

## Impact of Select Macro Economic Variables on SENSEX: A Behavioural Study during the Pre & Post-Economic Recession Era



### Finance

KEYWORDS :

**Dr. M. Subrahmanya Sharma**

Sr. Professor, Department of Commerce & Business Management, University P.G. College, Kakatiya University, Warangal, Andhra Pradesh.

**Mrs. Ch. Chaitanya**

Asso. Prof. Vidyadayini College of Information Technology, Aff. Osmania University, RCI Main Road, Mallapur, Hyderabad, A.P. 500005

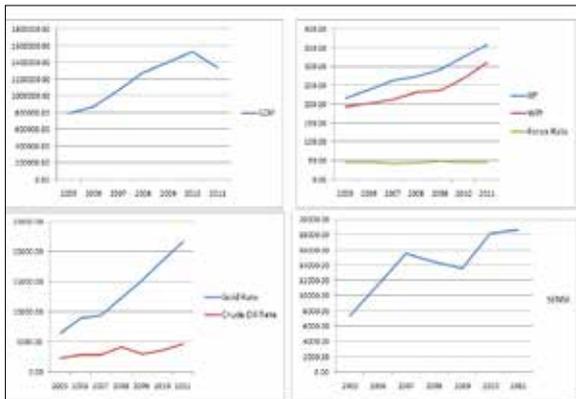
### ABSTRACT

*In this paper, an attempt has been made to explore the influential relationship between SENSEX of Bombay Stock Exchange (BSE) and select macro economic variables of India by using Stepwise Regression model. Quarterly data has been used from 2005 to 2011 for all the used variables to study the relationship. The statistical findings of the study reveal that there is an influential relationship on SENSEX by Industrial Production and Foreign Exchange Rate*

### INTRODUCTION

The last five years have been a significant period in the Indian capital market. BSE Sensitive Index, the prime benchmark in India, has risen from 6,300 in Jan 2005 to 19,300 in Jan 2008. SENSEX has risen to 3 times in this period. Then from Feb 2008, it started falling and touched 8,995 by Mar 2009. SENSEX has been most affected by the global financial crisis that first erupted with the collapse of the U.S. subprime mortgage during this term. However, Indian financial markets remained largely orderly for most part of the 2008-09. From April 2009, the SENSEX started recovering and touched all time highs by Oct 2010. This is basically attributed to the continued and robust growth of the Indian economy during 2008-09 and further. The stock market index has seen all time highs, as well as lows during the past five years. A rising trend in SENSEX indicates improving business climate and greater growth expectations as it attracts capital infusion from retail, institutions, and FIIs. At the same time, a falling trend in the market index is attributed to several factors. Any negative growth in these factors in turn makes the index to fall. It is believed that government financial policy and macro-economic variables, primarily Gross Domestic Product, Industrial Production, Inflation (Wholesale Price Index), Foreign Exchange Rate, Gold Rate, and Crude Oil Rate have large influence on the overall economy, including the stock market.

Trend lines of select Economic variables & Sensex during 2005-11:



**GDP:** The growth in GDP indicates the overall improvement of an economy. The rate of growth of GDP in comparison with growth in population and rate of inflation specify the additional resources made available in the country. It also attracts Foreign Institutional & Direct Investments facilitating capital infusion. From the past few years, the growth in India's GDP was affected by the negative impact of tightening of monetary policy by RBI, as well as a slowdown in global growth due to recession and rising oil prices. There are indications that India's GDP is witnessing a slowdown in fixed capital formation (i.e. new corporate investments) affecting the stock market. Average annual growth of GDP during 2005-11 is at 8.5%.

Year	2005	2006	2007	2008	2009	2010	2011
GDP (annual growth %)	7.50	9.50	9.60	9.30	6.80	8.00	8.50

**Inflation:** Inflationary pressures are persisting from the last five years. The Wholesale Price Index (WPI) y-o-y inflation was also on an average remaining around 9, as well as price pressures persisting across a range of commodities covered in the WPI. High rates of inflation increase the cost of living thereby eroding the purchasing power of income. This shifts resources from investments to consumption leading to a fall in the demand for market instruments thereby reducing the volume of stock traded.

