

A Survey on the Influence of Gold, Crude Oil & US Dollar Rates on Stock Price Movement in India

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ABSTRACT: The Global Financial Crisis (GFC) which began in the midst of 2007 and gained momentum in 2008 by the fall of leading American Banks like Lehman Brothers affected the economic environment all over the globe. This crisis rattled all the developed and developing market sentiments. The prime aim of this study is to predict the impact of GFC on stock and commodity market in India. We have employed granger causality test and vector auto regression (VAR) model using monthly average price of Standard Gold, Brent Crude Oil, US Dollar Exchange Rate and S&P BSE 100 index for twenty five years from 1990 to 2015. Granger causality test reveals that there exists uni-directional causality from US Dollar Exchange rate to BSE 100, from oil price index to US Dollar which means there is short run interchangeable lead-lag relationship between these variables. Valid evidence resulted from impulse-response function shows that oil market has a negative effect on BSE 100 in long run.

JEL Classifications: G01, G15

KEYWORDS: BSE 100, Global financial Crisis, Impulse-response function

I. INTRODUCTION

In the fast growing Indian economy today's investors are mostly concerned about the protective environment for their investment. After the LPG (Liberalisation, Privatisation and Globalisation) of Indian economy in 1991, the Indian financial and commodities market, are facing strategic changes. In this respect Indian financial and commodities market investors /players, are concerned about global economic and political conditions. Stock market is one of the important factors, which is considered as indicator of economic growth of a country. Stock markets are getting more integrated with financial markets as well as financial indices. Generally, stock markets are influenced by several interconnected economic, social and political factors and these factors interact with each other in a very intricate manner, that stock prices are determined by few macroeconomic variables like crude oil price, gold price and exchange rate. For example, precariousness of oil price sometimes has a serious impact on other economic variables [1] The review of literatures have established significant effects of oil price changes on economic activity in several developed and developing countries [2]. Similarly, international crude oil price and exchange rates are greatly influenced by the stock market. It is particularly true in the case of Indian stock market; number of studies (Amlendu Bhunia [3]and Vivek Sharma [4]) state that any significant change in the price of petroleum makes an impact on inflation numbers, which in turn have an impact on the stock market. The commodity and stock markets are receptive to geopolitical and economic events that take place at international and national level and reacts instantaneously. Negative news flow which leads to volatility in the markets dents the confidence of investors due to loss in wealth and asset value. Volatility is an important input for taking decisions about diversification in portfolio and hedging plans (Hameed and Ashraf, 2006) [5]. At times higher volatility due to negative shock implicates the investor to quit from the market as panic grips. As the world economy is not steady due to various businesses, political, social and more importantly globalised economic environments, Indian economy also faces the same kind of problem, which in recent times has resulted in the decline of GDP growth and increasing inflation rate. The Global Financial Crisis (GFC) which began in the midst of 2007 and gained momentum in 2008 by the fall of leading American Banks like Lehman Brothers affected the economic environment all over the globe. The investor confidence in US hit a rock bottom due to credit crunch which was due to various parameters. By the midst of 2008, the crisis spilled over across all the stock markets around the globe causing

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high volatility in the markets. This crisis rattled all the developed and developing market sentiments. GFC is more peculiar than Asian Financial Crisis which caused deeper wounds in the markets. Probably, it is the largest crisis after great recession of 1930s that has affected both real and financial sectors (Llanto and Badiola, 2010) [6]. GFC basically started in a small way in second half of 2007 due to subprime mortgage disaster and got wild impetus in 2008. This crisis badly affected FDI, portfolio investment and exports of the developing countries (Iqbal, 2010)[7]. The developing and developed countries faced a knee jerk reaction due to GFC. Spillover effect was unprecedented in the economies due to the advanced technological environment and globalisation. An inflow to the emerging markets from emerged markets was drastically reduced during this crisis. Like other sectors, world's stock markets also affected by this storm and faced steep declining trend from the first month of 2008 (Usman, 2010) [8]. the present study has the objectives as

1. To examine the interrelationship between S&P BSE 100, Standard Gold price, Brent Crude oil and US Dollar rates.
2. To estimate the individual influence of these indices on BSE 100 index.
3. To examine the combined influence of Standard Gold price, Brent Crude Oil price and US Dollar on BSE 100 index.

