e. data is not stationary.
- **Alternate Hypothesis:** There is no unit root in the univariate time series i.e. data is stationary.

Null hypothesis will be accepted if the calculated value of statistics is found to be lesser than the critical value. At the flip side if the value of statistics is greater than the critical value, the null hypothesis is rejected and

the data is assumed to be stationary. In case of unit root, the data is needed to be transformed by differencing at different orders.

(III) Short-term Linkages (Causality)

The Short-term relationship can be examined primarily through two tests viz., a) Granger causality test which is a bivariate test and b) Block Exogeneity Wald test (a test popular to check causality among multivariate data series). As compared to bivariate model, the Wald test has an added advantage in the form of its ability to check the joint significance of lagged endogenous variables on the exogenous variable. Therefore, in the present study, Block Exogeneity Wald test has been applied to examine the causality among variables. The test investigates the authenticity of following null hypothesis:

Null Hypothesis: The lagged values of one variable doesn't Granger cause other variable i.e. it doesn't explain the variation in the other variable.

(IV) Long-term linkage (Co-integration among variables)

All the selected series found to be integrated of order one therefore Johansen Co-integration test has been applied to check the possibility of long-term relationship among the variable. The test examines the null hypothesis on the basis of two statistics viz., trace test statistics and maximum Eigen value statistics. The null hypotheses to be evaluated are as follows:

- **Null Hypothesis for Trace test:** Number of distinct co-integrating vector(s) is less than or equal to number of co-integration relations.
- **Null Hypothesis for Maximum Eigen value:** There is exactly 'r' number of co-integrating relations against the alternative of $r + 1$ co-integrating relations.

The cointegration equations are very sensitive to lag length. There may be an absence of contemporaneous

relationship among variables however the same may exist considering a specific time interval. Therefore, the determination of appropriate lag length is very much essential. Sequential modified LR test, Final Prediction Error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn (HQ) information criterion have been used to decide the optimal size of lag length.

(V) Vector Error correction

Vector error correction model has been applied to confirm / reject the long-term or short-run relationship between stock market and monetary policy. The VECM methodology allows the long-run behaviour of the endogenous variables to converge to their long-run equilibrium while allowing a range of short-run deviations.

Null Hypothesis: There is a long run and short run relationship between identified macroeconomic variables and Sensex.

