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Relationship between selected macroeconomic variables and S&P BSE index: A statistical analysis

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Abstract

The relationship between stock market and various macroeconomic variables has always been discordant. Studies indicate that stock market is influenced by changes in various macroeconomic variables. Some of which affect the stock market positively while others have an adverse impact. This article examines the impact of five macroeconomic variables i.e. Exchange Rate, Inflation, Interest Rate, Money Supply and Consumer Price Index on BSE S & P index of India. It covers a period of 60 months from October, 2014 to September, 2019. Statistical Package for Social Sciences (SPSS) is used to test the Descriptive Statistics, Correlation Matrix and Regression analysis (Goodness of Fit, Variance Inflation Factor, Coefficient of Determination and Durbin – Watson d-Statistic). Analysis results indicate that S & P BSE value has a positive correlation with all independent variables except for Interest Rate; whereas Interest Rate is seen to have a negative correlation with all variables. Money Supply and Consumer Price Index have a positive relation with Exchange Rate and negative correlation with Interest Rate. VIF of all the independent variables, except for Money Supply and Consumer Price Index are within the acceptable limit and influence of independent variables on the S & P BSE value appears to be very strong.

Keywords: Skewness, kurtosis, regression, correlation, multicollinearity and determination

1. Introduction

The Indian stock market had seen various up-down since 1991, after the government implemented the LPG, i.e., Liberalization, Privatization and Globalization. According to the Economic Survey 2018-19, India's growth rate is forecasted to be between 7.0 -7.5 percent for the FY19 as compared to 6.80 percent for FY18 and 7.20 in FY17. The government has planned on achieving a fiscal target of 3.40 percent of GDP and 44.50 percent debt to GDP ratio with the 3.40 percent inflation for the FY18. Over the years, India has attracted many investments by different economies and a large consumption base. With this growth rate, India also became the fastest growing economy in FY18.

Stock market is a place where investors, whether Indians or foreigners can invest or take the funds for capital appreciation. Their decision to invest or withdraw the funds depends upon the numerous factors. For this cause Indian stock market plays a vital role in the growth of Indian economy and every movement on it puts an impact on the performance of the economy.

The stock prices reflect all information about the stocks and also the expectations of the future performances of corporate sector. As a result, if stock prices reflect these assumptions in real, then it should be used as a major indicator for the economic activities (Ray S, 2012)^[1]. Hence the dynamic relationship between stock prices and macroeconomic variables contains academic interest as well as policy implications.

Macroeconomics is the analysis of the nation's economy as a whole. It scrutinizes the cyclical movements and trends exists in economy such as Gross Domestic Production, Unemployment, Inflation, Money Supply, Budget Deficits, International Trade and Exchange Rate, etc. The various schools of thoughts like Classical theory by Adam Smith, David Ricardo, Thomas Robert Malthus and John Stuart Mill, Keynes theory by John Maynard Keynes, New Classical theory, New Keynesian theory and New Growth theory developed their own views about the role of macroeconomic variables in economy by considering different assumptions. But, they accepted that macroeconomic variables are the most remarkable variables and Government's can't make their policies, rules and regulations without contemplating them.

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So, macroeconomic variables are the key indicators to show the prevailing trends in the economy as well as stock market.

1.1. Bombay stock exchange (BSE): A bird's eye view

Established in 1875, the BSE (formerly known as Bombay Stock Exchange Ltd.) is Asia's oldest stock exchange was founded by an influential businessman Premchand Roychand, located at Dalal Street, Mumbai. The BSE is the world's 10th largest stock exchange with an overall market capitalization of more than \$2.2 trillion. Today, BSE is the world's number one exchange in the world in terms of the number of listed companies (over 4900). It is the world's 5th most active in terms of number of transaction handle through its electronic trading system. The BSE Index, SENSEX, is India's first and most popular stock market benchmark index. Exchange traded funds (ETF) on SENSEX, are listed on BSE and in Hong Kong. SENSEX, first compiled in 1986, was calculated on a "Market Capitalization-Weighted" methodology of 30 component stocks representing large, well-established and financially sound companies across key sectors. SENSEX is being calculated on a free-float market capitalization methodology. The free-float market capitalization-weighted methodology is a widely followed index construction methodology on which majority of global equity indices are based; all major index providers like MSCI, FTSE, STOXX, S&P and Dow Jones uses the free float methodology.

2. Review of Literature

The various researchers did a remarkable work to evaluate the association between changes in macroeconomic variables and stock market returns in India by using different tools and techniques. Hemavathy P & Gurusamy S (2016)^[2], Poornima DS & Ganeshwari M (2016)^[3] studied the casual relationship of NSE and exchange rates. By using Granger causality test, exchange rates have a unidirectional casual relationship with stock price in the short run and the author referred as a vibrant connection. But Megaravalli AV & Sampagnaro G (2018)^[4] found that Indian stock market have a long term association with the inflation and bidirectional causality from Indian stock market to exchange rate and the stock market is somewhat dependent on the macroeconomic variables of the economy (Pilinkus D, 2010)^[5].

