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## INTER-RELATIONSHIP BETWEEN MACROECONOMIC VARIABLES AND S&P BSE AUTO INDEX

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### **ABSTRACT:**

*The macroeconomic variables and sector-specific index are inter-linked. The objective of this Paper is to investigate the relationship between S&P BSE Auto index and macroeconomic variables. This study uses monthly data to find the inter-relationship between S&P BSE Auto index returns and selected macroeconomic variables by applying Cointegration and VECM techniques.*

### **INTRODUCTION:**

There are interlinkages between macroeconomic variables and different sector-specific indices. The sectoral index is based on basket of stocks and average price movement of basket of stocks indicates the movement in sectoral index. The value of indices is calculated and disseminated on real time basis during the trading time. The calculation is based on the prices at which trades in index constituents are executed. Sector-based indices facilitate investors to scale the performance of stocks grouped by specific sectors. It allows investors to make more selective choices to invest in the companies or banks on the basis of the performance of sectoral index. Understanding the interlinkage between macroeconomic variables and S&P BSE sectoral index like S&P BSE Auto index is useful for sector-specific investors as well as policy makers.

The performance of the sectoral indices summarizes the performance of stocks grouped by specific sectors. The movement of sectoral indices can be linked to the changes in macroeconomic variables. It depends on several factors like global factors, economic factors, political factors, scrip-specific factors, market news, human emotions, and stochastic factors. Assuming that other

factors remain the same, i.e., ceteris paribus, inter-relationship between macroeconomic variables and S&P BSE Auto index is investigated in India.

This paper is organized into the following Sections. After this introductory Section, Section 2 emphasizes insights from selected empirical literatures. Section 3 rationalizes specification of variables. In Section 4, the data and methodology for the analysis are discussed. The empirical results are reported and interpreted in Section 5 and the conclusions of study are provided in Section 6.

### **Insights From Literature Review:**

Several studies have examined the relationship between macroeconomic variables and composite stock index but there are few papers which analysed the impact of macroeconomic variables on sectoral indices. Some studies (Maysami et. at. (2004), Kalyanarayan L. (2015) etc.) analyzed the relationship between macroeconomic variables and sector-specific indices using cointegration and VECM techniques.

The main aim of this paper is to fill the research gap by examining a long-run relationship between the macroeconomic variables and sectoral indices in India with reference to S&P BSE Auto index by using cointegration and VECM method. We have used monthly data to examine the relationship between sectoral index (S&P BSE Auto) and macroeconomics variables

### **SPECIFICATION OF THE VARIABLES:**

This section has been divided into two categories i.e. S&P BSE sectoral index (S&P BSE Auto) and macroeconomic variables that affecting the index.

#### **I. S&P BSE Auto**

S&P BSE Auto index is the sectoral index representing automobile sectors. The base year of BSE Auto Index is 1<sup>st</sup> February, 1999 and the base value is 1000. This Index was launched on 23<sup>rd</sup> August, 2004 following the free-float market capitalization methodology. This methodology is a widely followed standard index construction methodology on which majority of global equity indices are based. The free-float methodology does not include restricted stocks,  
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such as those held by promoters, government and strategic investors. S&P BSE Auto Index represents 13 companies, which are listed below in the **Box 1**.

<b>Box 1: Companies Represents by S&amp;P BSE Auto</b>	
<ul style="list-style-type: none"> <li>• Ashok Leyland Ltd.</li> <li>• Bajaj-Auto Ltd.</li> <li>• Bharat Forg Ltd.</li> <li>• Bosch Ltd.</li> <li>• Cummins India Ltd.</li> <li>• Exide Industries Ltd.</li> <li>• Eicher Motors Ltd.</li> </ul>	<ul style="list-style-type: none"> <li>• Hero-Motocorp Ltd.</li> <li>• Mahindra &amp; Mahindra Ltd.</li> <li>• Maruti Ltd.</li> <li>• Motherson Sumi System Ltd.</li> <li>• MRF Ltd.</li> <li>• Tata Motors Ltd.</li> </ul>