II. LITERATURE REVIEW

Let us review few studies which reported the volatility of stock markets and the influence of global financial crisis on these markets. The negative effect of Asian Financial crisis 1997 was studied by many researchers. Alper and Yilmaz (2004) [9] analysed the impression of financial crisis that initiated in Turkey during 1994, Asian Financial Crisis 1997 and Latin America crisis during 1998 on Istanbul and other stock markets. They concluded that these crises had an impact on these markets. Lim, et al., (2008) [10], in their study analysed in detail the repercussions of Asian Financial Crisis on eight Asian regional markets, found that the efficacy of the Asian Stock markets worsened during both pre and post crisis period out of these eight stock markets Hong Kong stood worst affected by this crisis. Olowe (2009)[11] analyses proved that Nigerian Market was invulnerable both in volatility as well as asset quality during this crisis period. WimNaude (2009)[12] in his study on the financial crisis 2008 and developing countries critically discussed the aftermath of this effect which led to US and Western countries markets jittery with anticipated deep global recession. His study concluded that developed nations sustained this crisis with a deal of optimism and without the support of developing markets with a great deal of resilience, developed markets growth prospects would have been much bleaker.

III. RESEARCH METHODOLOGY

In line with this objective, the researcher has used both quantitative and qualitative methodology. For the qualitative analysis, the researcher has used the empirical evidences from literature review regarding the macroeconomic factors affecting the stock market. Theories and previous studies suggest that macroeconomic variables such as exchange rate, oil price and gold price influence each other. The exchange rate considered was the RBI reference rate of daily nominal spot rate i.e., rupee per US Dollar price as available for each foreign exchange market day under the study period. For oil price, OPEC countries prices are taken into consideration. The gold price taken for consideration is the monthly average price obtained from the World Gold Council. S&P BSE 100 index is considered as the benchmark index since this index is comprehensive and the data are available for analysis and is used to measure the market price movements of Indian securities.

Data Sources: Since the present study relay on the economic variables, it required secondary data. Hence, the present data has been collected from various sources like, websites, journals, books and thesis. Monthly average closing value has been taken for representing the series of S&P BSE 100 index; data has been collected from the BSE website. The monthly average gold price data has been collected from Reserve Bank of India (RBI) website. The monthly average Brent oil price has been collected from the U.S. Energy Information Administration website. **Tools of Analysis:** To satisfy the objectives of the study, various time series econometric models were used. The analysis was carried out using the computer software EVIEWS 6 which is made for econometric analysis. The following tools were used for the analysis of the study:

1. Descriptive Statistics for checking normality of the data
2. Augmented Dickey-Fuller Test for Unit-Root

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3. Johnson's Co-integration test
4. Granger Causality test
5. VAR model selection
6. Vector Error Correction model
7. Impulse response functions
8. Variance decomposition Analysis

IV. ANALYSIS

The following section presents the co-integration results which show that BSE-100 and USD/INR, BSE and Gold price and BSE and Oil price are co-integrated. The economic time series may be non-stationary but its appropriate linear combination may confiscate common trend. This makes the resulting new series to be stationary which implies that the time series is co-integrated.

Johansen's Co integration Test **Table 1.1**
Johansen's Co-Integration Test during Global Financial Crisis

Unrestricted Co-Integration		Trace Rank Test			Max-Eigen Value test		
Hypothesized No. of CE (s)	Eigen Value	Trace	Critical value @ 5%	Prob* *	Max Eigen Value	Critical Value @ 5%	Prob**
None	0.16447	30.9377	47.85613	0.6698	16.17206	27.58434	0.6512
At most 1	0.09473	14.7656	29.79707	0.795	8.956738	21.13162	0.8359
At most 2	0.03928	5.80889	15.49471	0.718	3.606765	14.2646	0.8983
At most 3	0.02417	2.20213	3.841466	0.1378	2.202125	3.841466	0.1378

Source: Data Analysis Eviews Out put *denotes rejection of the hypothesis at 5%;**MacKinnon-Haug-Michelis(1999) p- values.