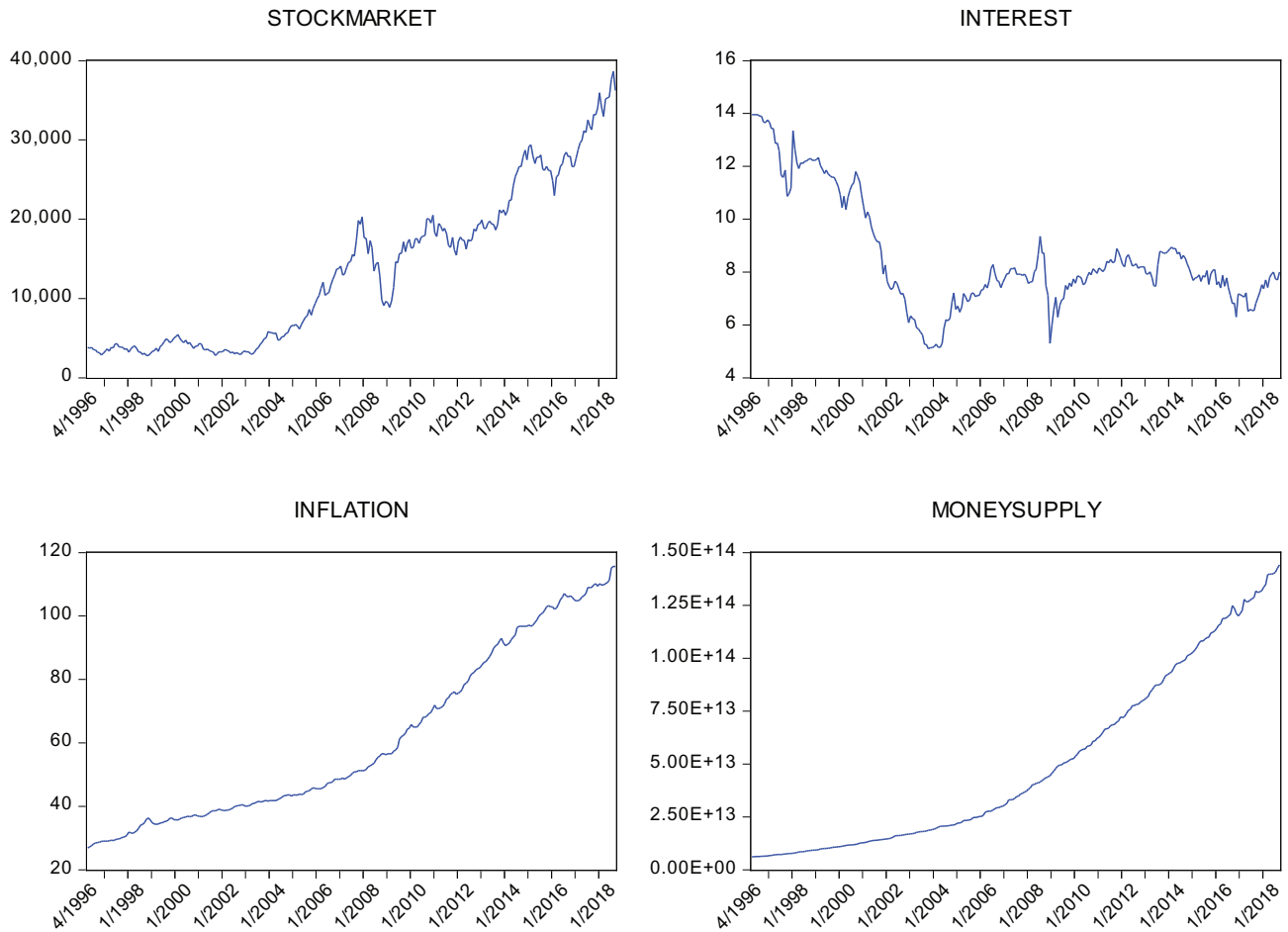
Alternate Hypothesis: There is neither a long run nor short run relationship between identified macroeconomic variables and Sensex.

The test assists in knowing the direction as well as the extent to which one variable may get influenced from the other variable.

FINDING AND ANALYSIS

During the study period, the stock market revealed a rising pattern with highest volatility in terms of standard deviation. Interest rate also found to be volatile. The same has observed many swings during the study period. The inflation in Indian economy has shown a persistent rise with least standard deviation. In response to the growing demand for liquidity the money supply by RBI has also registered an upward slope. Figure 1 depicts the pattern of selected variables throughout the sample period.

Figure 1: Trend of Logarithmic values of selected variables (1996-2018)



Source: Author's Calculation

Table 1 provides the descriptive statistics of the selected variables and the results of Jarque Berra & Phillips Perron Unit root test. The results of Jarque Berra test indicate that none of the selected variable follows normal distribution. Stock market and money supply

found to be negatively skewed whereas interest rate and inflation reported to be positively skewed. The unit root of variables has been checked through Phillips Perron Unit root test. The symbol * signifies the rejection of null hypothesis at 5% level of significance.

