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Dynamic Association between Macroeconomic Variables and Stock Return Volatility: Evidence from India

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Abstract
The nexus between macroeconomic variables and stock return is incessantly being investigated by different researchers over the last few decades all over the academic world. The objective of the present study is to examine the impact of select macroeconomic variables like exchange rate, gross domestic product, gold price, inflation and oil price fluctuations on the stock return volatility in the Bombay Stock Exchange of India. Econometric techniques like unit root test by applying ADF test (testing stationery), Johansen co-integration test (predicting long run relation) and GARCH (1, 1) model have been used to judge volatility clustering and unconditional return distribution. In addition, some statistical tools like descriptive statistics, autocorrelation function test, chow breakpoint test, diagnostic tests and finally impulse response function tests have been performed for conclusive inference. We have found that causality between stock return (SR) and exchange rate(LNEX) is bidirectional , no causality exist between stock return (SR) and GDP growth(LNGDP), stock return (SR) and gold price (LNGLD). There exist unidirectional causality between stock return (SR) and oil price (LNOIL). The findings from GARCH analysis suggest that only exchange rate has a significant negative effect on stock returns. It is observed that depreciation of Indian rupee has caused lower stock returns and vice versa. The effect of one standard deviation shock in exchange rate results in the decline of stock return since beginning to the third segment of the period of study and reverts back to equilibrium during subsequent periods. Oil price and inflation have also negative impact, though not significantly, on stock return volatility. Other macroeconomic variables like GDP growth, gold price are not found noteworthy in explaining stock returns. Chow breakpoint test statistics suggests that there does not have any structural break (change) in the Indian stock market return function before and after 2008:10, though, BSE SENSEX declines sharply after sub prime lending crisis.

Keywords
Stock Return, Volatility, BSE, Macroeconomic Variables, India, GARCH

1. Introduction

There is an admired conviction that well developed stock markets facilitate in organizing liquidity, encouraging risk management tools, reducing information asymmetries, rewarding performance and efficiency and finally resulting acceleration in overall economic growth. The contribution of capital markets is a necessity for maintaining the competitiveness of an economy today given the strongly increased international competition, rapid technological progress and the increased role of innovation for growth performance. According to Galbraith (1955), the stock market is but a mirror, which provides an indication of causal and fundamental economic situation of a country. The vibrant relationship between macroeconomic variables and market volatility is considered as an incessant topic for deliberation amongst the academicians, researchers and strategists. Economists and financial experts have made multiple researches on the dynamic causal relationship for different countries under diverse time periods. Though they strive to corroborate the influence of macroeconomic variables on the stock market indices but conclude that the type and magnitude of the association diverge depending on the country's financial structure and its policies. They advocate that the response of market returns to policy changes in macroeconomic variables is difficult to appraise in advance as it differ across countries. The global economic proceedings in recent times are perceived as more significant than the domestic ones in explaining returns across markets. Zakaria and Shamsuddin (2012) remark that the causal relations and dynamic interactions among macroeconomic variables and stock prices are important in the formulation of the nation's economic policy and any restraint in policymaking on economic environment, poor policymaking and implementation even in a single emerging market may have spiralling effect to other markets. Theories on economics suggest that while stock prices should reflect expectations about future corporate performance, the corporate profits reveal the level of economic activities. If stock prices accurately reflect the underlying fundamentals, then it should be employed as leading indicators of future economic activities.

The financial literatures have explored the dynamic relationship between macroeconomic components and stock market returns based on the famous Arbitrage Pricing Theory (APT) promulgated by Ross (1976). The theory speaks that stock prices are determined by some fundamental macroeconomic variables, which can influence investment decisions. Many authors consider diverse macroeconomic variables seeking to identify their relationship with stock market prices in several countries. Chen, Roll, and Ross (1986) were one of the first to explore the link while some allied studies confirmed. McElroy and Burmeister (1988), Poon and Taylor (1991), Shanken (1992), Mukherjee and Naka (1995), Cheung and Ng (1998), Gjerde and Saettem (1999), Maysami and Koh (2000), Hassan (2003), Islam and Watanapalachaikul (2003), Humpe and Macmillan (2005) also confirmed on the same line and remarked that the linkage between the macroeconomic properties and the stock market has intuitive appeal, as they affect both expected cash flows accruing to stockholders and discount rates. Using APT, it is perceived that economic variables have organized significance on market returns as economic forces impact discount rates, the potential of firms to generate cash flows and future dividend payments. As such these variables become part of risk factors in equity markets. According to simple discount model, the fundamental value of corporate stock is equal to the present value of expected future dividends which eventually reflect the real economy activity. Similarly, based on stock valuation models, the current prices of equity is approximately equal to the present value of all future cash flows, hence any macroeconomic variable that affects cash flow and the required rate of return in turn influences the share value as well. According to dividend discount model, new macroeconomic information may impinge on stock prices as it impacts either expectations about future dividends, discount rates, or both (Arnold and Vrugt, 2006).

Questions are also raised whether there is any connection between stock market volatility and macroeconomic variables. Since the value of corporate equity at the aggregate level depends on the state of economic activity, it is likely that any change in the level of uncertainty of future economic conditions would cause a change in stock return volatility. In other words, stock markets may be volatile simply because real economic activities fluctuate as it is truly observed to some elementary macroeconomic factors such as exchange rate, gold price, gross domestic product, oil price, inflation and others. To investors, in spite of being considered as a measure of risk, excessive stock returns volatility or "noise" undermines the usefulness of the stock prices which acts as an indicator about the true intrinsic value of the firm (Karolyi, 2001). Officer (1973) pioneered his observation linking stock price volatility with economic indicators and found high volatility during great depression in 1930s. Schwert (1988) studied the nexus between macroeconomic uncertainty and stock returns and highlighted a counter-cyclical behaviour of market volatility, with the direction of causality being stronger from the stock market to macroeconomic variables. Corradi, Distaso and Mele (2013) also find that volatility moves counter-cyclically with respect to GDP. Karolyi (2001) argued that decrease in stock prices leads to increased volatility in stock market. Bollerslev *et al.* (1994) and brooks (2008) found that negative shocks contributed to more volatility as compared to positive shocks of the identical magnitude. Campbell and Hentschel (1992) commented that good news and bad news have different impacts on volatility. Morana and Beltratti (2002), Chowdhury *et al.* (2006), Saryal (2007) found a significant relationship between stock market return and volatility of macroeconomic factors. Wang (2010), on the other, found no causal relationship between stock market volatility and real GDP volatility, bilateral causality between stock market volatility and inflation volatility and unidirectional causality from stock prices to interest rate. Choo *et al*. (2011) tried to examine the relationship of stock market volatility with some macroeconomic variables and showed that uncertainty in the latter did not explain the volatility of the former. Aliyu (2012) explored the effect of asymmetric shocks and showed that the impact of bad news on stock volatility was larger than good news for some, while the results were different for others.