H0: Co integration analysis confirms existence of long-run relationship between the selected variables.

H1: There does not exist a long-run relationship between the selected variables.

With reference to the results summarised in Table 1.1 above, Maximal Eigen statistic (λ max) of 16.17 is less than the 5 % critical value of 27.58 and the trace test statistic (λ trace) of 30.94 is less than the critical value of 47.856 and the corresponding p values less than 05. Therefore, the null hypothesis of no co integration (ie. $r = 0$) will be accepted. Since co integration tests indicate only the existence of long-run relationship among the series, granger causality tests were used to analyse the direction of relationship among the series. The Granger causality test gave the following results:

Table 1.2
Pair-wise Granger Causality Tests during Global Financial Crisis

Null Hypothesis	F Stat	P-Value	Remarks	Causality
DOLLAR does not Granger Cause BSE_100	7.70739	0.0067*	Reject	Unidirectional
BSE_100 does not Granger Cause DOLLAR	0.01327	0.9086	Accept	No Causality
GOLD_PRICE does not Granger Cause BSE_100	2.65336	0.1069	Accept	No Causality
BSE_100 does not Granger Cause GOLD_PRICE	0.26965	0.6049	Accept	No Causality
OILPRICE does not Granger Cause BSE_100	2.36509	0.1277	Accept	No Causality
BSE_100 does not Granger Cause OILPRICE	0.00023	0.988	Accept	No Causality
GOLD_PRICE does not Granger Cause DOLLAR	1.38443	0.2426	Accept	No Causality

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DOLLAR does not Granger Cause GOLD_PRICE	1.37471	0.2442	Accept	No Causality
OILPRICE does not Granger Cause DOLLAR	4.96103	0.0285*	Reject	Unidirectional
DOLLAR does not Granger Cause OILPRICE	2.69008	0.1046	Accept	No Causality
OILPRICE does not Granger Cause OLD_PRICE	0.22929	0.6333	Accept	No Causality
GOLD_PRICE does not Granger Cause OILPRICE	0.01467	0.9039	Accept	No Causality

Source: Computed Data *indicates that 5% level of Significance

The f-values and the p-values in the test results shown in the above Table 1.2 suggest that the null hypotheses of No Causality are significant at 1% and therefore can be rejected. There is evidence of uni-directional causality from US Dollar Exchange rate to BSE 100, from Oil price index to US Dollar Exchange rate which means in the short run there is interchangeable lead- lag relationship between these variables.

VAR Model: The result of the co integration test established the number (three) of co integration vectors. It is moreover indicating that three common stochastic trends or a degree of market integration are present there. The Table 1.3 presents the applications of Vector Auto regression (VAR) Model at the selected time series.

Table 1.3
Estimations of the 'Unrestricted Series Autoregressive Vector' during Global Financial Crisis