Table 1: Descriptive Statistics and Results of Unit Root test

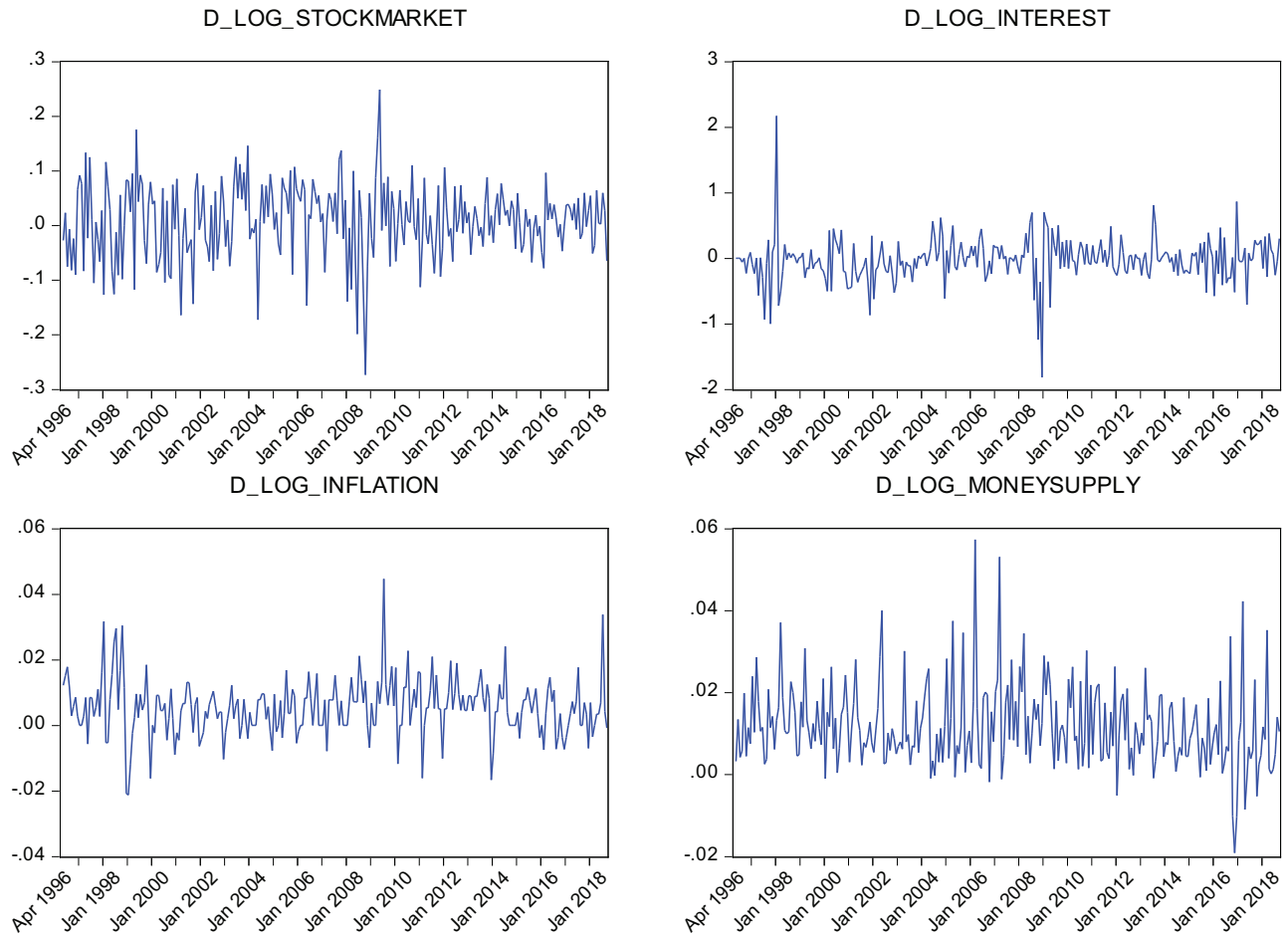
Variables	Standard Deviation	Jarque Berra Test	Unit Root Test	
			Original Level	1 st difference
Stock market	0.8383	27.1965*	-0.3702	-15.6830*
Interest rate	0.2336	9.7388*	-2.3110	-17.0237*
Inflation	0.4336	21.7112*	-0.1236	-11.7144*
Money supply	0.9687	19.9938*	-2.3538	-15.7763*

Source: Author's calculations

All the variables found to have unit root i.e. are non-stationary at original level. Therefore, all variables

have been differenced. All series turned to be stationary when the variables are differenced at first order (Figure 2).

Figure 2: Differenced Variables



Source: Author's calculations

To examine the possible short-term linkage among the variables, multivariate Block Exogeneity Wald test has been applied (table 4). The result has been marked * if probability is more than 5% and marked as ** if the

same is more than 10%. Since the Wald statistics is valid only for stationary data series, the test has been administered on the first difference of all variables.