Box- Jenkins ARIMA technique was used by Gay Jr. RD (2016)^[6] to analyse both the positive and negative correlation between the stock market with exchange rate and oil price respectively. Benaković D & Posedel P (2010)^[7] analyses the strength of association of independent by Arbitrage Pricing Theory (APT). He analysed the market index and proved that, interest rates, oil prices and industrial production have a positive impact. Aanchal (2017)^[8] found that all the independent variables and market data were non-stationary in nature. Sometimes it was also found that both the independent and the dependent variable have no relation. Melicher RW (1974)^[9] examines link between various risk factors and data of these firms by CAPM model to ascertain the expected returns on any asset with the given sensitivity of the asset and the returns of the market. The sensitivity of any stock is found by dividing the covariance of the asset with the market return; by the variance on market returns. Ramanujam V & Leela L (2011)^[10] examines the effect of various macroeconomic variables, using the Wald test and the results were proved that these variables have a long term effect on the stock market.

Bhattacharya B and Mukherjee J (2002)^[11], Nath GC and Samantha GP (2002)^[12] found the causal relationship between

stock prices and macroeconomic factors in India by Toda and Yamamoto. It was found that industrial production affects significantly the stock prices. Similar results are also obtained by Chakravarty S (2005)^[13], but Johansen and Juselius's cointegration test pointed out, at least one cointegration vector and long-run relationships between BSE Sensex with index of industrial production and call money rate (Dasgupta R, 2012)^[14]. Positive relationship between industrial production and stock prices was examined by using Granger causality test and observed uni-directionality from industrial production to stock prices in India.

The results of Chohan PK *et al.* (2000)^[15] are supported by the similar findings of Sahu NC & Dhiman HD (2011)^[16]. They have tried to explore the causal relationship between stock market indicator and macroeconomic variables of India by using correlation, regression and Ganger causality techniques. Sarkar P (2005)^[17] examined the relation between growth and capital accumulation exists in case of India. Maken *et al.* (2012)^[18] found that, there is a positive relation between FII and Sensex, call rate and Sensex, whereas exchange rate and Sensex shows a negative relation by using Granger causality test. However, the studies of Kanakaraj A *et al.* (2008)^[19], Ray S (2012)^[1] and Naik PK & Padhi P (2012)^[20] and others have found significant relationship between macroeconomic variables and stock returns. They have tried empirically to explore upon and answer that if the recent stock market boom can be explained in the terms of macroeconomic fundamentals and have concluded by recommending a strong relationship between the two.

Johansen's approach of co-integration and Toda – Yamamoto Granger causality test was used by Ahmed S (2008)^[21] to investigate the relationship between stock prices and the macroeconomic variables using quarterly data whereas, Singh D (2010)^[22] attempted to explore the causal relation between the BSE Sensex and three key macroeconomic variables of Indian economy by using correlation, unit root stationarity tests and Granger causality test. Results showed that IIP was having bilateral causal relationship with BSE Sensex, while WPI was found to be related to stock market unidirectional.

Srivastava A (2010)^[23] demonstrated the effect of macroeconomic variables on the Indian stock market by using Johansen's cointegration analysis and Vector Error Correction mechanism. It was concluded that IIP, WPI and Interest Rate are the most effecting variables in the long run (Pal K and Mittal R, 2011 & Naka A, Mukherjee TK and Tuftte D, 2001)^[25] whereas, macroeconomic variables and BSE 500 were cointegrated with each other and bilateral causality exists during the World Financial Crisis (Hojatallah G and Ramanarayana CS, 2011)^[26].

Hosseini MA (2011)^[27] investigated the nature of the causal relationships between the Bombay Stock Exchange's stock prices and the key macroeconomic variables. The results of the study revealed both long-run and short-run linkages between the macroeconomic variables and stock market indices by applying Augmented Dickey Fuller (ADF) unit root test, Johansen-Juselius Multivariate Cointegration and Vector Error Correction Model techniques. The study also confirmed the evidence of causality among the variables (Patel S, 2012)^[28].

Ljung-Box Q test, Breusch-Godfrey LM test, Unit Root test and Granger Causality test was employed by Tripathy N (2011)^[29] to examined the weak form market efficiency and casual relationship between the selected macroeconomic variables and the Indian stock market. Pethe A and Karnik A (2000)^[30] have taken monthly data over the period of Apr

1992 to Dec 1997 to conduct a study on relationship between Indian stock market and macroeconomic factors using error correction model and co-integration. Their study showed that the condition of economy and the stock market prices don't show a long run relationship.

The review indicated that, the relationship between macroeconomic variables and stock market can be divided

into three groups. Some researchers found that there exist a significant relationship between macroeconomic variables and stock market. Some found that, there is no significant relationship between macroeconomic variables and stock market, while other found that some macroeconomic variables are significant and some are not (Barakat MR *et al.*, 2016 and Joshi P, 2015)^[32, 33].

Table 1: Summarizes the previous studied that reviewed relationship between macroeconomic variables with countries under investigation, methodologies and result found.