	BSE_100	DOLLAR	GOLD_PRICE	OIL_PRICE
BSE_100(-1)	0.786865	-0.0005	-0.34716	0.004773
	-0.11602	-0.00037	-0.28024	-0.00207
	[6.78209]	[-1.36005]	[-1.23881]	[2.30294]
BSE_100(-2)	0.146927	0.000553	0.340343	-0.00496
	-0.11588	-0.00037	-0.27989	-0.00207
	[1.26794]	[1.50645]	[1.21598]	[-2.39653]
DOLLAR(-1)	-33.9009	1.1506	-39.0231	-0.20773
	-39.9832	-0.12672	-96.5752	-0.71422
	[-0.84788]	[9.08001]	[-0.40407]	[-0.29085]
DOLLAR(-2)	53.86675	-0.17348	20.43479	-0.27583
	-41.1204	-0.13032	-99.3218	-0.73453
	[1.30998]	[-1.33116]	[0.20574]	[-0.37552]
GOLD_PRICE(-1)	0.033738	-6.46E-05	1.00708	0.000832
	-0.04806	-0.00015	-0.11607	-0.00086
	[0.70205]	[-0.42420]	[8.67617]	[0.96891]
GOLD_PRICE(-2)	-0.02615	6.44E-05	-0.00577	-0.00029
	-0.04957	-0.00016	-0.11973	-0.00089
	[-0.52757]	[0.40984]	[-0.04819]	[-0.32691]
OILPRICE(-1)	4.561337	-0.00624	10.10543	1.354263
	-5.51682	-0.01748	-13.3253	-0.09855
	[0.82681]	[-0.35658]	[0.75837]	[13.7424]
OILPRICE(-2)	-8.49129	0.01578	-12.9419	-0.48194
	-5.52677	-0.01752	-13.3493	-0.09872
	[-1.53639]	[0.90089]	[-0.96948]	[-4.88172]
C	-397.477	0.220089	1439.6	25.18989
	-476.294	-1.50951	-1150.44	-8.50801
	[-0.83452]	[0.14580]	[1.25135]	[2.96073]

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R-squared	0.940985	0.978799	0.987073	0.934126
Adj. R-squared	0.935083	0.976679	0.98578	0.927538
Sum sq. resids	9407399	94.49091	54883857	3001.755
S.E. equation	342.9176	1.086801	828.2803	6.125515
F-statistic	159.4483	461.6778	763.5609	141.804
Log likelihood	-641.078	-128.95	-719.564	-282.851
Akaike AIC	14.60849	3.099992	16.37222	6.55844
Schwarz SC	14.86015	3.351651	16.62388	6.8101
Mean dependent	5598.877	51.10642	22269.6	94.18247
S.D. dependent	1345.898	7.116663	6945.895	22.75558
Determinant resid covariance (dof adj.)		2.43E+12		
Determinant resid covariance		1.59E+12		
Log likelihood		-1755.32		
Akaike information criterion		40.25435		
Schwarz criterion		41.26099		

By application of the VAR model, the time series has been observed with others can be established if the table value is more than 1.96. The Table 1.3 shows that BSE 100 index at the lag of 1 had influence on the returns of Oil price index and BSE 100. However, with a lag of 2, it had influence only on the returns of Oil price index under the study. The index of US Dollar Exchange rate at the lag of 1 and 2 had influence on the returns of US Dollar index only means that Dollar index movement does not influence other indexes. At the lag of 1, only Gold price index have influenced and others not influenced while at lag order 2, none of the indexes has influenced under the study. The Oil price index at the lag order 1, Oil price index only has influenced while at lag order 2, none of the variables has influenced.

Variance Decomposition Analysis (VDA):The following section deals with variance decomposition, to check the percentage change in the variable when a shock is introduced in the residual series. Usually one standard deviation shock is assumed in residual series.

In the Table 1.4 the percentage change in BSE 100, Dollar, Gold and Oil prices are analysed when there is one standard deviation shock in BSE 100.

Table 1.4
Variance Decomposition of BSE 100 during Global Financial Crisis

Period	S.E.	BSE_100	DOLLAR	GOLD_PRICE	OIL_PRICE
1	342.9176	100	0	0	0
2	445.6299	98.69839	0.582933	0.350808	0.367867
3	522.5203	98.6162	0.454718	0.618567	0.310514
4	573.3622	98.27723	0.455145	0.895987	0.371635
5	611.0406	96.84552	0.941116	1.109135	1.104228
6	642.4558	93.94069	2.138175	1.231102	2.690034
7	671.89	89.73545	4.128629	1.257364	4.878561
8	701.0742	84.73877	6.850929	1.212267	7.198038
9	730.3562	79.48868	10.16046	1.131399	9.219457
10	759.5297	74.37225	13.8862	1.046329	10.69522
11	788.3356	69.59321	17.86538	0.976954	11.56445
12	816.6448	65.21967	21.95583	0.931113	11.89339