*Source: BSE*

## **II. Macroeconomic Variables**

Based on the review of literature, we have used index of industrial production, wholesale price index, exchange rate, broad money supply and short-term interest rate as macroeconomic variables. Rationalization of macroeconomic variables with respect to overall index is necessary. The Composite index, i.e., BSE Sensex also includes important sectors like auto, finance, pharmaceutical, healthcare etc. Therefore, the expected direction for macroeconomic variables can be the same for composite index and sectoral indices. To explore the directions, this paper examines the relationship between macroeconomic variables and sector-specific index like S&P BSE Auto index.

There are two main factors that determine the variations in equity returns, namely, local risk factors and world risk factors. Bailsen et al. (1999) have addressed macroeconomic variables as proxy for local risk factors, which are the primary source of variation in equity returns. Maysami et al. (2004) used the domestic macroeconomic variables with respect to stock market's sector indices in Singapore. Based on literature, we have chosen macroeconomic variables, namely, index of industrial production, wholesale price index, exchange rate, broad money supply, and 91-Day T-bill rate for this study.

**DATA AND METHODOLOGY:**

The techniques for data analysis include the Unit Root Test, Cointegration and Vector Error Correction Model to find the impact of macroeconomic variables on stock market returns with reference to S&P BSE Auto index. A time series data at monthly frequency is used for the period from January, 2004 to March, 2016 which comprises 147 data points for the analysis. The data are obtained from the Handbook of Statistics on Indian Economy, Reserve Bank of India (RBI) and the Bombay Stock Exchange Ltd. (BSE). The data of S&P BSE Auto index are taken from Bombay Stock Exchange. Since it is difficult to incorporate all aspects to explain the stock market behavior, the selected macroeconomic variables, namely, Index of Industrial Production, Wholesale Price Index, Broad Money Supply, Exchange Rate and 91-Day T-Bill rate are used to represent state of economy. All variables are converted into natural logarithmic form for analysis. Description of variables is depicted in following **Table 1**.

**Table 1: Description of the Variables**

<b>Abbreviations</b>	<b>Construction of Variables</b>	<b>Data Source</b>
<b>LNAUTO</b>	Natural logarithm of the monthly average of S&P BSE Auto Index	BSE
<b>LNIP</b>	Natural logarithm of the monthly Index of Industrial Production	RBI
<b>LNWPI</b>	Natural logarithm of the monthly Wholesale Price Index	RBI
<b>LN3M</b>	Natural logarithm of the monthly Broad Money Supply (M3)	RBI
<b>LNEXCH</b>	Natural logarithm of the monthly average Exchange Rate of the Indian Rupee	RBI
<b>LNTBILL</b>	Natural logarithm of the Month-end Rate of the 91-day Government of India treasury bills	RBI

*Source: Author Estimated.*

Granger (1986), Johansen & Juselius (1990), Mukherjee and Naka (1995), Maysami & Koh (2000) etc. have applied the VECM methodology to establish a

long-run relationship between selected macroeconomic variables and stock market returns along with short-run dynamics. Sims (1980) introduced a technique to characterize the joint dynamic behavior of a collection of variables that is known as Vector Auto Regression (VAR). A VAR system contains a set of ( $m$ ) variables, each of which is expressed as a linear function of  $p$  lags of itself and of all of the other ( $m - 1$ ) variables, plus an error term. When variables of a VAR are cointegrated, a Vector Error Correction (VEC) model can be used.

VECM requires investigation of stationarity properties of the series. The widely-used tests for stationary are ADF, PP and KPSS. The unit root test is conducted to test whether data series in the model are stationary or non-stationary. In a multivariate context, if the variable under consideration are found to be integrated  $I(1)$  but the linear combination of the integrated variables is  $I(0)$  (i.e. stationary), such variables are said to be cointegrated (Enders, 2004).