Though there are diverse observations on this relationship for developed and emerging countries, the present study makes an endeavor to investigate the dynamic linkages between some selected macroeconomic variables (exchange rate, GDP, gold price, inflation and oil price) and the stock market return volatility in India during February 1990 to March 2015. The time series data set comprising the monthly observations of the Bombay Stock Exchange (BSE), the inflation rate (INFLA), gross domestic product (GDP), Exchange rate (EX), gold price (GLD), oil price (OIL) are considered for empirical observations. This period is marked by series of both global and national events which have resulted significant impact on the Indian economy. The hypothesis states that whether those selected macroeconomic variable have any impact on the market return volatility in India. The rest of the paper has been organized as follows. Section 2 contains the data and models used and the methodology and empirical results are discussed in Section 3. The concluding remarks take place in Section 4.

In the next few lines, the select macroeconomic components considered for our study are discussed for a better understanding.

1.1. Exchange Rates and Market Return Volatility

Reinhart (2000) and Calvo and Reinhart (2002) comment in their research findings that most of the currencies in the world are more or less linked to the dollar (USD) or the euro (EUR), even if very few of them have strict fixed exchange rates. Like EUR has been confined to Europe, its immediate vicinity and some African countries (ECB, 2008), most of the countries in the globe is under the influence of the USD. As emerging markets like India have integrated to global economy, they have opened themselves up to foreign capital inflows and hence rendered themselves vulnerable to exchange rate risks. Dornbusch and Fischer (1980) advocate that changes in exchange rates affect the competitiveness of a firm due to fluctuations in exchange rate which affects the value of the earnings and cost of its funds. Because of such, as many companies borrow in foreign currencies to fund their operations there is obvious impact on its stock price. Bahmani-Oskooee and Sohrabian (1992) reported no long term relationship between stock prices and exchanges rates in the US. However, they reported a short term relationship between these two variables using Granger causality tests. Golaka C. Nath and G. P. Samanta (2003) found strong causal influence from stock market return to FOREX market return and concluded a significant impact on exchange rate movement as FII investment used to play a dominant role. The contagion effects involved in currency crises have been closely scrutinized, especially in the aftermath of the 1997 Asian crisis (Masson, 1998; Corsetti, Pesenti and Roubini, 1999; Kaminsky and Reinhart, 2000). During Asian crisis of 1997-98, the world has noticed that the emerging markets collapsed due to substantial depreciation of exchange rates (in terms of US$) as well as dramatic fall in the stock prices. Granger, Huang and Yang (2000), Khalid and Kawai (2003) as well as Ito and Yuko (2004) among others, claim that the link between the stock and currency markets helped propagate the Asian Financial Crisis in 1997. This is the case for the yen and the Swiss franc (Ranaldo and Söderlind, 2007), but also probably for the USD in the immediate aftermath of the bankruptcy of Lehman Brothers in late 2008 (McCauley and McGuire, 2009). Solnik (1987) finds a negative relationship between domestic stock returns and real exchange rate movements. Stock price of an export-dominant economy is found to be negative related to exchange rate but exchange rate movement does have positive effects on stock price of an import-dominant economy (Ma and Kao, 1990). Tabak (2006) analyze the dynamic relation between stock prices and exchange rate in Brazilian economy and showed that there is no long-term relationship between these variables.

Whether the exchange rate volatility causes stock price volatility or vice versa is another serious concern and this leads to divergent researches. According to Jorion (2000), if a firm is acting internationally then it is exposed to exchange rate risk. Soenen & Hennigar (1988) and Aggarwal (1981) acknowledge the significance of exchange rate and its effect on stock return volatility. Najang & Seifert (1992) conducted the similar study as by Maysami-Koh (2000) and concluded that exchange rate is a major contributor to stock return volatility. Bahmani-Oskooe and Sohrabian (1992) confirm that the nature of relationship of the two variables is bi-directional. Abdalla and Murinde (1997) observed some mixed findings and concluded that the exchange rate was causing stock return volatility to some Asian countries, where for some countries the stock prices fluctuations were incorporated in exchange rate. Ozair (2006) proved no causal linkage and no co-integration between these two financial variables while Vygodina (2006) argued causality between large-cap stocks to exchange rates. Benita and Lauterbach (2004) upheld that exchange rate volatility have spiral effect on general economic stability. Carruth *et al*. (2000), Kanas (2000), Serven (2003), Chen *et al* (2004), and Rizwan and Khan (2007) also opined on the same line. De Grauwe (2005) and Schnabl (2007) conclude that a decline in exchange rate uncertainty also enhances price transparency and increases the efficiency of price mechanisms at international level.

1.2. Gross Domestic Product (GDP) and Market Return Volatility

The performance of the stock market works as one of the significant indicators of the overall health of the economy. When there is rise in stock prices, the investors, both domestic and international, possess more wealth and become optimistic and confident. This confidence spills over into increased spending, which leads to increased sales and earnings for corporations, further boosting GDP. In other sense, when GDP rises, it is bullish for stocks as it leads to increase in corporate earnings. The inverse happens when GDP falls lower than consensus or expectations of GDP decline. Goldsmith (1969) sought to trace the impact of overall financial development on the quality and quantity of financial instruments, markets and intermediaries and found a positive correlativity between stock market movements and GDP growth. Modigliani (1971) recognizes a bond between the two and suggests that stock market performance may influence GDP. Levine and Zervos (1998) were among the first to find a positive and significant correlation between stock market development and long run economic growth. According to Fama (1990), Liua and Sinclairb (2008), Oskooe (2010), economic growth influences the profitability of firms by affecting the expected earnings, dividends on shares and stock prices fluctuations. Garcia and Liu (1999) derived positive and robust relationship between stock market development and economic growth. Atje and Jovanovich (1993), Rousseau and Wachtel (2000) and Beck and Levine (2004) find positive relationship between economic growth and stock market development. This is also consistent with the work of Levine and Zervos (1995) and Demirguc-Kunt (1994) that stock markets and banking sector development can give a big boost to economic development. Wu *et al.* (2010) comment that liquidity of the stock market has negative short-run consequence on economic growth while stock market capitalisation and liquidity have positive long-run effect on economic development.

Schwert (1989, 1990), Caporale and Spagnolo (2003) and Diebold and Yilmaz (2008) ascertain that there exists a significant correlation between GDP volatility to stock market volatility. Leon and Filis (2008) posit that GDP shocks counteract stock market volatility and the latter may give rise to the former. However, their study failed to give a systematic cross-country analysis of the mutual-interaction effects of volatilities across various stock market returns and GDP growth rates. Caballero and Krishnamurty (1999, 2001) and Caballero (2000a and 2000b) evidenced volatility in market return associating it to weak international links and to underdeveloped domestic financial system, which makes the economy sensitive to changes in the direction of international capital movements. Ridditz (2003) relates volatility in per capita GDP to liquidity of the financial system, finding evidence that more liquidity in the system tends to reduce volatility. Beetsma and Giuliodori (2011) investigate empirically the role of stock market volatility in predicting subsequent GDP growth. Diebold and Yilmaz (2008) find a unidirectional influence from GDP volatility to stock market volatility. Caporale and Spagnolo (2003) captured a positive influence on output growth volatility from the stock market volatility. In contrast, others have reported empirical evidence of a bidirectional relationship between stock market volatility and the volatility of GDP growth.