Year	2005	2006	2007	2008	2009	2010	2011
WPI(real values)	193.68	203.01	212.79	232.19	237.13	268.28	312.58

**Foreign Exchange Rate:** In the past few years, the rising interest rates, raw materials costs, and oil prices; withdrawal of incentive schemes by Govt.; and slowdown in Global and Asian economies hindering the growth in exports. Ideally, exchange rate i.e. the supply and demand position of the currency would dependent on balance between exports and imports between the 2 countries. Further in a globalised environment, currency flows, through FIIs and FDIs tend to affect the exchange rate. But as aforementioned in GDP, this growth was hindered by several factors causing depreciation in rupee value. This leads to a high burden on corporate borrowings in turn affecting the stock market.

Year	2005	2006	2007	2008	2009	2010	2011
Forex Rate (Rs./ \$)	44.10	45.31	41.33	43.51	48.40	45.73	44.99

**Industrial Production:** As mentioned in GDP that there is a slowdown in the investment activity level in the economy showing negative impact on the industrial production. It is a well known fact that in any Economy, while consumer spending indicates the Demand then IIP indicates the total Production and in turn the Supply. Any fall in the consumer spending leads to lower demand and in turn lower productivity. This downwards the Index of Industrial Production (IIP) making stock prices to fall.

Year	2005	2006	2007	2008	2009	2010	2011
IIP (real values)	216.72	239.58	263.33	274.98	293.18	326.66	359.42

**Gold:** Gold has seen an impressive surge over the past few years. It has become the 'best' alternative investment in times of economic turmoil and currency instability. Hence, the gold movement is seen as inversely proportional to stock markets, as well as dollar movements.

Year	2005	2006	2007	2008	2009	2010	2011
Gold Rate (Rs/10gms)	6441.88	8910.21	9343.39	12248.52	15227.76	18438.24	21615.00

Crude Oil: Crude oil has become one of the prime variables impacting the economy. India imports 70% of its oil needs. Past few years have witnessed high international oil prices and no upward revision in daily oil production quota by oil producing countries. This in turn puts pressure on India's overall oil import bill, as well as making India to a continuous upward revision in retail oil prices. Eventually these things affect the India's Forex reserves, and increases consumer spending lowering the investments in capital market, as well as industrial production.

Year	2005	2006	2007	2008	2009	2010	2011
Crude Oil Rate(Rs./Barrel)	2354.39	2914.72	2922.76	4158.73	2976.77	3609.55	4717.17

Considering all these developments on SENSEX during the past five years, as well as the inferred interrelationships among the market index and macro economic variables, a necessity has been arisen to explore for the influential relationship, if any, between them. To be more precise, the author felt the need to study the relationship between SENSEX of Bombay Stock Exchange (BSE) and Macro Economic Variables of India. The study has been conducted by using Stepwise Regression Model between SENSEX and Economic variables, including Gross Domestic Product, Industrial Production, Wholesale Price Index, Foreign Exchange Rate, Gold Rate, and Crude Oil Rate. Data and Methodology

The quarterly data from 2005(Q1) to 2011(Q2) has been used in the study to investigate the influential relationship between SENSEX and Macro Economic Variables. The data for the aforementioned variables is available at Financial Statistics maintained by Reserve Bank of India (RBI). Crude Oil prices are collected from IMF and other relevant Websites.