Authors	Country	Macroeconomic Variables	Periods	Models used	Result
Hondroyannis and Papapetrou (2001)	Greece	Real OP, IR, ER and the Performance of Foreign Stock Market	1984 - 1999	VAR Analysis, ADF, PP and KPSS Test, Zivot-Andrews Test & Generalized IRF	Stock returns do not lead changes in real economic activity while the macroeconomic activity and foreign stock market changes explain only partially stock market movements.
Abugri (2008)	Latin America	ER, IR, IIP and MS	1986 - 2001	VAR Model	The global factors are consistently significant in explaining returns in all the markets. The country variables are found to impact the markets at varying significance and magnitudes.
Goodhart <i>et al.</i> (2003)	Brazil and Korea	Equity Returns and ER	1995 - 1998	Theoretical Model of Financial Market	To find monetary policy effectiveness during a crisis can come about not only because of the endogeneity caused by a 'leaning against the wind' policy reaction.
Robert (2008)	BRICS	ER and OP	Mar. 1999 - Jun. 2006	Box-Jenkins ARIMA Model	The effect of ER and OP is on the stock market exchange price of Brazil & Russia only, not in other countries.
Horobet and Dumitor (2009)	Central & Eastern Europe	GDP, CPI, Real Interest, MS and REER	Jan. 1998 - Sep. 2007	Cointegration, GCT and IAT	CPI is positively related to stock prices, while the REER exhibits an opposite behaviour, except for Romania. REER in Czech Republic, Poland and Romania are positively correlated with stock prices.
Peng <i>et al.</i> (2009)	China	GDP	1992 - 2008	VAR/VEC Model, IRF and ADF Test	The IRFs show a small and weak link from the stock market to the economy but a stronger and much more substantial effect in the opposite direction.
Tsoukalas (2003)	Cyprus	MS, IP, ER and CPI	1975 - 1998	Unrestricted VAR & GCT	GCT states that macroeconomic factors and stock prices in Cyprus are strongly related. The statistically significant evidence implies that, overall the Cyprus stock market is weak form of efficient.
Ahmed and Osman (2007)	Bangladesh	MS, TBR (91-day Weighted Average Rate), IR, GDP and IIP	Jul. 1997 - Jun. 2005	URT, JCT, VEC and GCT	Bangladesh SMI does not reflect macroeconomic effect on stock price indices. The JCT and the VEC Model illustrate that stock price indices are not co integrated with IIP, Broad Money Supply and GDP growth.
Coleman and Tettey (2008)	Ghana	Lending Rates, Inflation and SMI	Quarterly: 1991 - 2005	Cointegration and the ECM	Lending rates from deposit money banks have an adverse effect on stock market and particularly serve as major hindrance to business growth.
Bhattacharya <i>et al.</i> (2001)	India	ER, Foreign ER and Trade Balance	1990 to 2000	URT, Cointe. and Long-run GNCT	There is no causal linkage between stock prices and the three variables under study.
Assagat <i>et al.</i> (2019)	Indonesia	Inflation, IR, MS and ER	Nov. 2016 - Jun. 2019	Multiple Linear Regression	Inflation rate, IR, MS, and FER, stock returns have a significant effect on companies on the Indonesia Stock Exchange.
Kurihara (2006)	Japan	IR, ER and United State SMI	Mar. 2001 - Sep. 2005.	URT, ADF, OLS and Cointegration	IR has not impacted on Japanese stock prices but ER and U.S. stock prices have. Quantitative easing has influenced on stock prices.
Vena (2014)	Kenya	CPI and Inflation	1998 - 2013	GARCH, EGARCH	The role of the stock exchange market in directing economic growth. This will enable investors make rational decisions in order to maximize returns.
Ibrahim and Aziz (2003)	Malaysia	IIP, MS, CPI and ER	1977 - 1998	ADF,PP, URT & JCT, Ljung-Box-Pierce Q stat, VEC, Variance Decomposition and IRF	The presence of cointegration between stock prices and macroeconomic variables indicate long-run predictability of the Malaysian Equity Prices.
Gan <i>et al.</i> (2006)	New Zeland	Inflation, Long Term IR, Short Term IR, Real Trade Weighted ER, Real GDP, MS and Domestic Retail OP	Jan. 1990 - Jan. 2003	Johansen MCT, GCT and IAT	The NZSE40 is consistently determined by the IR, MS and real GDP.
Akbar <i>et al.</i> (2012)	Pakistan	MS, IR, Inflation and Foreign ER	Jan. 1999 - Jun. 2008	Co-integration, GCT and ECT	Co-integrating tests suggested that stock prices and macroeconomic variables were co-integrated and at least uni-directional causality exists between the two sets of variables.
Mukherjee and Yu (1997)	Singapore	Broad MS, Foreign Reserve, Narrow MS	Oct. 1984 - Apr.	Cointegration and Causality Test with	The causality tests and forecasting equations provide conflicting evidence on the informational efficiency of