1.3. Gold Price and Market Return Volatility

Gold prices are regarded as another economic indicator for measuring the health of an economy. There is a common perceptive that gold price become bullish when the outlook of an economy and the financial market are found bearish, the policy makers struggle to instigate any exposition and there is uncertainty over future trends. The other factors contribute to increase in price of gold include a weak currency, an increase in the rate of inflation and low interest rates over a long term. Universally, gold price and stock market moves in an opposite direction. Basically, when gold price goes down, people withdraw their investment from gold and invest the same in stock market which in turn increase the value of stock and attract more investments. When the economy is in a downturn, the return from stock markets start negative and investors tend to park their funds in metal stocks and stay out of the market storm. The historical data reveals that when the stock market crashes or dollar weakens, gold is perceived to be a safe haven investment because of rising gold prices in such circumstances. According to Baur and Lucey (2010), among all physical assets, gold is considered to be highly durable, universally acceptable, and provides a hedge against inflation, political uncertainty, slow economic growth, and exchange rate movements. Capie *et al*. (2005), Mahdavi and Zhou (1997) and Worthington and Pahlavani (2007) also commented like Baur and Lucey. Gold demand and prices are known to respond quickly to inflationary pressure and any variation in gold prices is of concern to policy makers, investors, financial institutions, central banks, and society at large.

Hammoudeh et. al (2009) found volatility and correlation dynamics in price returns of gold and the associated risk management implications for market risk and hedging. Coudert et. al. (2011) observed that during recessions or bear markets, the covariance between gold and stocks returns was negative or null in all circumstances. Hillier, Draper and Faff (2006) come across low correlations between gold and stock market returns, which indicate that these metals can provide diversification benefit for stock portfolios. Tully and Lucey (2007), Baur and Lucey (2010) investigate the constant and time-varying relations between stock and bond returns and gold returns and response of gold returns and volatility to public information arrival (Kutan and Aksoy, 2004).

1.4. Inflation and Market Return Volatility

The discourse about linkage between stock market returns and inflation, coined by Fisher in 1930, hypothesised that the nominal interest rate consists of a real rate plus expected inflation rate. As such, in the event of an increase in the rate of inflation, the company's earnings will subside and affect the stock prices unfavourably and eventually the returns from company stocks. Johnson (1972) opines that with increase in inflation, every sector of the economy is affected including interest rates, unemployment, exchange rates, and stock markets and there is an aftermath in each sector. According to economic theory, interest rate movement has a close relationship to inflation movement in order to compensate lender for changes in the real value of nominal interest rate payments. However, interest rates do not always move exactly with inflation and the relationship between unexpected inflation and stock prices is unclear.

While some literature argues that inflation and other macroeconomic variables seem to substantially affect the behavior of financial aggregates, such as stock prices, other researchers have different arguments in respect to those variables that impact stock prices (Wongbampo and Sharma, 2002, Gunasekarage *et al*., 2004, Sohail and Hussain, 2009 and Dasgupta, 2012). Studies by Fama and Schwert (1977), Schwert (1981) and Fama (1981) found a significant negative relationship between stock market and inflation. Pearce and Roley (1985) and Hardouvelis (1988) found no significant relationship between the two variables. Merika and Anna (2006) state that inflation is negatively related to real economic activity and the negative relationship between stock returns and inflation reflects the positive impact of real variables on stock returns. Ioannides, Katrakilidis and Lake (2002) support negative correlation between stock market and inflation and conclude that stock market can hedge against inflation. Adrangi, Chatrath, and Sanvicente (2000) identify negative relationship between inflation and real stock returns, which supports Fama's proxy hypothesis framework.

Saryal (2007), established evidence of a strong time varying volatility for stock market returns in both markets, and on the impact of inflation on conditional stock market volatility found that the rate of inflation was one of the underlying determinants of conditional market volatility in Turkey, which has higher inflation rate than Canada. Kaul (1987), Schwert (1989), Davis and Kutan (2003), Hamilton and Lin (1996), Engle (2004), Engle and Rangel (2005), Rizwan and Khan (2007) established a strong predictive power of inflation on stock market volatility and returns.

1.5. Oil Price and Market Return Volatility

Oil prices, the strong empirical predictors of macroeconomic growth, have received substantial attention both from the academicians and researchers. Theories suggest that fall in global oil prices leads to significant revenue shortfalls in many oil exporting nations. It is alleged that the gains from low oil prices can be substantial for developing-country importers by stronger global growth. The decline in oil prices reflects a confluence of factors, including receding geopolitical risks, change in policy objectives of the Organization of the Petroleum Exporting Countries (OPEC), and appreciation of US dollar (Global Economic Prospects, 2015). Various researches linking oil prices to the macro-economy observe investment uncertainty (Bernanke, 1983; Dixit and Pindyck, 1994; International Monetary Fund, 2005), consumption smoothing of durable goods (Hamilton 1988a, 2003b; Lee and Ni, 2002) and it has been found that oil price shock has effect on inflation (Pierce and Enzler, 1974; Mork, 1981; Bruno and Sachs, 1982). There are mixed observations on the linkage between oil prices and economic output. Basher and Sadorsky (2006), with weekly and monthly data, find that decrease in oil price have positive and significant impacts on emerging market returns. Rasche and Tatom (1981), Darby (1982), Hamilton (1983), Burbidge and Harrison (1984), and Gisser and Goodwin (1986) found a linear negative relationship between oil prices and real activity in oil importing countries. Adaramola (2012) found a significant positive stock return to oil price shock in the short-run and a significant negative stock return to oil price shock in the long-run. Ansar and Asghar (2013) reveal a positive relationship among oil prices, CPI and KSE-100 Index but conclude that such relationship is not much stronger.

Impact of oil price fluctuations on stock market returns was studies by Abdalla (2013) and remarked that fluctuations in crude oil price led to increase in stock return volatility. Aloui, Jammazy and Dhakhlaoui (2008) comment that volatility of oil price has a negative impact on international stock market returns. According to them, oil price volatility has a negative impact on stock market behavior. A negative relationship between oil prices and stock market returns was observed by Jones and Kaul (1996), Sadorsky (1999), Papapetrou (2001), Nandha and Faff (2008), Miller and Ratti (2009). Ramos and Veiga (2010) observed that oil price could impale the depressed international stock markets but reduction in oil price might not necessarily increase stock market returns. Hamilton (1983), Cunado and Perez de Garcia (2005), and Kilian (2008) report that oil price shocks has a causal link on recessions, inflation, economic growth, and other economic variables in most developed and emerging countries. There is also empirical evidence to suggest that economic activity and financial market returns are nonlinearly associated with oil price changes (Hamilton, 2003; Zhang, 2008; Cologni and Manera, 2009). Agren (2006), using an asymmetric BEKK model, finds strong evidence of volatility spillovers from oil prices to stock markets. Malik and Ewing (2009) study volatility spillovers between oil prices and five US equity sector indices (Financials, Industrials, Consumer Services, Health Care, and Technology) and conclude in favour of significant transmission of shocks and volatility between oil prices and some of the examined market sectors.