Table: 1

Symbol	Variable	Definition
BSE	BSE SENSEX	Index with base year as 1978-79
GDP	At Factor Cost (At Current Prices)	(Base : 1993-94)
Inflation	Wholesale Price Index (WPI)	Index with base year as 1993-94
Industrial Production	Index of Industrial Production (IIP)	Index with base year as 1993-94
Exchange Rate	Monthly Average Rs./\$ Exchange Rate	Actual Value
Oil Prices	Rs./Barrel	Average Price (Whenever Revised)
Gold Prices	Monthly Average Price of Gold Rs./10 gms	Actual Value

The authors have chosen the widely known and used of the search procedures, Stepwise Regression. It begins by developing a regression model with a single predictor and adds and deletes predictors one step at a time, examining the fit of the model at each step until no more significant predictors remain outside the model.

Step 1: In Step 1 of the regression procedure, the 'k' independent variables are examined one at a time by developing a simple regression model for each independent variable to predict the dependent variable. The model containing the largest absolute value of 't' for an independent variable is selected as the 'best' single predictor of 'y'. Let the selected independent variable be

X1. Now the model appears as  
 $\hat{y} = b_0 + b_1x_1$

If after examining all possible single-predictor models, it is concluded that none of the independent variables produces a t value that is significant at  $\alpha$ , then the search procedure stops at step 1 and recommends no model.

Step 2: In Step 2, the procedure examines all possible 2 predictor regression models with X1 as one of the independent variables in the model and determines which of the other k-1 independent variables in conjunction with X1 produces the highest absolute t value in the model. Let the second variable selected from the remaining independent variables be X2.  
 $\hat{y} = b_0 + b_1 x_1 + b_2x_2$

Sometimes the regression coefficient for X1 will become statistically insignificant when X2 is entered in to the model. In such a scenario, the procedure drops X1 and continues to find relevant variable from the remaining. If no such variable is identified then the procedure stops.

Step 3: It begins with independent variables that were finally selected at Step 2, namely X1 and X2. A search is made to find out which of the remaining independent variables in conjunction with X1 and X2 produces the largest significant absolute t value in the regression model. Let the selected independent variable be X3.  
 $\hat{y} = b_0 + b_1x_2 + b_2x_2 + b_3x_3$

If no significant values are found at this step, the process stops here and the model determined in the Step 2 will be final.

Further, the model continues step by step until no significant independent variables remain that are not in the model.

**ANALYSIS**

To develop a regression model to predict the SENSEX, the author used the stepwise regression search procedure considering the following 6 independent variables:

1. GDP
2. IIP
3. WPI
4. FOREX RATE
5. GOLD RATE
6. CRUDE OIL RATE

Step 1: Each of the above independent variables is examined one at a time to determine the strength of each predictor in a simple regression. The results are as follows:

**Results of Simple Regression Using Each Independent Variable to Predict Impact on SENSEX**

Dependent Variable	Independent Variables	tRatio	R <sup>2</sup>	Resolution
SENSEX	GDP	4.996	50.98%	X <sub>1</sub>
	WPI	5.388	54.74%	
	IIP	6.966	66.91%	
	FOREX RATE	-1.101	4.81%	
	GOLD RATE	3.806	55.82%	
	CRUDEOIL RATE	5.016	51.18%	

The independent variable IIP is selected as the predictor variable X<sub>1</sub>. The results say that IIP produced the largest absolute t value i.e. 6.97 of the single predictors. By itself, IIP accounted for 67% of the variation of the SENSEX values. The regression equation is

$Y = -7709 + 78.0 X_1$ , which transforms as  
 SENSEX = -7709 + 78.0 IIP

Step 2: X1 was retained in the model and the search was conducted among the five remaining independent variables to determine which of those variables in conjunction with X1 produce the largest significant t value.

**Regression Results with Two Predictors**

Dependent Variable	Independent Variable	Independent Variables	t Ratio of	Resolution
Y	X <sub>1</sub>	X <sub>2</sub>	X <sub>2</sub>	R <sup>2</sup>
SENSEX	IIP	GDP	0.070	66.91%
SENSEX	IIP	WPI	-0.500	67.30%
SENSEX	IIP	FOREX RATE	-5.040	84.30%
SENSEX	IIP	GOLD RATE	-1.380	69.40%
SENSEX	IIP	CRUDE OIL RATE	2.490	73.90%

The above table shows that the model selected in Step 2 also includes IIP and the results say that Forex Rate produced the largest absolute t value = 5.05 and is significant at  $\alpha = 0.05$ . The model produced at this step has R2 of 84.5%. These two variables taken together accounted for almost 85% of the SENSEX in this sample.

