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COINTEGRATION BETWEEN MACROECONOMIC VARIABLES AND S&P BSE TECHNICAL SECTOR INDEX

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ABSTRACT:

The macroeconomic factors and the index for specific industries are connected to each other. The prominence of this paper is to look into how S&P BSE Teck index connects with different macroeconomic factors. This study uses monthly data to examine how the returns of the S&P BSE Teck index are connected with certain macroeconomic variables, and it applies cointegration and VECM methods to analyze this relationship.

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 Teck 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 Teck 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 Teck index by using cointegration and VECM method. We have used monthly data to examine the relationship between sectoral index (S&P BSE Teck) 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 Teck) and macroeconomic variables that affecting the index.

1. S&P BSE Teck Index:

S&P BSE Teck index is the sectoral index representing technical sectors. The base year of BSE Teck Index is 2nd April, 2001 and the base value is 1000. This Index was launched on 11th July, 2001 following the free-float market capitalization methodology. The S&P BSE Teck index represents 30 companies, which are listed below in the **Box 1.**

Box 1: Companies/Banks Represents by S&P BSE Teck Index	
• Bharti Airtel Ltd. • **Bharti Infratel Ltd.** • **DB Corp Ltd.** • **Dish TV India Ltd.** • **Eros International Media Ltd.** • **Finolex Cables Ltd.** • HCL Technologies Ltd. • **Himachal Futuristic Communications Ltd.** • Idea Cellular Ltd. • Infosys Ltd. • **Inox Leisure Ltd.** • **Jagran Prakashan Ltd.** • **Just Dial Ltd.** • **KPIT Technologies Limited** • **Mindtree Ltd.**	• **Mphasis Ltd.** • **Mahanagar Telephone Nigam Ltd.** • **Oracle Financial Services Software Ltd.** • **On-mobile Global Ltd.** • **PVR Ltd.** • Reliance Communications Ltd. • **Sun TV Network Ltd.** • **Tata Communications Ltd.** • Tata Elxsi Ltd. • Tata Consultancy Services Ltd. • Tech Mahindra Ltd. • **TV18 Broadcast Ltd.** • **TV Today Network Ltd.** • **Wipro Ltd.** • **Zee Entertainment Enterprises Ltd.**

Source: BSE

2. 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 consumer durables, finance, pharmaceutical, metal, public sector unit, teck 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 Teck 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 Teck 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 Teck 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

Abbreviations	Construction of Variables	Data Source
LNTECK	Natural logarithm of the monthly average of S&P BSE Teck Index	BSE
LNIIP	Natural logarithm of the monthly Index of Industrial Production	RBI
LNWPI	Natural logarithm of the monthly Wholesale Price Index	RBI
LNM3	Natural logarithm of the monthly Broad Money Supply (M3)	RBI
LNEXCH	Natural logarithm of the monthly average Exchange Rate of the Indian Rupee	RBI

Abbreviations	Construction of Variables	Data Source
LNTBILL	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 Teck 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 Teck index are reported in **Table 2**.

Table 2: Multivariate Johansen Cointegration Test Result

Sectoral Indices (Y_t)	$LNIIP_t$	$LNWPI_t$	$LNEXCH_t$	$LNM3_t$	$LNTBILL_t$
$LNTECK_t$	-1.08	5.73	-1.80	-1.76	-0.93

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	LNM3	LNTBILL	C
LNTECK	**-1.08** (0.29) **[-3.69]**	**5.72** (1.05) **[5.42]**	**-1.80** (0.40) **[-4.54]**	**-1.76** (0.46) **[-3.78]**	**-0.93** (0.14) **[-6.84]**	**-3.07**

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

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

$$LNTECK_t = 3.07 + 1.08\ LNIIP_t - 5.72\ LNWPI_t + 1.80 LNEXCH_t + 1.76\ LNM3_t + 0.93 LNTBILL_t \quad \text{.....(1)}$$

It is found that S&P BSE Teck 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 Teck Index

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

Source: Author Estimated.

CONCLUSION:

The connection between the S&P BSE Teck index and macroeconomic factors has been found using the VECM approach. It is found that the BSE Teck index has a positive relationship with IIP in the estimation. This shows that when the industrial production index goes up, the returns on the Teck Index also tend to increase. This result matches what Chen et al. found. (1986) and Maysami et al. (2004). However, it has a negative but not significant connection with inflation. The exchange rate has a positive connection with the S&P BSE Teck index. The positive result regarding the exchange rate is like what Yip (1996) and Maysami et al. found. (2004) for Singapore. The broad money supply has a positive connection with the S&P BSE Teck index. The upward trend in broad money supply does not align with the findings of Mukherjee & Naka (1995) and Maysami et al. (2004) for Japan and Singapore respectively. It indicates a positive trend with short-term interest rates. The positive trend in short-term interest rates is like the findings of Bulmash and Trivoli (1991) for the US, Mukherjee and Naka (1995) for Japan, and Maysami et al. (2004) in the case of Singapore.

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