2. Data and Methodology

The objective of the present study is to examine the effect of select macroeconomic factors like exchange rate, gross domestic product, gold price, inflation and oil price fluctuations on the stock return volatility in the Bombay Stock Exchange.

2.1. Research Hypothesis

H_{01}: Exchange rate has no significant effect on stock return volatility.

H_{02}: Gross domestic product has no significant effect on stock return volatility.

H_{03}: Inflation rate has no significant effect on stock return volatility.

H_{04}: Gold price has no significant effect on stock return volatility.

H_{05}: Crude oil price has no significant effect on stock return volatility.

2.2. Data Source

All variables used in this study are monthly observations spanning from February, 1990 to March, 2015. Stock market variable considered in this study signifies the stock return is based on closing index value of Bombay Stock Exchange (BSE) index. Information on this is collected from BSE SENSEX Historical Indices & Handbook of Statistics on Indian Securities Market. The empirical investigation considers BSE share price indices as proxy for Indian stock prices. Returns are calculated for the stock index according to the following formula:

$SR_t = Ln(P_t / LnP_{t-1})$

Here, SR_t is the stock return in month t, Ln is the logarithm, and P_t is the Bombay Stock Exchange price index at the end of month t.

In order to do time series analysis, transformation of original series is required depending upon the type of series when the data is in the level form. We have transformed the series of return by taking natural logarithm of the series. Some scholars (Bollerslev, 1986; Schewert, 1989; Engle and Patton, 2001; Harvinder Kaur, 2002) have pointed out two advantages of this kind of transformation of the series. First, it eliminates the possible dependence of changes in stock price index on the price level of the index. Second, the change in the log of the stock price index yields continuously compounded series.

The selected macroeconomic variables used in this study include inflation, GDP, exchange rate (Indian Rupee/USD), gold price and crude oil price. Information on all the macroeconomic variables is collected on monthly basis. In the estimation process, all data are transformed into logarithmic form.

2.3. Method & Model

The relationship between stock returns and the macroeconomic variables at the Indian stock exchange was implicitly specified as follows:

SR = f (GDP, ER, OIL, GLD, INFLA)

Here, SR refers to stock returns and the variables on the right hand side is the real gross domestic product (GDP), exchange rate (ER), Oil price (OIL), gold price (GDL), inflation rate (INFLA).

In analysing the effect of several macroeconomic variables on stock return volatility in Indian economy, Ordinary Least Square (OLS) model is found insufficient in analyzing data to demonstrate variances which change through time (Rachev et al., 2007). On this basis, Engle (1982) developed a new method, namely, the Autoregressive Conditional Heteroskedasticity (ARCH) model. The ARCH model pays attention more on the moving average specification than auto-regression. The GARCH models, (Bollerslev, 1986) the modified extension to ARCH (*p*), have been the most universally employed class of time series models in recent finance literatures for studying volatility. The justification of applying GARCH model is that it reduces a more complicated dynamic structure for time-varying, conditional, higher order moments of ARCH model by just adding an additional lagged conditional variance term. The uniqueness of the model lies in its ability to capture both volatility clustering and unconditional return distribution with heavy tails. In a nut shell, the key benefit of using GARCH model is allowing a longer memory process, and simultaneously, getting along with a much more flexible lag structure. This model is intended to account for a time-varying variance that, by and large, is associated with high frequency financial and economic data. Hence, to assess the effect of the time-varying variance of India's stock returns, this study adopts the standard GARCH (1,1) Mean model (Bollerslev, 1987 and Engle, 1993).

In general, the GARCH (*p,q*) can be presented as follow:

Mean equation: $y_t = x_t b + \varepsilon_t$

Variance equation: $h = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-q}^2 + \sum_{j=1}^{p} \beta_i h_{t-j}$

$$\varepsilon_t = v_t \sqrt{h_t}; v_t \sim N(0,1)$$

Since both variables on the RHS of the variance equation are known at time t, then a one-step-ahead conditional forecast can be applied by simply iterating through the model without the need for successive substitutions or complex iterations of the conditional expectations operator.

The necessary and sufficient condition for a GARCH process to be stationary is that the sum of ARCH and GARCH coefficients has to be lower than one. This condition guarantees that the effect of past shocks is gradually disappearing. For GARCH (1, 1), the above condition is simplified to: $\alpha + \beta < 1$

If this condition is not satisfied and the sum of alphas and betas is bigger than one, then we have a process which is explosive in its variance. In other words, past shocks should have bigger and bigger impact on current variance. If the sum of alphas and betas is exactly one, then we have a unit root in the variance process, which is called as the Integrated GARCH (IGARCH).

The simplest form of GARCH (p,q) is the GARCH (1,1) model for variance model. The GARCH terms represents the today's price volatility with previous volatility.

The GARCH (1,1) model is of various forms such as:

$$\sigma^2 = \alpha + \beta\mu^2_{t-1} + \gamma\sigma^2_{t-1}$$

$\gamma\sigma^2_{t-1} \rightarrow$ The part included in the ARCH equation that represents the GARCH.

$$\begin{aligned} \sigma^2 SR_{t-1} &= \alpha + \beta\mu^2_{t-1} + \gamma\sigma^2_{t-1} + \\ &\delta_a \sum EX_{t-i} + \delta_b \sum GDP_{t-i} + \delta_c \sum GLD_{t-i} + \\ &\delta_d \sum OIL_{t-i} + \delta_e \sum INFLA_{t-i} + \gamma\sigma^2_{t-1} \end{aligned}$$

3. Analysis of Results

This section performs the empirical results those include descriptive statistics, unit root tests, co- integration and relevant econometric tests. Prior to the estimation of the model, several diagnostic tests are carried out. An essential criteria in data analysis is to decide whether a series is stationary (having no unit root) or not stationary (contains a unit root). Time series data are frequently assumed to be non-stationary and accordingly it is essential to perform a pretest to ensure that all the variables are stationary in order to avoid the problem of spurious regression (Granger et. al, 2000). Non-stationary time series data has, over and over again, been a problem in empirical analysis as it may cause spurious regressions. Consequently, in testing for stationary, the standard Augmented Dickey-Fuller test is performed to test for the existence of the unit root (Dickey and Fuller, 1979). Non-constant variance in time series data generally causes problem in their analysis and hence, Bruesch-Godfrey test is used to test for heteroskedasticity in the stochastic term. Adjusted R^2 and F statistics are applied to evaluate parsimony, stability and reliability of each model (Wooldridge, 2003).