#### EMPIRICAL RESULTS AND INTERPRETATIONS:

ADF test has been applied to check stationarity in data series of BSE Auto index. Based on the ADF test, all the series are found to be non-stationary. Further, after taking the first difference these series are found to be stationary at 1 percent level. The Johansen procedure has been applied to establish cointegration by using lag 3. Specifically, trace statistic and the maximum Eigen value have been used to test for the number of cointegrating vectors. It has been identified that there exists one cointegrating vector. The normalized cointegrating coefficients for the S&P BSE Auto index are reported in **Table 2**.

**Table 2: Multivariate Johansen Cointegration Test Result**

Sectoral Indices ( $Y_t$ )	LNIIIP <sub>t</sub>	LNWPI <sub>t</sub>	LNEXCH <sub>t</sub>	LNLM3 <sub>t</sub>	LNTBILL <sub>t</sub>
LNAUTO <sub>t</sub>	-2.08	3.25	-2.56	-0.60	-0.71

*Source: Author Estimated.*

Based on the Johansen Cointegration methodology, assuming one co-integrating vector, the Vector Error Correction Model has been estimated to check the variables that respond to the magnitude of the disequilibrium. The result of VECM for long-run relationship are presented below in **Table 3**.

**Table 3: Vector Error Correction Estimates (Long-run Relationship)**

Long-run Rel.	LNIIP	LNWPI	LNEXCH	LNМ3	LNTBILL	C
LNAUTO	-2.08 (0.55) [-3.79]	3.25 (2.01) [1.62]	-2.56 (0.72) [-3.57]	-0.60 (0.88) [-0.68]	-0.71 (0.27) [-2.63]	3.30

Source: Author Estimated, Standard errors in ( ) & t-statistics in [ ].

The cointegration relationships between S&P BSE Auto index and selected macroeconomic variables can be re-expressed in the equation form as:

$$\text{LNAUTO}_t = -3.30 + 2.08\text{LNIIP}_t - 3.25\text{LNWPI}_t + 2.56\text{LNEXCH}_t + 0.60\text{LNМ3}_t + 0.71\text{LNTBILL}_t \dots \dots \dots (1)$$

It is found that S&P BSE Auto index is cointegrated with macroeconomic variables. As expected, industrial production and inflation are turning out to be in the right direction for this index. Directions of IIP, WPI, Exchange Rate, M3 and T-Bill rate are summarized. Summary of the long-run relationship is presented below in **Table 4**.

**Table 4: Summary of the Long-run Relationship between Macroeconomic Variables and S&P BSE Auto Index**

Long-run Relation	IIP	WPI	EXCH	M3	TBILL
S&P AUTO	+	-	+	+	+

Source: Author Estimated.

**CONCLUSION:**

Cointegration relationship between S&P BSE Auto index and macroeconomic variables has been established by using VECM methodology. It is found that BSE Auto index shows positive relation with IIP in the estimation. It indicates that Auto Index returns are positively related to the level of real economic activity as proxied by the industrial production index. This result is reliable with the findings of Chen et al. (1986) and Maysami et al. (2004). However, it shows negative but insignificant relationship with inflation. Exchange rate is positively related to S&P BSE Auto index. The positive sign of exchange rate is similar to the findings of Yip (1996) and Maysami et al. (2004) for Singapore.

Broad Money Supply is positively related to S&P BSE Auto index. The positive direction of broad money supply is consistent with the results of Mukherjee & Naka (1995) and Maysami et al. (2004) for Japan and Singapore respectively. It shows positive direction with short-term interest rate. The positive direction of short-term interest rate is similar to the findings of Bulmash and Trivoli (1991) in the case of the US, Mukherjee and Naka (1995) in the case of Japan and Maysami et al. (2004) in the case of Singapore.

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