		and ER	1993	Forecasting Equation	the stock market in the short run.
Mgammal (2012)	Saudi Arabia and UAE	Inflation, IR and ER	Jan. 2008 - Dec. 2009	Multiple Regression and Correlation Analysis	In the short term ER influence positively on the stock market price index for UAE and there is no association between them for Kingdom Saudi Arabia.
Shawtari <i>et al.</i> (2015)	South Africa	IIP, MS, Inflation and ER	1998 - 2010	VEC Models	South Africa's stock market is highly sensitive to the country's IIP, MS, Inflation, and ER. IIP, Inflation, MS and ER are co-integrated on the long run with stock market prices
Menike (2006)	Sri Lanka	MS, ER, Inflation Rate, IR, Lagged MS & Lagged IR	Sep. 1991 - Dec. 2002	Multiple Regression Model	Inflation rate and ER react negatively to stock prices. Also negative effect of TBR implies that whenever the IR on Treasury securities rise, investors tend to switch out of stocks causing stock prices to fall.
Talla ST (2013)	Sweden	ER, CPI, MS and IR	1993 - 2012	UR & GCT & Multiple Regression Model	Inflation and currency depreciation have a significant negative influence on stock prices. IR is negatively related to stock price change. MS is positively associated to stock prices although not significant.
Singh <i>et al.</i> (2011)	Taiwan	Employment Rate, Inflation, MS, ER and GDP	2003 - 2008	Regression Analysis	ER and GDP have great effect on the returns of companies listed in Taiwan 50 Index while inflation rate has significant effect. Employment rate and MS do not appear to have any significant affect on stock returns.
Buyuksalvarci (2010)	Turkey	MS, IR, IIP, OP and FER.	Jan. 2003 - Mar. 2010	APT and Multiple Regression	IR, IIP, OP, FER have a negative effect on ISE-100 Index returns while MS positively influence ISE-100 Index returns in Turkey.
Ratanapakorn and Sharma (2007)	United States	IIP, Inflation, MS, STIR and ER	1975:Q1 - 1999:Q4	GCT and VDC	Stock prices negatively relate to the LTIR, but positively relate to the MS, IIP, inflation, ER and the STIR.
AL-Sharkas, Adel (2004)	Jordan	IIP, CPI, M2 and TBR	1980:Q1-2003:Q3	VEC Model	Macroeconomic variables are cointegrated i.e., there exists a cointegration relation among the variables.
Raymond K (2009)	Jamaica	Jamaica SMI, M3, IR, Inflation Rate and ER	Jan. 1990 - Mar. 2009	JCT	Jamaica SMI is positively influenced by the inflation rate and M3 and negatively by the ER, IR and M2.
Pilinkus and Boguslauskas (2009)	Lithuanian	GDP, Harmonized CPI, M1, UR and Three months Vilnius Inter-bank offered rate	Jan. 2000 - Jun. 2009	IRF	GDP and M1 have a positive effect on SMI while most of the time UR, ER and STIR negatively influence stock market prices.
Ade. O. Adenuga (2011)	Nigeria	Rate of change of Real GDP, CPI, Investment Ratio, MCR, FDI and BSD	1990:Q1-2009:Q4	VEC Model Technique	The model validates the hypothesis that stock market development promoted economic growth in Nigeria during the period of analysis.
Hsing (2011)	Hungary	Real Output, Govt. Debt, MS, Real IR, Nominal Effective ER, EIR, Foreign SMI and Foreign IR	2000:Q1 - 2010:Q2	GARCH Model	Hungary SMI has a positive relationship with real GDP, the ratio of the GD to GDP, the NEER and the German stock market index and quadratic relationship with real MS.
Zivengwa <i>et al.</i> (2011)	Zimbabwe	Per capital real GDP and investment	1980 - 2008	VAR and GCT	A unidirectional causal link that runs from stock market development to economic growth and there is evidence of an indirect transmission mechanism through the effect of stock market development on investment.
Abu-Libdeh H and Harasheh M (2011)	Palestine	GDP, Inflation, ER, Libor rate and Balance of Trade	Mar. 2000 - Jun. 2010	Regression Analysis and GCT	Regression analysis indicated a significant relationship between the macroeconomic variables used and stock prices.
Hsing (2011)	Czech Republic	Real Output, Govt. Borrowing, MS, Domestic Real IR, CZK ER, EIR, Foreign SMI and Foreign IR	2002:Q1 - 2010:Q2.	Regression Analysis	The Czech SMI is positively associated with real GDP and the German and US stock market indexes and quadratic relationship with the ratio of MS to GDP.
Sirucek M (2012)	USA	Inflation, IR, MS, PPI, IIP, OP and UR	1999 - 2012	Correlation, Regression and OLS Method	The PPI, IIP, OP and Dow Jones index are having a stronger relationship than between these factors and S&P 500.
Zhou <i>et al.</i> (2013)	Cameroon	SMC, Domestic Credit to the Private Sector, SMVAR, GDP per Capita, GDI, GDS, CIR, Real IR, FDI and Net Capital Flows	2006 - 2011	Calderon-Rossell Model	The stock market liquidity and financial openness represented by FDI and private capital flows are important determinants of stock exchange development in Cameroon.
Abdelbaki (2013)	Bahrain	GDP, Investment Rate, Saving Rate, Credit to the Private Sector, Per capita Income, M2, FDI and GDP Deflators	1990 - 2007	Autoregressive Distributed Lag model	Income level, domestic investment, banking system development; private capital flows and stock market liquidity are important determinants of stock market development.
Khodaparasti, R. B. (2014)	Iran	ER, Inflation, IIP and M1	2007 - 2011	VAR	The ER and IIP have more effect on the stock market than inflation and M1.

Hsing (2014)	Romania	Romanian SMI, IIP, GB to GDP, M2 to GDP, DRIR, NEER, EIR and SMI of U.S.	2001:Q4 - 2010:Q2	GARCH Model	The Romanian SMI is positively affected by IIP and the Stock Market Index of U.S, SMI.
Ngoc (2009)	Vietnam	IR and IIP	Jan. 2001 - Apr. 2008	Multivariate Vector Auto-Regression Model, URT & Multivariate Regression Analysis	There are statistically significant associations among the domestic production sector, money markets, and stock prices in Viet- nam.
Wong <i>et al.</i> (2005)	Singapore and United States	MS and IR	1982 - 2002	Cointegration, Johansen MCT, Fractional Cointegration and GCT	Singapore Stock Price generally displays a long- run equilibrium relationship with IR and MS but in the US, Stock prices were strongly cointegrated. With macroeconomic variables.