Table 1. *Unit Root Test: The Results of the Augmented Dickey Fuller (ADF) Test.*

Variables	Level/First difference	Calculated ADF	ADF critical value (at 5%)	Included in test equation	Inference
SR	Level	-15.44	-2.871	Intercept	Stationery
LnEX	Level	-3.06	-3.426	Intercept & Trend	Non-stationery
	First difference	-15.45	-2.871	Intercept	Stationery
LnGDP	Level	-2.60	-3.426	Intercept & Trend	Non-stationery
	First difference	-17.81	-2.871	Intercept	Stationery
LnGLD	Level	-1.55	-3.426	Intercept & Trend	Non-stationery
	First difference	-15.23	-2.871	Intercept	Stationery
LnOIL	Level	-2.96	-3.426	Intercept & Trend	Non-stationery
	First difference	-15.23	-2.871	Intercept	Stationery
LnINFLA	Level	-3.26	-3.426	Intercept & Trend	Non-stationery
	First difference	-13.08	-2.871	Intercept	Stationery

Ho: series has unit root; H_1: series is trend stationary

The decision on whether we analyze a time series in levels or differences is an important aspect of forecasting. Visual methods have been around for a long time. Relatively recently, statistical tests for the null hypothesis that the series is nonstationary, meaning that differencing is required, have been developed. Therefore, we should start test for stationery from intercept, intercept & trend in level (i.e no differences) and if the result is non-stationery, data need to be differenced at intercept, intercept and trend respectively in first differences to attain stationery of time series. Table 1 presents the results of the unit root test. The results show that variable of our interest- namely stock returns (SR) attained stationary at level [I(0)] using augmented Dickey Fuller Test. The results indicate that the null hypothesis of a unit root can be rejected for the given variable and, hence, one can conclude that the variable - stock returns (SR) -is stationary at level I(0). Thus the ADF tests also prove that the namely stock returns (SR) series is stationary. Macroeconomic variables like oil price (LnOIL), exchange rate (LnEX), GDP (LnGDP), gold price (LnGLD), inflation (LnINFLA) have also attained stationary after first differencing I(1) signifying that they are integrated of order one, I (1). The results show consistency with different lag structures and to the presence of the intercept or intercept and trend.

The necessary criteria for stationarity among non-stationary variables are called cointegration. Testing for cointegration is necessary step to check if our modelling has empirically meaningful relationships. Cointegration refers to a scenario where linear combination of nonstationery variables is stationery. If two series are non-stationary and integrated of same order (either I(1) or I(2) or...), their linear combination can be stationary. If this is the case, series are called co-integrated. The very concept of cointegartion was introduced to examine if there exist co-movements (long-run equilibrium relationship) among the time series which originally are non-statonary, but happen to attain stationarity after first-ordered differencing. Therefore, cointegration needs be examined only among the variables which were tested to be I(1). The unit root test result revealed that all the variables included in the model except stock eturn (SR) were found to be non stationary at level but became stationary after first difference. Therefore the concept of co-integration is relevant. Since the co-integration test requires variables must be non-stationary at level but when they are converted to first difference, then they become stationary-integrated of same order we, therefore, considered only the variables(except SR) that are integrated of the same order. The co-integration is done to test the presence of long-run relation among two or more variables. Subsequently, a co-integration test is carried out to examine the long-run relationship among selected macroeconomic variables. The results in table-2 show that, there exists long-run co-integrating relationship among different Macroeconomic variables.

Table 2. *Johansen Co-integration Tests.*

Sample: 1990:01 2015:03, Included observations: 297, Test assumption: No deterministic trend in the data, Series: LNEX, LNGDP, LNGLD, LNINFLA, Lag Interval: 1 to 4				
Hypothesized No. of CE (s)	**Eigen value**	**Likelihood Ratio**	**5% critical value**	**1% critical value**
None **	0.118792	88.93938	59.46	66.52
At most 1 **	0.106084	51.38035	39.89	45.58
At most 2	0.041023	18.07374	24.31	29.75
At most 3	0.011870	5.632847	12.53	16.31
At most 4	0.007000	2.086297	3.84	6.51

Software used: e.views
Ho: has no co-integration; H_1: has co-integration.
*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
L.R. test indicates 2 cointegrating equation(s) at 5% significance level.

3.1. Descriptive Statistics

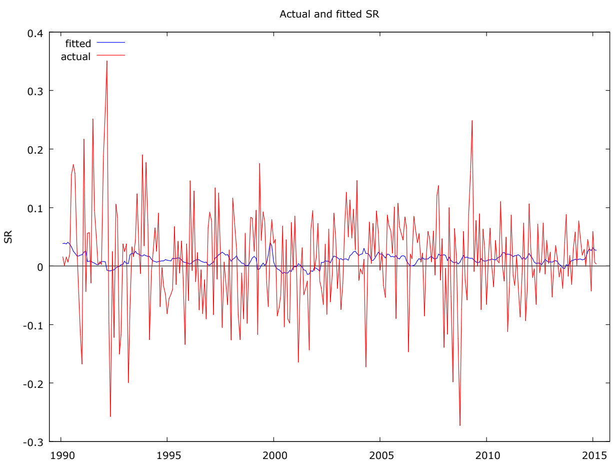
Sample mean, standard deviation, skewness and kurtosis, and the Jacque-Bera statistics and the p-value have been reported.

***Table 3.** Descriptive statistics for India's stock market returns and other macro-economic variables.*

	SR	LnEX	LnGDP	LnGLD	LnINFLA	LnOIL
Mean	0.012132	3.701209	7.574879	6.263989	1.948599	3.593813
Median	0.013742	3.783174	7.467462	5.959445	2.081313	3.350430
Maximum	0.350632	4.155703	9.272003	7.479271	2.979095	4.897093
Minimum	-0.27299	2.812362	5.941355	5.545490	-1.514128	2.282382
Standard Deviation	0.082562	0.278632	0.934786	0.602100	0.546261	0.738886
Skewness	0.063604	-1.196298	0.209815	0.740828	-1.550616	0.281348
Kurtosis	4.514929	4.577576	1.823171	2.028176	9.265674	1.629521
Jarque-Bera	29.08250	103.3502	19.64280	39.50849	615.0270	27.61841
Probability	0.000000	0.000000	0.000054	0.000000	0.000000	0.000001
Observations	302	302	302	302	302	302

Note: The standard value of the kurtosis for normal distribution is equal to 3, skewness value for the normal distribution is equal to zero. Jarque-Bera is used to test the hypothesis of normality.
Source: Authors' own estimate

Standard deviation being a measure of the dispersion or spread of the series, the unconditional standard deviation of 0.082562 shows that India's stock market returns are not so volatile during the study period. The kurtosis value of 4.514929 implies that this series strongly departs from normality. As it exceeds 3, which is normal value, it shows that the stock market returns is tailed to right and reveals leptokurtic distribution. The low probability value, as is estimated in the Jarque-Bera test, rejects null hypothesis that the data series is normally distributed. Therefore, as expected, the Jarque-Bera normality test strongly rejects the null hypothesis of normality for Indian stock market returns. Also, the series exhibits asymmetric skewness skewed to right (0.063604) signifying that the investors in India's stock market are likely to earn positive returns.