The t value for X1 is obtained as 6.97 in Step 1 whereas in Step 2 as 10.78 which is even higher than that in Step 1. Hence, X1 is retained in the model. Therefore the regression equation is  $Y = 19112 + 87.3 X1 - 657 X2$  which transforms as

$$SENSEX = 19112 + 87.3 IIP - 657 \text{ Forex Rate}$$

Step 3: The search procedure continues to look for an additional predictor variable from the remaining four independent variables retaining the already selected two variables, IIP & Forex Rate.

**Regression Results with Four Predictors**

Dependent Variable	Independent Variable	Independent Variable	Independent Variables	t Ratio of	Resolution
Y	X <sub>1</sub>	X <sub>2</sub>	X <sub>3</sub>	X <sub>3</sub>	R <sup>2</sup>
SENSEX	IIP	FOREX RATE	GDP	1.550	85.80%
SENSEX	IIP	FOREX RATE	WPI	-0.470	84.40%
SENSEX	IIP	FOREX RATE	GOLD RATE	1.060	85.00%
SENSEX	IIP	FOREX RATE	CRUDE OIL RATE	1.070	85.00%

The above results say that none of the four independent variables produce t ratios that are significant at  $\alpha = 0.05$ . No new variables are added to the model produced in Step 2. Hence the stepwise regression process ends here.

**MINITAB STEPWISE REGRESSION OUTPUT**

Following figure shows the MINITAB stepwise regression output for the sample considered in this research:



**CONCLUSION**

Year wise data of select Economic indicators Vs Sensex - real values

	2005	2006	2007	2008	2009	2010	2011
GDP	792236.25	869995.00	1065162.00	1278642.00	1402097.75	1526918.50	1337132.50
Gold Rate	6441.88	8910.21	9343.39	12248.52	15227.76	18438.24	21615.00
Crude Oil Rate	2354.39	2914.72	2922.76	4158.73	2976.77	3609.55	4717.17
IIP	216.72	239.58	263.33	274.98	293.18	326.66	359.42
WPI	193.68	203.01	212.79	232.19	237.13	268.28	312.58
Forex Rate	44.10	45.31	41.33	43.51	48.40	45.73	44.99
SENSEX	7386.04	11445.14	15551.55	14418.65	13605.19	18187.59	18631.09

The stepwise model resulted from the MINITAB solution also substantiate the results revealed from the research as

- Search for the regression model was halted at Step 2 indicating that none of the remaining 4 independent variables produced t ratios that are significant at  $\alpha = 0.05$ .
- IIP and Forex Rate are selected as X1 and X2 respectively.
- T-Value as 6.97 in Step 1 & 10.78 in Step 2.
- Regression Coefficients as -7709 and 19112 respectively.

**EXTENDED RESEARCH**

The statistical results from the above study are showing that there is an influential relationship on SENSEX by IIP & Forex Rate. On the other hand, an extended study was conducted to find out the indirect influence on SENSEX, if any, by the statistically irrelevant variables found in the initial research.

IIP: The author studied the relation between X1 (IIP) and remaining economic variables using a simple regression.

**Results of Simple Regression Using Each Independent Variable to Predict Impact on IIP**

Dependent Variable	Independent Variables	t Ratio	R <sup>2</sup>
IIP	GOLD RATE	17.948	93.07%
	WPI	12.521	86.72%
	GDP	8.546	75.27%
	CRUDE OIL RATE	3.874	38.48%
	FOREX RATE	1.147	5.19%

The results from the simple regression showing the possible influential relationship on IIP by Gold Rate (having highest absolute t value and r square) followed by WPI and GDP.