2.1. Abbreviation

OP-Oil Price, IR-Interest Rate, VAR-Vector Autoregressive, ADF-Augmented Dickey-Fuller, PP-Phillips-Perron Test, KPSS-Kwiatkowski-Phillips-Schmidt-Shin Test, IIP-Industrial Production Index, GDP-Gross Domestic Product, CPI-Consumer Price Index, REER-Real Effective Exchange Rate, GCT-Granger Causality Test, IAT-Innovation Accounting Technique, VEC-Vector Error Correction, IRF-Impulse Response Function, IP-Industrial Production, MS, M1, M2 & M3-Money Supply, TBR-Treasury Bill Rate, URT-Unit Root Test, JCT-Johansen Cointegration Test, ECM-Error Correction Method, GNCT-Granger Non Causality Test, OLS-Ordinary Least Square, GARCH-Generalized Auto-Regressive Conditional Heteroskedasticity, EGARCH-Exponential Generalized Auto-Regressive Conditional Heteroskedasticity, UR-Unemployment Rate, MCT-Multivariate Cointegration Test, ECT-Error Correction Test, APT-Arbitrage Pricing Theory, VDC-Variance Decomposition, MCR-Market Capitalization Ratio, BSD-Banking Sector Development, EIR-Expected Inflation Rate, PPI-Producer Price Index, SMC-Stock Market Capitalization, SMVAR-Stock Market Value Added Return, GDI-Gross Domestic Investment, GDS-Gross Domestic Saving, CIR-Current Inflation Rate, FDI-Foreign Direct Investment, SMI-Stock Market Index.

According to the past researches, it can be concluded that many macroeconomic factors combined affect the stock market and almost every Indian research was done on the two major indices of Indian Stock Market, i.e., CNX Nifty and BSE Sensex. Therefore, it is viable to use BSE Sensex for analysing the effect of macroeconomic variables on the stock market of India. Based on the Literature Review one of the major gaps observed from the studies was the time period of which the stocks were analysed. The study conducted before

by various scholars and researchers was limited on the ground of shorter time span which could have been studied for a longer time period in order to have a clear picture and to obtain more precise results to know the impact of the selected macroeconomic variables on the stock prices.

3. Objective of the study

Objective of the study are to determine the relationship between stock market value and selected macroeconomic variables through selected statistical methods. The present study is focused on the following objectives.

- To measure the movement of selected macroeconomic variables and stock market values, and
- To study the relationship between selected macroeconomic variables and stock market values.

4. Methodology

The study examines the impact of selected macroeconomic variables on stock market values, while other variables assumed to be constant. Data have been analysed through Descriptive Statistics, Correlation Matrix and Regression analysis (Goodness of Fit, Variance Inflation Factor, Coefficient of Determination and Durbin – Watson d-Statistic).

4.1. Variables description

For the purpose of the above study, secondary data has been used to analyse the effect and the influence of macroeconomic variables on stock prices of India. The closing prices of the stock market and macroeconomic variables are gathered on a monthly basis from Bloomberg terminal for the study. The selected macroeconomic variables are taken from various websites and their symbol, unit of measurement and proxy of each variable are illustrated in Table -2.

Table 2: Macroeconomic variables used in the analysis

Sl. No.	Variable	Symbol	Data Source	Unit of Measurement	Proxy
1	Exchange Rate	ER	www.rbi.org.in	In Rs.	USD
2	Inflation	Inflation	www.mospi.gov.in	Rs, (%)	WPI
3	Interest Rate	IR	www.rbi.org.in	Rs. (%)	Deposit
4	Money Supply	M3	www.bankbazaar.com	Rs in Billions	M3
5	Consumer Price Index	CPI	www.rbi.org.in.com	In Rs.	Combined

4.1.1. Exchange rate

An exchange rate is the cost of a country’s cash as far as money and has two segments, the country’s own money and foreign currencies can be cited either straight forwardly or roundabout way (Garg K & Kalra R, 2018) [33]. The whole procedure of sending out and bringing in procedure of any nation is entirely subject to the exchange rate of money value of the country. Gunasekarage A *et al.* (2004) [35] and Adam MA & Tweneboah G (2009) used USD (United States Dollar) as a proxy for exchange rate. It is also affect the net exports

(Osamwanyi IO & Evbayiro-Osagie EL, 2012) [37]. Vejzagic M & Zafarat H (2013) found that changes in exchange rate would have an impact on firm’s competitiveness as it affects the price of foreign currency, leading to changes in the firm’s profit and equity which in return will lead to price adjustments in the stock market.

4.1.2. Inflation

Inflation is an ascent in cost of price of a few things over a period of time. Everyone of the index is made in a particular

way with a specific year as the base year and they consider the value changes over a year. According to Pearce DK & Roley VV (1985)^[39], it has been calculated from Wholesale Price Index (WPI). Talla JT (2013)^[40] used Consumer Price Index is a proxy for inflation. He states that inflation can affect stock market either positively or negatively. He added that unexpected and expected inflation determines the direction of the relationship between stock market and inflation.

4.1.3. Interest rate

The rate of interest is the rate of exchange between future and current consumption (Reilly F & Brown K, 2003)^[41]. When borrowing money and receiving on it on their saving difference is accepted by people for accept to pay, which the author referred to as the pure time value of money. Moreover, if the investor expects an increase in price (Rise in inflation), he/she will demand a higher rate of return, that is, pure time value of money plus expected inflation rate. Joseph NL & Vezos P (2006)^[34] stated that, it is the difference between two time factor t and $(t-1)$.