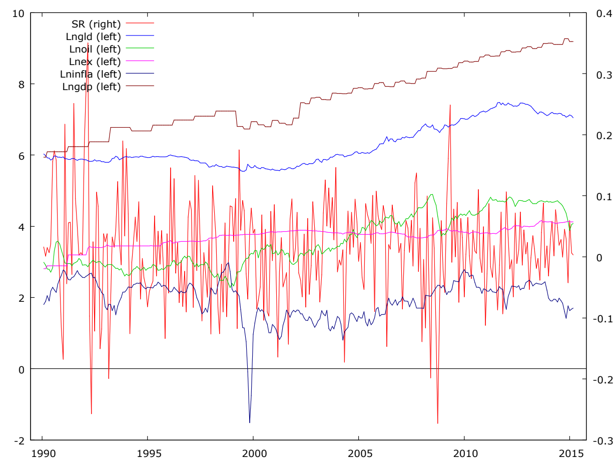


Source: Authors' own estimate from observed data

***Figure 1.** India's stock market returns.*

Another feature of Indian stock market returns is volatility clustering. It is evident from Figure 1 that periods of high (low) volatility in Indian stock market returns are followed by periods of low (high) volatility. Theoretically, clustered volatility reveals that at the beginning of each period new information leads to higher volatility associated with large returns. This can be attributed to the phenomenon of heterogeneity of expectations (Kirchler and Huber, 2007).

Figure 2 illustrates the monthly stock return, gold price, GDP, inflation, exchange rate, oil price from February, 1990 to March, 2015. The trend in the movement of stock return and the gold price, GDP, inflation, exchange rate, oil price was expected to be higher in 2008-2009 onward than 1990-91.



Source: Authors' own estimate from observed data

***Figure 2.** Monthly stock return, gold price, GDP, Inflation, Exchange rate, Oil price:1990:2-2015:3.*

3.2. Auto Correlation Function Test

Durbin-Watson (D-W) statistic measures the linear association between adjacent residuals from a regression model. As a rule of thumb, with 50 or more observations and only a few independent variables, a D-W statistic below 1.5 is a strong indication of positive first order serial correlation. In our study, D-W statistic is found below 2 (1.797) as indicated form table 7 which is a clear indication of positive autocorrelation. Therefore, D-W statistic of less than 2 indicates auto correlation in the residuals.

The ACF plot is also useful for identifying stationery or non-stationary time series.

Table 4. *ACF&PACF.*

Lag	ACF	PACF	Q-Stat	Prob
1	0.113	0.113	3.8818	0.049
2	0.041	0.029	4.3989	0.111
3	-0.049	-0.058	5.1411	0.162
4	-0.059	-0.049	6.1961	0.185
5	0.050	0.067	6.9699	0.223
6	0.073	0.063	8.6020	0.197
7	-0.040	-0.067	9.0911	0.246
8	-0.074	-0.068	10.797	0.213
9	-0.043	-0.010	11.387	0.250
10	0.019	0.033	11.497	0.320
11	0.059	0.036	12.589	0.321
12	0.009	-0.017	12.613	0.398

Source: Authors' own estimate

Alternatively, since the AC's are significantly positive and the AC (k) dies off geometrically with increasing lag k, it is a sign that the series obeys a low-order autoregressive (AR) process. In addition, since the partial autocorrelation (PAC) is significantly positive at lag 1 and close to zero, thereafter, the pattern of autocorrelation can be captured by an auto regression of order one (i.e., AR(1)).

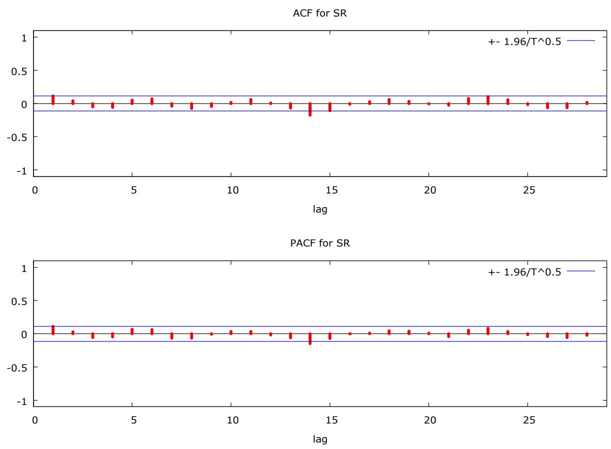


Figure 3. *Correlogram.*

The correlogram shows that its spikes are not showing any pattern, which means series or data becomes stationary. The correlogram shows also that there is no discernable pattern, and because the lags pierce the ±1.96 standard error boundaries less than 5% of the time, this time series (SR) is stationary. Augmented Dickey-Fuller (Unit Root) Test in table also supports that ADF value is smaller than critical vaule (p-value) at 5% which signifies that null hypothesis of unit root test, i.e., series is non-stationary or series has unit root, is rejected.

Autocorrelation, if present, would appear in Lag 1 and progress for k lags, then disappear. Normally, the graph would have limits (blue shaded) in above figure. Here, the bar at a particular lag in the middle of the diagram exceeded the limit, it would indicate the presence of autocorrelation.

3.3. Diagnostic Tests

The diagnostic tests are performed to the equation regarding problems such as autocorrelation and heteroskedasticity. Diagnostics are necessary to establish the power of the results in respect to robustness, biasness and efficiency of the estimates. We have conducted different diagnostic tests (Reliability tests as well as stability tests) in order to see whether our results are free from problem of serial autocorrelation, heteroskedasticity etc.

Table 5. *Residual Test.*

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	1.591410	Probability	0.205387
Obs*R-squared	7.234411	Probability	0.003452
ARCH Test			
F-statistic	15.29669	Probability	0.000114
Obs*R-squared	14.64955	Probability	0.000129
White Heteroskedasticity Test: cross term			
F-statistic	3.856308	Probability	0.000064
Obs*R-squared	35.33785	Probability	0.000109
White Heteroskedasticity Test: no cross term			
F-statistic	2.862551	Probability	0.000063
Obs*R-squared	51.11532	Probability	0.000153

Source: Authors' own estimate

The top part of the output presents the test statistics and associated probability values. The Obs*R-squared statistic is the Breusch-Godfrey LM test statistic for the null hypothesis of no serial correlation. Since the calculated Breusch-Godfrey LM test statistic of 7.23 exceeds the critical χ^2 (1) value (i.e 3.84), we can reject the hypothesis of no serial correlation up to lag order 1 at the 95% confidence level. The (effectively) zero probability value corresponding to 'Obs*R-squared' strongly indicates the presence of serial correlation in the residuals.

ARCH is a Lagrange multiplier (LM) test for autoregressive conditional heteroskedasticity in the residuals (Engle 1982). In our study, there is evidence of autoregressive conditional heteroskedasticity (ARCH) in the residuals. The ARCH test results strongly suggest the presence of ARCH in the residuals as probability corresponding to Obs*R-squared is zero or near zero. White's Heteroskedasticity test is a test for heteroskedasticity in the residuals from a least squares regression (White, 1980). It also refers to the test of the null hypothesis of no heteroskedasticity against heteroskedasticity of some unknown general form. The test statistic is computed by an auxiliary regression, where we have regressed the squared residuals on all possible (non redundant) cross products of the regressors. Since the Obs*R-squared value of 35.33785 (with cross term) and 51.11532 (with no cross term) is greater than the 5% critical value of 11.07, we can reject the null hypothesis of no heteroskedasticity up to lag order 5 at the 95% confidence level. The above result suggests that the distribution is not free from heteroskedasticity.