Forex Rate: The author studied the relation between X2 (Forex Rate) and remaining economic variables using a simple regression.

**Results of Simple Regression Using Each Independent Variable to Predict Impact on Exchange Rate**

Dependent Variable	Independent Variable	t Ratio	R <sup>2</sup>
FOREX RATE	GOLD RATE	1.906	13.15%
	WPI	1.155	5.27%
	GDP	1.693	10.67%
	CRUDE OIL RATE	-1.004	4.03%
	IIP	1.147	5.19%

The above simple regression results are showing that there is no significant relation among Forex Rate and remaining economic variables. The reason for this could be the supply and demand position of the currency is again dependant on various other factors.

The statistical results of the Stepwise regression between the SENSEX and the selected Macro Economic Variables revealed that there is a significant influential relationship between SENSEX, and Industrial Production & Foreign Exchange Rate fluctuations. These two factors taken together are accounted for almost 85% of the SENSEX movements during the considered time period. An extended study to find out the indirect influence on SENSEX, if any, by the statistically irrelevant variables as per the study revealed that

- o There exist a possible influential relationship on IIP by Gold Rate, WPI and GDP. Plausible reasons: It is a well know fact that in any Economy, while consumer spending indicates the Demand then IIP indicates the total Production and in turn the Supply. Any fall in the consumer spending leads

to lower demand in turn to lower productivity. This downwards the IIP making stock prices to fall. Again Industrial Production is dependent on various other factors, including but not limited to, Technological; Managerial; Financial; and Govt. Policy & Regulation.

- o There is no significant relation among Forex Rate and remaining economic variables. Plausible reasons: Forex Rate: Ideally in any Economy, exchange rate i.e. the supply and demand position of the currency is primarily dependent on balance between exports and imports between the 2 countries. Further in a globalised environment, 'currency flows' through FIIs and FDIs tend to affect the exchange rate. Again Exchange rate is dependent on various other factors, including but not limited to, Interest Rates, Government Budget Deficits/Surpluses, and Business & Political Environment.

## REFERENCE

- Text Books and Published Material: | 1. Ken Black, Business Statistics: For Contemporary Decision Making – 4th Edition, WILEY INDIA Pvt. Ltd, New Delhi. | 2. Macroeconomic and Monetary Developments - Mid-Term Review 2008-09 Reserve Bank of India. | 3. Macroeconomic and Monetary Developments Second Quarter Review 2011-12. | 4. Current State of Indian Economy June 2011 – RBI | 5. Macroeconomic Factors and Stock Market Movement: Evidence from Ghana By Anokye M. Adam | 6. 'EdelEye – A Monthly Wealth Management Perspective' - October 2008 Publication of Edelweiss Securities Limited (Edelweiss). | 7. Leading Indicators of The Indian Economy - By Lt Col D G Naik, Grenville Savio Noronha, Gnanasundaram C, and Kaushik K | 8. Input Output Modeling of Impact of Exchange Rate Fluctuations on Indian Economy - By Dr. Shri Prakash and Ms. Rekha Sharma | 9. Understanding the relationship of domestic and international factors with stock prices in India: an application of arch - By Gupta, Rajnarayan | 10. 'What Moves Indian Stock Market: A Study on the Linkage with Real Economy in the Post-Reform Era' By Ray, Prantik and Vani, Vina | 11. Determinants of BSE SENSEX: A Factor Analysis Approach By Arijit Ghosh, Samrat Roy, Gautam Bandyopadhyay, Kripasindhu Choudhuri | | Websites: | 1. <http://www.rbi.org.in> | 2. <http://www.bseindia.com> | 3. <http://www.imf.org/external/np/res/commod/> | 4. <http://www.indexmundi.com> | 5. <http://www.x-rates.com> | 6. <http://stockshastra.moneyworks4me.com/learn> |