4.1.4. Money supply

Walter J (1989)^[42] argued that monetary aggregates can be used to measure any nation's money stock. He also stated that in order to forecast the changes in economic activities, inflation and interest rate analysts need to study the relationship between the monetary measures and other macroeconomic variables. The components of money supply are drawn from the liability side at the balance sheet of the banking sector. Kumar R (2013)^[43] and Barakar MR *et al.* (2016) used M3 as a proxy of money supply and stated that there is a strong relationship between money supply and stock prices.

4.1.5. Consumer price index

The Consumer Price Index (CPI) is a measure that examines the weighted average of prices of a basket of consumer goods and services, such as transportation, food, and medical care. It is calculated by taking price changes for each item in the predetermined basket of goods and averaging them. Schwert GW (1981) examined that stock market responds negatively to the announcement of unanticipated inflation in the CPI. He reported that there are at least three theories that predict a positive relation between volatility and volume. First if investors have heterogeneous beliefs, new information causes both the price changes and the trading. Second, if some investors use price movements as information on which to make trading decisions, large price movements cause large trading volume. Finally, if there is short term "price pressure" due to illiquidity in secondary trading markets; large trading volume that is predominantly either buy or sell orders cause price movements. Whereas, using hourly data, Jain PC (1988)^[45] found that CPI announcement surprises have significant negative effects on stock prices and trading volume was not associated with surprises in the CPI announcements and the results were consistent with the hypothesis that market participants interpret the surprises in announcements in an analogous manner and do not engage in additional trading. By using monthly data Chen NF, Roll R and Ross SA (1986)^[46] found that inflation related variables were highly significant in the 1968-77 periods and insignificant both earlier and later. Smirlock M & Yawitz Y (1985)^[47] found a significant positive response of long-term rates to unexpected inflation.

4.1.6. Comparison between macroeconomic variables and stock market return

Many academic researchers, financial and industry analysts and practitioners have tried to establish the relationship between macroeconomic variables and stock market movements from the past decades. They have done several empirical and descriptive studies to check the effect of macroeconomic variables on stock prices or vice versa and the existing relationship between the two. To help those who are interested in the stock market either government officials, investors or academics, a stock market index was invented as a tool in order to evaluate the decision of portfolio managers and investment advisors. According to Rafique A *et al.* (2013)^[48], the stock performance is measured through movement in the index. The fluctuations in the index are affected by macroeconomic, social, political and the firm's specific variables. In this work, we established some empirical proof relating designated macroeconomic variables to stock market return.

4.2. Exchange rate and stock market return

According to portfolio management, any inflow or outflow of foreign capital will be a result of changes in stock prices. When stock prices increase, they will attract towards foreign capital and when price decreases, they will be less appealing to foreign investors, which will lead to a corporate wealth (Vejsagic M & Zarafat H, 2013)^[38]. It is also creation of country's external business and straightly related to balance of payment. The balance of payment deficit and the intensity of external reserve frequently influence exchange rate (Oaikhena H.E, 2002)^[49].

4.1.2. Inflation and stock market return

Chandra P (2004)^[50] stated the effect of inflation rate towards the corporate sector has been found to be bi-directional. For unexpected inflation, an increase in general price level leads to the increase in cost of living, which forces people to invest less and relocate their resources for consumption. When inflation increases, nominal interest rate also increases. This will reduce the present value of the income generated by firms as the discount rate used to determine the intrinsic values of stocks went up. This will force stock prices to decrease (Amadi SN & Odubo TD, 2002)^[51]. If the price elasticity of demand for the firm's product is high, a rise in inflation that leads to an increase in price will cause a decline in a firm's sale and net income and thus its stock price (Fama EF, 1981)^[52].

4.2.2. Interest rate and stock market return

Interest proportion varies with time, inflation and output of capital among others (Chandra P, 2004)^[50]. According to Kelvin S (2000)^[53], the interest changes in systematized and synthesized financial segment of the economy are focused within anticipated range over monetary strategy. Alam MN & Uddin MGS (2009)^[54] argued that, interest rate on deposit has a negative relationship with stock prices. When rates on deposit in the bank increase, people will redirect their money from capital market to the banks and this will lead to decrease in demand of shares stock prices, and vice versa.

4.2.3. Money supply and stock market return

Monetary aggregates can be used to measure any nation's stock (Walter J, 1989)^[42]. In order to forecast the changes in stock prices, inflation and interest rates, researcher need to

find out the relationship between the monetary measures and other macroeconomic variables. In the short run disequilibrium, supply and demand of capital might occur and it will change the ease of tightness of capital market (a decrease in the growth rate of money supply will results in decline in supply of capital and an increase in interest rate). Sudden changes in money supply among other variables might be a cause of this disequilibrium through affecting the normal risk free rate (Reilly F & Brown K, 2003) [41].

4.2.4. Consumer price index and stock market return

Fama EF, (1981) [52] stated that negative stock returns with inflation are defined by the positive connection between stock returns and basic determinants like cost of capital, the average real rate of return capital and productivity of a firm. Fieldstein MS (1980) [54] also confirmed the effect of inflation on stock prices through corporate income taxation, cost depreciation and taxation of normal capital gains, since the depreciation is determined based on historical cost which is not affected by the increase in inflation rate. The depreciation is less then it is supposed to drive the real taxable earnings to go up (Hong H,

1977) [56].