Table 2: Results of Block Exogeneity Wald test

Independent variables	Dependent variable			
	Stock market	Interest rate	Inflation	Money supply
Stock market	NA	2.9925	0.5435	1.1366
Interest rate	8.5194**	NA	0.8594	2.9127
Inflation	6.0966**	4.7448*	NA	6.6232**
Money supply	0.0481	2.1265	0.6888	NA
All	13.3430**	9.4520	2.3652	9.0628

Source: Author's calculations

The results concluded short-term linkage of stock market with interest rate and inflation. But only the unilateral causality running towards stock market has

been observed. We may deduce that whenever there is a change in interest rate, stock prices also fluctuate. Similarly variation in inflationary pressure brings vola-

tility in stock prices. The results are in tune of previous research like Naik and Padhi (2012). It has also been observed that inflation causes change not only in stock market but also all other variables i.e. interest rate and money supply. The long-term relationship has been explored through Johansen co-integration analysis. At the

outset, one must decide the optimal lag length because such relationships are highly sensitive to selected time interval. The lag length has been decided through five models viz., sequential modified LR test, FPE, AIC, SIC and HQ criterions (Table 3).

Table 3: Lag length selection

Lag	LR	FPE	AIC	SC	HQ
1	4712.218	5.50e-14	-19.17957	-18.90718*	-19.07009*
8	60.99646*	4.35e-14*	-19.41945*	-17.62166	-18.69688

Source: Author's calculations

SIC & HQ criterions suggest the use of one lag interval whereas LR test, AIC and FPE all advocate for 8 lags. In the present paper lag length 8 has been adopted for

exploring any possible linkage among the variables. The results of co-integration test have been reported in table 4.

Table 4: Results of Cointegration

Hypothesized No. of CE(s)	Trace Statistics	Max-Eigen Statistics
None *	82.29121	47.85613
At most 1 *	39.73731	29.79707
At most 2	12.91282	15.49471
At most 3	3.284102	3.841466

Source: Author's calculations

The p-values have been taken on the basis of MacKinnon-Haug-Michelis (1999). The result of unrestricted cointegration rank test reports the presence of long-term relationship among the variables. The results of trace as well as Maximum Eigen value test indicate that the hypothesis of having maximum one cointegrated equation can be rejected and we may conclude that

there are two or three cointegrated equations among the studied variables. In other words, out of four selected variables, at-least two are having long-term relationship. Since the variables are cointegrated, Vector error correction model has been applied to confirm/reject the relationship between stock market and monetary policy (Table 5). The results of the model are as follows:

Table 5: Results of VECM

Variable	Stock Market	Interest	Inflation	Money Supply
Error correction term	-0.0005	-0.0012*	0.0000	0.0007***
Stock Market (-1)	0.0090	0.0345	-0.0088	-0.0064
Stock Market (-2)	0.0233	0.1000**	0.0021	-0.0028
Stock Market (-3)	0.0560	-0.0254	0.0042	0.0002
Stock Market (-4)	0.0471	-0.0192	0.0007	0.0087
Stock Market (-5)	-0.0135	-0.0329	-0.0062	0.0033
Stock Market (-6)	0.0114	0.0613	0.0095	0.0141*
Stock Market (-7)	-0.0919	0.1450***	0.0005	-0.0090
Interest (-1)	0.1981*	-0.0002	0.0086	-0.0145
Interest (-2)	0.1328	0.0949	-0.0027	0.0111

Contd.