Source: Data Analysis Views Out put

From table 1.4 its concluded that, when there is one standard deviation change in residual BSE 100 equation, i.e. three months, 98.62% of change happens in BSE, and other indexes has influenced only less than 1 percent. Likewise one standard deviation change in residual BSE 100, in long run i.e. twelve months, 65.22% of change happens in BSE 100, 21.96% change in Dollar, 0.93% in Gold price and 11.89% in Oil price (total being 100). Further it is clear from the

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table that, the level of influence of long run shock in BSE 100, is increasing Dollar Exchange rate and Oil prices as compared with short run shock in BSE 100. The following Table 1.5 presents the variance decomposition of US Dollar Exchange Rate.

Table 1.5
Variance Decomposition of US Dollar Exchange Rate during Global Financial Crisis

Period	S.E.	BSE_100	DOLLAR	GOLD_PRICE	OIL_PRICE
1	1.086801	17.91058	82.08942	0	0
2	1.714128	23.37676	76.49001	0.086774	0.046449
3	2.164254	24.08744	75.70078	0.176886	0.034892
4	2.499305	24.03003	75.62843	0.230616	0.110916
5	2.757119	23.46445	75.73054	0.250265	0.554744
6	2.963661	22.6404	75.6173	0.240281	1.50201
7	3.135247	21.70276	75.18683	0.216691	2.893712
8	3.28141	20.76151	74.48653	0.203225	4.548741
9	3.407455	19.88746	73.62789	0.225913	6.258739
10	3.5165	19.1176	72.72022	0.308171	7.854017
11	3.610768	18.46324	71.84041	0.467926	9.228416
12	3.692237	17.91957	71.028	0.71662	10.33582

Source: Data Analysis Eviews Out put

From the above Table 1.5 it can be concluded that, when there is one standard deviation shock change in residual US Dollar Exchange rate equation, in the short term i.e. three months, 75.70% of change happens in US Dollar Exchange rate, 24.09%.change in BSE 100, 0.18% in Gold price and 0.03% in Oil price (total being 100). Likewise one standard deviation shock change in residual US Dollar Exchange Rate, in the long run i.e. twelve months, 71.03% of change happens in US Dollar Exchange Rate , 17.92% change in BSE 100, 0.72% in Gold price and 10.34% in Oil price (total being 100). Further it is clear from the table that, the level of influence of long run shock in US Dollar Exchange rate, influences increasing BSE 100, Oil prices as compared with short run shock in US Dollar Exchange rate.

The following Table 1.6 presents the variance decomposition of Gold price.

Table 1.6
Variance Decomposition of Gold price during Global Financial Crisis

Period	S.E.	BSE_100	DOLLAR	GOLD_PRICE	OIL_PRICE
1	828.2803	6.418454	4.98234	88.59921	0
2	1191.34	9.817726	3.645739	86.2839	0.252635
3	1455.998	9.680756	3.104111	86.89398	0.321156
4	1678.994	9.439409	2.612118	87.64691	0.301559
5	1874.012	9.114681	2.217816	88.41908	0.248426
6	2049.623	8.810499	1.901579	89.07497	0.212952
7	2210.317	8.536285	1.650718	89.58785	0.225151
8	2358.925	8.293641	1.452399	89.95769	0.296271
9	2497.247	8.07829	1.295973	90.20137	0.424364
10	2626.503	7.885585	1.172832	90.34154	0.600039
11	2626.503	7.885585	1.07615	90.40142	0.811059
12	2861.086	7.552341	1.000548	90.40182	1.045288

Source: Data Analysis Eviews Out put

From the above Table 1.6 it can be concluded that, when there is one standard deviation shock change in residual Gold price equation, in the short term i.e. three months, 86.89% of change happens in Gold prices, 9.82% change in BSE 100, 3.65% in US Dollar Exchange rate and 0.25% in Oil price (total being 100). Likewise one standard deviation

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shock change in residual Gold price, in the long run i.e. twelve months, 90.40% of change happens in Gold price, 7.55% change in BSE 100, 1.00% in US Dollar Exchange Rate and 1.04% in Oil price (total being 100). Further it is clear from the table that, the level of influence of long run shock in Gold price, influences increase in BSE 100 index as compared with short run shock in Gold price.