5. Analysis and interpretation

5.1. Descriptive statistics

Various descriptive statistics are calculated of the variables under study in order to describe the basic characteristics of these variables. Table - 3 presents the descriptive statistics of the data, containing Sample Means, S.E of Mean, Medians, S.D, Variance, Skewness, Kurtosis, Range, Maximums and Minimums.

During the study period, the result quantified that S & P BSE has the mean of Rs. 31255.046 with S.D of Rs. 4614.933 and the range was Rs. 16712.20 with Rs. 39714.20 as maximum and Rs. 23002.00 as minimum values. The ER has mean Rs. 66.591 and S.D Rs. 2.904. The range was between Rs. 61.340 to Rs. 73.630 (Rs. 12.29). Furthermore, Inflation has mean 1.075 with S.D of Rs. 3.198. The IR has mean Rs. 6.513% and range was between Rs. 5.4% to Rs. 8.0% with S.D Rs. 0.616%. Similarly the mean of M3 (in Billions) and CPI have the Mean of Rs. 127647.889 and Rs. 132.258 with S.D. Rs 16318.181 and Rs. 7.489 respectively.

Table 3: Descriptive Statistics of Variables

Descriptive Statistics		S&P BSE Value	ER (USD)	Inflation	IR (%)	M3 (Billions)	CPI
Valid	N	60	60	60	60	60	60
Mean		31255.046	66.591	1.075	6.513	127647.889	132.258
S.E of Mean		595.785	0.375	0.413	0.079	2106.668	0.967
Median		29769.450	66.666	1.850	6.375	127334.705	131.300
S.D		4614.933	2.904	3.198	0.616	16318.181	7.489
Variance		21297605.483	8.432	10.231	0.380	266283029.475	56.083
Skewness		0.319	0.322	-0.543	0.920	0.209	-0.134
Kurtosis		-1.244	-0.517	-0.760	0.448	-1.010	-1.055
Range		16712.200	12.290	11.820	2.600	55349.800	26.400
Minimum		23002.000	61.340	-6.140	5.400	101150.650	119.400
Maximum		39714.200	73.630	5.680	8.000	156500.450	145.800
Sum		1875302.750	3995.460	64.490	390.800	7658873.330	7935.500

As it can be seen from the Table - 3, all the variables are asymmetrical. More precisely, Inflation and CPI have a negative skewness, which indicates the fat tails on the left-hand side of the distribution. Kurtosis value of all variables also shows data is not normally distributed because values of kurtosis are deviated from 3. The S.E of mean play a very important role in large sample theory and forms the basis of the testing of hypothesis. For any statistic, the large sample

$$|\text{Statistic} - E(\text{Statistic})| \leq Z_{\alpha} \cdot S.E (\text{Statistic})$$

The deviation is not regarded significant at 5% level of significance. It also enables us to determine the probable limits within which the population parameter may be expected to lie. So the descriptive statistics shows that the values are not normally distributed about its mean and variance or in other word we can says no randomness in data and therefore, is sensitive to periodic change and speculation.

$$Z = \frac{\text{Statistic} - E(\text{Statistic})}{S.E(\text{Statistic})} \sim N(0,1)$$

Thus, if the discrepancy between the observed and expected / hypothetical value of a statistic is greater than Z_{α} times its S.E, the null hypothesis is rejected at α % level of significance. Similarly, if

5.2. Correlation matrix

It is found that S & P BSE value has a positive correlation with all independent variables except for IR (%). According to the correlation matrix obtained in the Table - 4, it can be seen that various independent variables are inter-correlated to each other but some are very significant and can be used in further analysis.

Table 4: Correlation Matrix

Correlation Analysis		S&P BSE Value	ER (USD)	Inflation	IR (%)	M3 (Billions)	CPI
Pearson Correlation	S&P BSE Value	1.00	0.52	0.65	-0.57	0.90	0.86
	ER (USD)	0.52	1.00	0.45	-0.55	0.75	0.74
	Inflation	0.65	0.45	1.00	-0.61	0.69	0.73
	IR (%)	-0.57	-0.55	-0.61	1.00	-0.81	-0.86
	M3 (Billions)	0.90	0.75	0.69	-0.81	1.00	0.98
	CPI	0.86	0.74	0.73	-0.86	0.98	1.00

It was found that ER (USD) has a positive relation with all other independent variables like Inflation, M3 (Billions) and CPI; except with IR (%). Also, Inflation has a positive

correlation with all other variables except IR (%). IR (%) is seen to have a negative correlation with all variables.M3

(Billions) and CPI have a positive relation with ER (USD) and negative correlation with IR (%).

5.3. Regression analysis

5.3.1 Goodness of fit

Levin RI & David SR (2005) [57] states that in multiple regression, F-test explains the level of influence of independent variable on dependent variable. If the value of significance is higher the significance F then it indicates that Independent variable has influence on dependent variable and vice versa.

Table 5: ANOVA

ANOVA ^a						
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1204523765.18	5	240904753.04	250.00	0.00 ^b
	Residual	52034958.29	54	963610.34		
	Total	1256558723.47	59			

a. Dependent Variable: S&P BSE Value

b. Predictors: (Constant), CPI, Inflation, ER (USD), IR (%), M3 (Billions)

The output of Table-5 presents an analysis of variance (ANOVA). A good regression model generates high level of F value and very low level of F-significance value. In line with the thumb rule, the F-value is very high (250.00) and its significance value is the lowest (0.00) at 5 percent level of significance. This signals the goodness of fit of the model.