Interest (-3)	0.1795	-0.1818***	0.0161	0.0133
Interest (-4)	-0.0991	0.1835***	0.0071	-0.0408***
Interest (-5)	-0.2106*	-0.1358**	0.0029	-0.0032
Interest (-6)	0.0188	-0.0714	0.0035	-0.0042
Interest (-7)	-0.1891*	0.0850	-0.0159	-0.0251*
Inflation (-1)	-1.3597**	0.5461	0.3095***	-0.0588
Inflation (-2)	0.5877	0.0128	-0.1831***	-0.0618
Inflation (-3)	0.0894	-0.2159	0.0726	0.0002
Inflation (-4)	0.0740	-0.3064	-0.0822	-0.1691**
Inflation (-5)	0.2491	-0.1197	-0.1831***	0.1883**
Inflation (-6)	-0.6844	0.2521	0.2217***	-0.0284
Inflation (-7)	0.0906	0.7208**	-0.3025***	0.0471
Money Supply (-1)	-0.0584	0.1586	-0.0080	-0.0815
Money Supply (-2)	0.1549	-0.3568	0.0850	-0.1435**
Money Supply (-3)	0.0234	0.9180***	0.1352**	-0.2921***
Money Supply (-4)	0.3815	0.3011	0.0890	-0.1441**
Money Supply (-5)	-0.0399	0.0995	0.0545	-0.0551
Money Supply (-6)	-0.2932	0.6738**	0.1379***	0.1659**
Money Supply (-7)	0.3376	-0.1352	0.0852	-0.1223*
Constant	0.0084	-0.0290**	-0.0008	0.0200***

* 1% significance level, ** 5% significance level and *** 10% level of significance

Source: Author's calculations

The VECM methodology allows a range of short-run deviations to converge to the long-run equilibrium. The coefficient of the error correction term (ECT) determines the extent of such correction. Rate of interest has a significant negative ECT with 0.12% speed of convergence to the equilibrium. This suggests that 0.12% of any previous disequilibrium in the long run will be corrected in the short run. The negative sign represents the direction of change. The rise in the interest rate makes the debt costlier for the business and this eventually brings down the stock prices. In the same manner if interest rate reduces, it broadens investment demand until the marginal productivity of capital is equalized to the lower interest rate. The expansion of investment creates an accelerator-multiplier effect, causing aggregate demand to expand. The expanded aggregate demand also reflects in stock market. This expansion of demand for stock market shares puts pressure on prices. In the end, this process leads to increased stock market prices. Low absolute value of the coefficient of ECT for mon-

ey supply indicates a slow speed of adjustment towards equilibrium. The system corrects its previous period's level of disequilibrium by 0.07% per month. Remaining two ECT coefficients found to be insignificant.

Since the variables are in logarithms, the coefficient can be interpreted as long run elasticity. The results of VECM indicate that at 5% level of significance the rise in inflation by 1% will bring down the stock market by 1.36%. The increased level of inflation pulverizes the purchasing capacity of money resulting into lesser output and profitability for the organisation. The reduced level of profit trounces the stock prices and market index starts to fall down. At 4th and 5th lag interval Inflation affects money supply also. Stock market has no significant impact over other variables except a meagre positive impact over money supply (0.0007%) at 5% level of significance. At 1% significance level it was reported insignificant. Money supply positively affects the interest rate at 3rd Lag. 1% increment in money supply causes an increase in interest rate by 0.92% and also 0.13% rise

in inflation at 6th lag. Inflation affects the money supply at 5% level of significance. The estimated value of the error correction term of inflation shows that the system corrects its previous period's level of disequilibrium by 0.31%.

CONCLUSION

The present paper attempts to investigate the possible linkage between stock market and monetary policy in Indian context. Interest rate (yield on government security), money supply and inflation have been taken as a proxy to monetary policy. BSE S&P Sensex the leading indices of India has been analysed to study the movements of Indian stock market. The study covered a period of 22 years from 1996 to 2018. None of the selected variable follows normal distribution. Further the all variables are non stationary at original level but turned to be stationary at first difference. All variables found to have long-term linkage and the presence of two or more cointegrated equation has been suspected.

The Block Exogeneity Wald test reported the unidirectional causality running from monetary policy to stock market but reverse causality hasn't been diagnosed. Therefore we may conclude that change in monetary policy has strong implications to the Indian stock market. VECM deduced that 1% rise in inflation may bring down the stock market by 1.36% because increased level of inflation pulverizes the buying capacity of consumers and results into declined profitability and fall of stock prices. Interest rate also has significant negative influence over capital market. The rise in the interest rate makes the debt costlier for the business and this eventually brings down the stock prices. Therefore the investors must devise their investment strategies after proper analysis of prevalent inflation and interest rate in the country. Further the policy makers should also take policy decisions after taking due care of the above cited results.

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