3.4. Chow Breakpoint Test

U.S. recession, from December 2007 till June 2009, extending over 19 months owing to U.S. sub-prime mortgage crisis has not only affected the stock markets in India but the global stock markets at large. With the increasing integration of the Indian economy and its financial markets with rest of the world, our country has faced downside risks from the economic meltdown. The combination of a rapid sell off by financial institutions and the prospect of economic slowdown have severely affected the stocks and commodities market. Foreign institutional investors pulled out close to US $ 11 billion from India, dragging the capital market down with it (Lakshman 2008). The immediate impact of the US financial crisis has been felt when India's stock market started crashing. Following global cues and heavy selling in the international markets, the BSE SENSEX fell by 615-points in a single day on August 1, 2007. Stock prices have fallen by 60 per cent. SENSEX which touched above 21,000 mark in January, 2008 subsequently plunged below 10,000 during October 2008 (Kundu 2008).

Table 6. *Stability Test.*

Chow Breakpoint Test: 2008:10			
F-statistic	0.856847	Probability	0.510555
Log likelihood ratio	4.398784	Probability	0.493539

Source: Author's own estimate

Table 7. *Pairwise Granger Causality Tests.*

Sample: 1990:02 2015:03				
Lags: 2				
Null Hypothesis:	**Obs**	**F-Statistic**	**Probability**	**Accept /Reject**
LNEX does not Granger Cause SR	300	2.81349	0.04161	Reject
SR does not Granger Cause LNEX		4.13779	0.01689	Reject
LNGDP does not Granger Cause SR	300	0.59725	0.55099	Accept
SR does not Granger Cause LNGDP		0.97695	0.37767	Accept
LNGLD does not Granger Cause SR	300	1.25555	0.28644	Accept
SR does not Granger Cause LNGLD		0.82191	0.44059	Accept
LNINFLA does not Granger Cause SR	300	0.36393	0.69525	Accept
SR does not Granger Cause LNINFLA		1.60331	0.20298	Accept
LNOIL does not Granger Cause SR	300	0.41953	0.65775	Accept
SR does not Granger Cause LNOIL		8.71885	0.00021	Reject

Source: Author's own estimate

A series of data may often contain a structural break, due to a change in policy or sudden shock to the economy like sub-prime lending crisis in US economy. With respect to our analysis, it is of particular interest whether the US crisis which later transform to global recession has somehow changed the relationship between the Indian stock market return and their determinants. To test for presence of structural breaks, the Chow test is applied. It was introduced by Chow (1960) to determine whether the impact of explanatory variables is time-varying. In our study, we have examined presence of structural breaks through Chow test. The F-statistics was the highest during December, 2008, with a *p*-value more than zero. It means that we accept the null hypothesis of no breaking point in our sample. it is also to be noted that the breakpoint test statistics decisively does accept the hypothesis of no structural break in the Indian stock market return function before and after 2008:10.

The results of pairwise granger causality between stock return (SR) and different macro economic variables are contained in Table 7. We have found that causality between stock return (SR)and exchange rate(LNEX) is bidirectional , no causality exist between stock return (SR) and GDP growth(LNGDP), stock return (SR)and gold price (LNGLD). There exist unidirectional causality between stock return (SR)and oil price(LNOIL).

3.5. Generalized Autoregressive Conditional Heteroskedasticity [GARCH (1,1)] Analysis

The GARCH (1,1) test has been applied after checking for heteroskedasticity. Table 7 below presents the GARCH-Mean, variance equations of the GARCH (1,1) model using the maximum likelihood method and different diagnostic fits of the model. The mean equation in Panel A, clearly shows that LNEX influences the stock mean returns. On the other hand, LNGDP, LNOIL and LNINFLA do not influence the stock mean returns significantly. The LNGLD has no form of influence on stock mean returns.

The ARCH and GARCH estimate the conditional variances of prices of macro economic variables like gold price, GDP, inflation, exchange rate, oil price etc. In the GARCH (1,1) model, the effect of a return shock on current volatility declines geometrically over time. The sizes of the parameters α and β determine the short-run dynamics of the resulting volatility time series.

The three coefficients in the variance equation in panel-B are listed as C, the intercept: ARCH (α), the first lag of the squared return; and GARCH (β), the first lag of the conditional variance. The variance equation in panel B shows that the ARCH (α) and GARCH (β) coefficients are found to be significantly positive. These results indicates that lagged conditional variance and lagged square distribute have a significant bearing on the conditional variance. Moreover, the coefficient of the lagged squared effect was positive and statistically significant for Indian stock market. We conclude that strong GARCH effects are visible for Indian stock market. However, this provides evidence of ARCH and GARCH effect on volatility of stock returns in India. This shows that there is volatility clustering in Indian stock market. The positive sign of ARCH observed is in support with Engle (1982) and Bollerslev (1986), whose emphases were on a non-negative estimate of the ARCH. Alshogeathri (2011) observed that in the GARCH model, the sign of the shock is irrelevant, but the magnitude of the positive or negative shocks is the only factor that matters for conditional volatility.

In our study, the ARCH (α) estimates are usually small (less than 0.2) and the GARCH (β) estimates are usually high and close to one. Therefore, the long run persistence is generally close to one indicating a near long memory process. A shock in the volatility series impacts on futures volatility over a long horizon. We observe that the coefficients sum up to a number less than one, which is required to have a mean reverting variance process. The sum of the ARCH and GARCH coefficients is less than one ($\alpha + \beta = 0.9747<1$), which reveals that the unconditional variance is stationary. It also indicates that all markets satisfy the second moment and log-moment condition. Since the sum of $\alpha + \beta$ is averagely close to one, this process only mean reverts slowly signifying that the time-varying volatility of Indian stock market returns is moderately persistent which indicates that a 'shock' at time t will persist for many future periods. That is, there is a mean reverting variance process. A high value of $\alpha + \beta$, therefore, implies a 'long memory', which is again a property of the return series used in this study as the value of $\alpha + \beta$ in the GARCH estimation is very close to unity.

The ARCH (α) is found lower than GARCH (β), which implies that the volatility of the stock market is affected by past volatility ARCH (α_1) more than the economic news from the previous period GARCH (β_1). Large GARCH error coefficient β means that volatility reacts quite intensely to market movements. Also, the large GARCH coefficient ($\beta = 0.847392$) indicates that shocks to the conditional variance take a long time to die out, so volatility is persistent.