5.3.2 Variance inflation factor

Multicollinearity has been considered as a critical factor while execution of multiple regression analysis. Correlation among independent variables is considered as the main reason behind existence of multicollinearity. Results of the analysis would be biased, if we ignore the multicollinearity in the research data. VIF (Variance Inflation Factor) has been used as a multicollinearity diagnostic technique. VIF indicates whether independent variables have any correlation among themselves or not. If the value of VIF is more than 10 then it indicates the existence of multicollinearity in the data and if the value of VIF is less than 10 then it indicates that data is free from multicollinearity.

Table 6: Variance Inflation Factor

VIF Table	Unstandardized Coefficients		Standardize Coefficients	t	Sig.	Co linearity Statistics	
	B	S.E	Beta			Tolerance	VIF
1	(Constant)	-59085.51	11370.47		-5.196	0.000	
	ER (USD)	-691.79	68.63	-0.435	-10.080	0.000	0.411
	Inflation	-20.41	60.25	-0.014	-0.339	0.736	0.440
	IR (%)	5005.80	434.28	0.668	11.527	0.000	0.228
	M3 (Billions)	0.26	0.040	0.923	6.451	0.000	0.037
	CPI	533.00	107.47	0.865	4.959	0.000	0.025

As, shown in Table-6, VIF of all the independent variables, except for M3 (Billions) and CPI are within the acceptable limit. In case of M3 (Billions) and CPI are 26.716 and 39.662 respectively, which are more than 10, indicating the presence of collinearity but that will not affect the actual outcome. The estimated regression coefficients for predicting the S & P BSE value can be derived from the above table as

$$S \& P \text{ BSE value} = -691.79 \text{ ER (USD)} - 20.41 \text{ Inflation} + 5005.80 \text{ IR(\%)} + 0.26 \text{ M2 (Billions)} + 533.00 \text{ CPI} - 59085.51$$

These coefficients indicate the direction of relationship between independent and dependent variables. These coefficients also tell us to what degree each predictor affects the outcome when the effects of all other predictors are held constant. The signs of coefficients of all the independent variables except IR (%) and CPI are as per theoretical predictions. Among the five independent macroeconomic variables IR (%) and CPI appears to have very high influence on S & P BSE value. As the IR (%) and CPI are increases by

1 unit, the S & P BSE value increases by 5005.8 and 533.0 units respectively, subject to the condition that, other variables are constant. This positive relationship appears to be unusual. The negative sign implies that stock index performances would decrease by 691.79 and 20.41 respectively for every unit increase in ER (USD) and Inflation subject to other variables are constant.

5.3.3 Coefficient of determination & Durbin – Watson d-statistic

The impact of macroeconomic variables on the S & P BSE value has been captured statistically by the regression model. From the model summery presented in Table-7, it can be seen that the computed Durbin-Watson (d) value is 1.476 and the tabulated value of D -W d statistic for k=5 and k=60 at 5% level of significance is: Lower d value (d_L) = 1.41; upper d value (d_U) = 1.77, where k=number of independent variables and n=number of total variables. As d_L < d_{cal} < d_U, the test is inconclusive.

Table 7: Coefficient of Determination & Durbin – Watson d-Statistic

Model	R	R ²	Adj. R ²	S.E of Estimate	Change Statistics				Durbin Watson	
					R ² Change	F Change	df1	df2		Sig. F Change
1	0.979 ^a	0.959	0.955	981.636	0.959	250.002	5	54	0.000	1.476

a. Predictors: (Constant), CPI, Inflation, ER (USD), IR (%), M3 (Billions)

b. Dependent Variable: S&P BSE Value

The combined influence of independent variables on the S & P BSE value appears to be very strong. Field A (2013) [58] states that R² represent the percentage of variance in the outcome that are explained by the independent variables or predictors. As shown in Table-7, the R² = 0.959, which implies that the macroeconomic variables account for 95.9%

variation in the S & P BSE value? However, in a multiple regression model adjusted R² is the more reliable explanator of dependent variable than R². In the above model, adjusted R² is 0.955, which implies that 95.5% of the variation in S & P BSE is explained by the five macroeconomic variables, viz. CPI, Inflation, ER (USD), IR (%) and M3 (Billions). Only

4.5% changes in S & P BSE is caused by the external factors outside the model. Thus, S & P BSE is highly sensitive to the variations in CPI, Inflation, ER (USD), IR (%) and M3 (Billions).

6. Conclusion

The prime aim of the study was to examine factors influencing S & P BSE behaviour through selected macroeconomic variables. We expected a relationship between selected macroeconomic variables and stock indices performances as proxy for Indian Capital Market. The relationship was tested by using Descriptive Statistics, Correlation Analysis and Regression Analysis (Goodness of Fit, Variance Inflation Factor, Coefficient of Determination and Durbin – Watson d-Statistic) with the past 60 months data and we found that stock market indices are influenced by selected macroeconomic variables. In line with this, the grades also suggest the need for policy makers to design policies that will help to curtail rapid growth in money supply. There is also the need to formulate policies that are capable of enhancing the national income of the country. Export policies should be encouraged, as they rise to issue of balance of payments, their deficit or surplus and also responsible for the appreciation or otherwise of a nation's foreign exchange.

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