V. FINDINGS

The study found that gold price recorded the highest followed by stock, exchange rate and oil price. Volatility is high in the case of gold price and stock price. Skewness was negative in the case of gold price and oil price index and the kurtosis is more than 3 for BSE 100, for oil price it was close to 3. Further, the probability value of gold and oil price index is less than 0.05, it signifying that the distribution is leptokurtic. Further, other variable distributions are platykurtic since kurtosis is less than 3. It is found from the study that the calculated value of the test statistic 't' is less than its critical value and all the probability values are also greater than 0.05, the null hypothesis is accepted. Which means for the series BSE 100, Exchange rate of dollar and oil price, unit root exists and they are non-stationary of the series at it levels both in intercept with and without constant. Even though at its level all the data has unit root, the unit root tests reject the same null hypothesis in the first differenced form of the series. At their first-difference the calculated |t| value is more than the critical value and all the probability value is also less than 0.05. Hence, the null hypothesis is rejected, which indicates that in the first differenced form, all the series are stationary. Therefore, each time series data is integrated in order one, or I (1). Maximal Eigen statistic (λ max) of 16.17 is less than the 5% critical value of 27.58 and the trace test statistic (λ trace) of 30.94 is less than the critical value of 47.856 and the corresponding p values less than 0.05. Therefore, the null hypothesis of no co-integration (ie. $r = 0$) will be accepted. Hence, the time series of the selected variables during this period are co-integrated. Further, it can trace any co-movement for the period. The null hypotheses of no causality are significant at 1% and therefore can be rejected. There is evidence of uni-directional causality from US Dollar exchange rate to BSE 100, from oil price index to US Dollar exchange rate which means in the short run there is interchangeable lead-lag relationship between these variables. The analysis shows that BSE 100 index at the lag of 1 had influence on the returns of oil price index and BSE 100. However, with a lag of 2, it had influenced only on the returns of oil price index under the study. The index of US Dollar exchange rate at the lag of 1 and 2 had influenced on the returns of US Dollar index which means that dollar index movement does not influence other indices. It is found from the study that one standard deviation change in residual BSE 100 equation, in short term i.e. three months, 98.62% of change happens in BSE, and other indices has influenced only less than 1 percent. Likewise one standard deviation change in residual BSE 100, in long run i.e. twelve months, 65.22% of change occurs in BSE 100, 21.96% change in dollar, 0.93% in gold price and 11.89% in oil price (total being 100). Valid evidence resulted from Impulse-Response Functions indicates that BSE 100 may react to independent variable changes. Interestingly, BSE 100 shows a negative reaction with a standard deviation in oil price, that means, oil market will have a negative effect on BSE 100 in long run. In addition, it appears that the US Dollar exchange rate index reaction to oil price is negative both in long run as well as in short run.

VI. CONCLUSION

This study aims at investigating the relationship among the S&P BSE 100, US Dollar Exchange Rate, Crude Oil Price and Gold Price in India during post global financial crisis period. The major conclusion of the study is that the selected time series exhibits non-stationary and therefore provides an indication of long-term co-integration relationships. In short, selected time series variables are closely interlinked. US Dollar exchange rate and Oil price are essential unpredictable variables that operate as channel during which the stock prices are associated. The Granger causality test reveals that the US Dollar Exchange rate, Gold and Oil prices instability has an influence on each other. However, BSE 100 does not cause other series. Further, it is clear from the result that, the level of influence of long run shock in S&P BSE 100, is increasing dollar exchange rate and oil price compared to short run shock in BSE 100. This study has brought out the relationships between macro-economic variables Gold Price, Crude Oil and US Dollar rates with S&P BSE 100 index. This study is of immense use for the policy makers to make appropriate decision for mitigating the problems faced by the investors while their investments by unpredictable shocks in the economy.

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