Table 8. *Estimates of the GARCH (1,1) Model.*

Panel: A: Mean Equation

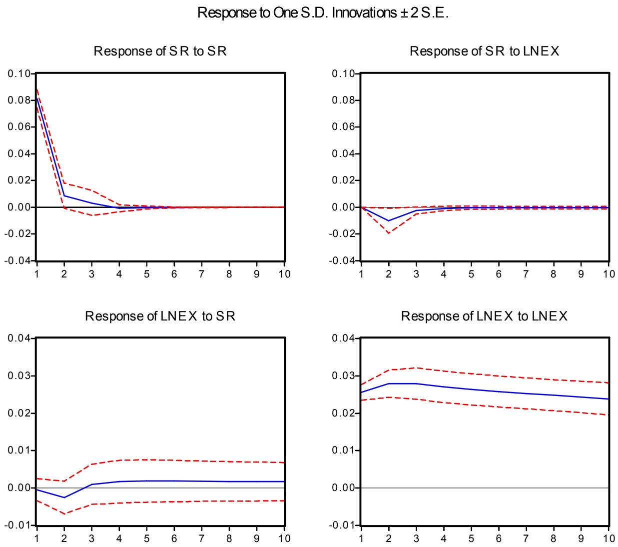
Variables	Coefficient	Std. Error	z-Statistic	Prob.
C	0.176107	0.109884	1.602668	0.1090
LNEX	-0.089573	0.034900	-2.566560	0.0103
LNGDP	0.037143	0.023331	1.591999	0.1114
LNGLD	-0.002052	0.029077	-0.070575	0.9437
LNINFLA	-0.017383	0.012770	-1.361189	0.1735
LNOIL	-0.018909	0.015503	-1.219722	0.2226
Panel:B: Variance Equation				
C	0.000193	0.000180	1.071021	0.2842
ARCH(α)	0.127348	0.038515	3.306426	0.0009
GARCH(β)	0.847392	0.051475	16.46217	0.0000
α + β	0.9747< 1			
R-squared	0.020786	Mean dependent var		0.012132
Adjusted R-squared	-0.005951	S.D. dependent var		0.082562
S.E. of regression	0.082808	Akaike info criterion		-2.235760
Sum squared residual	2.009135	Schwarz criterion		-2.125184
Log likelihood	346.5997	F-statistic		0.777432
Durbin-Watson stat	1.797046	Prob(F-statistic)		0.622928

Source: Authors' own estimate

3.6. The Response of Stock Market Returns to Shocks in Each Macroeconomic Variable

In economics, and especially in contemporary macroeconomic modeling, impulse response functions are used to describe how the economy reacts over time to exogenous impulses, which economists usually call shocks, and are often modeled in the context of a vector autoregression. The vector autoregression (VAR) is an econometric model used to capture the linear interdependencies among multiple time series. VAR models generalize the univariate autoregressive model (AR model) by allowing for more than one evolving variable. All variables in a VAR are treated symmetrically in a structural sense (although the estimated quantitative response coefficients will not in general be the same); each variable has an equation explaining its evolution based on its own lags and the lags of the other model variables. In a VAR, we are often interested in obtaining the impulse response functions. Impulse responses trace out the response of current and future values of each of the variables to a one-unit increase (or to a one-standard deviation increase, when the scale matters) in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. The implied thought experiment of changing one error while holding the others constant makes most sense when the errors are uncorrelated across equations, so impulse responses are typically calculated for recursive and structural VARs.

Therefore, to examine the signs and persistence of the short-run response of the stock market returns to one standard error shocks in each of the macroeconomic variables, impulse response functions are estimated. Impulse response function for exchange rate only was done since other macroeconomic variables like GDP, inflation, gold price and oil price were not significant in determining stock market returns. Figure 4 shows the results of the response of stock market returns resulting from one standard deviation shock in exchange rate. As for the Impulse Response Function, figure 4 suggests that LNEX has an immediate effect on stock return(SR) indicating negative responses from very beginning to second segments and it (negative responses) continued upto third segment period and reverts to equilibrium in the subsequent segment period. The decline in stock returns as a result of the shock is consistent with the findings from the GARCH model that stock returns were negatively related with exchange rate. Similar findings were reported in the study by Adam and Twenoboah (2008), Evans Kirui, Nelson H. W. Wawire & Perez O. Onono (2014).



Source: Authors' own estimate from observed data

Figure 4. *Response to One S.D Innovations ± 2 S.E.*

4. Findings and Conclusion

This study examines the relationships between the BSE stock returns and a set of macroeconomic variables during the period of February 1990 to March 2015. The time series data set employed in this study is comprised of the monthly observations of the Bombay Stock Exchange (BSE), the inflation rate (INFLA), gross domestic product (GDP), exchange rate (EX), gold price (GLD), oil price (OIL). Unit root test by Augmented Dickey Fuller test and Johansen co-integration test are used to examine stationarity and the existence of long-run relationship among the variables respectively. The effect of the one standard deviation shock is traced by impulse response functions. Volatility of stock returns in response to changes in macroeconomic variables is traced by the GARCH (1,1) model.

The paper suggests that the stock returns are leptokurtic and thus not normally distributed and the volatility of returns is not highly persistent. By employing Johansen co-integration, it has been observed that long term relationship exists between stock market return volatility and macroeconomic variables. We have found that causality between stock return (SR)and exchange rate(LNEX) is bidirectional , no causality exist between stock return (SR) and GDP growth(LNGDP), stock return (SR)and gold price (LNGLD). There exist unidirectional causality between stock return (SR)and oil price(LNOIL).

The findings suggest that only exchange rate has an effect on stock returns. There is a significant negative relationship between stock returns and the exchange rate. The depreciation of Indian rupee causes the stock returns to be lower and vice versa. One standard deviation shock to the first differenced value of log of exchange rate negatively affects stock returns. This is evident that stock returns are negatively related to changes in exchange rates. The effects of one standard deviation shock in exchange rate result in the declined of stock returns from the beginning to third segment period and reverts back to the equilibrium in the subsequent periods. The decline in stock returns supports the negative and significant coefficient of the exchange rate. Oil price and inflation have also negative impact, though not significantly, on stock return volatility. Other macroeconomic variables like GDP growth, gold price are not important in explaining stock returns. But it should be noted that the Chow breakpoint test statistics suggests that there does not have any structural break or change in the Indian stock market return function before and after 2008:10 although BSE SENSEX declines sharply after sub prime lending crisis.

High volatility of stock return leads to high risk and as because most investors are risk averse, they tend to set themselves aside from the market due to uncertainty in expected returns. High market volatility also adds to unfavorable market risk premium. Therefore, it is vital for policy makers to trim down the stock market volatility and eventually develop economic stability in order to improve the effectiveness of the asset allocation decisions. The government should put in place suitable policy measures to make certain that the exchange rate is stabilized. This is because empirical evidence from study has exposed that exchange rate affects stock returns. Depreciation in the exchange rate leads to a decline in returns from the stock exchange. Once the currency starts stabilizing, it would help in building investors' confidence and shove them towards stock exchange. Moreover, it will create a more noteworthy impact on the performance of the Indian stock market and hence promote economic growth. Thus, there is an urgent call for recognizing those relevant and dynamic factors that have significant corollary on stock market return. Information on persistent news of return would not only enable investors make coherent investment decisions but aid the regulators in framing appropriate policies bearing a holistic development of the country.

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