Chapter- 5

EMPIRICAL ANALYSIS

5.1Descriptive Statistics

Tables 5.1 presents a summary of descriptive statistics of the variables. Sample mean, standard deviation, skewness and kurtosis, and the Jacque- Bera statistics and *p*- value have been reported in the table below. Table shows that all the variables are positively skewed except exchange rate (ER) which is negatively skewed. The volatility of variables in terms of standard deviation as percentage of mean varies from 4.59 percent LnWPI to 32.65 percent for IR. The Jarque-Beta statistics and corresponding p values reveal that the null hypothesis that the variables are normally distributed are rejected at 5 percent level of significance.

Table: 5.1 Descriptive Statistics

	LnBSE	LnNSE	LnIIP	IR	LnWPI	ER
Mean	8.646154	7.448718	5.199487	7.284103	5.121538	42.46615
Median	8.400000	7.200000	5.200000	7.100000	5.100000	43.80000
Maximum	9.900000	8.700000	5.900000	13.00000	5.600000	51.20000
Minimum	7.900000	6.700000	4.600000	3.200000	4.700000	31.40000
Std. Dev.	0.616544	0.599429	0.315166	2.378274	0.235393	5.296593
Skewness	0.732965	0.714070	0.138444	0.603589	0.066353	-.787446
Kurtosis	2.027153	2.023742	2.048663	2.973375	2.029793	2.493692
Jarque-Bera	25.14999	24.31540	7.976385	11.84614	7.791156	22.23516
Probability	0.000000	0.000005	0.018533	0.002677	0.020332	0.000015
Observation	195	195	195	195	195	195

5.2 Unit Root Tests

In order to analyze the impact of macroeconomic variables on stock prices in India, the study utilizes the monthly time-series data. For this purpose, application of OLS to a regression equation is not desirable because, there can be a problem of spurious regression if the variables are not stationary. Therefore, it is necessary to examine all the variables for their stationarity. To check the stationarity of the data series, the study employs the Augmented Dickey-Fuller and Phillip-Perron tests to identify stationarity of the data. The results of the unit root test (ADF and PP test) are exhibited in table 5.1. The ADF and PP test are performed for two models; intercept as well as trend and intercept. Both models are performed on the level as well as first difference of the series. The table 5.1 for the ADF and PP test indicates that all the variables' data are non-stationary in level form for the intercept model and also non-stationary in level form for the trend and intercept model except LnIIP and LnWPI. Whereas, all the data on variables are stationary in first difference for both intercept and trend & intercept models. So now, the co-integration model can be performed on the given data-series.

The result of the unit root tests are presented in table 5.2. The tables shows that all the variables except LnIIP and LnWPI are integrated of order one I(1), which Ln IIP and LnWPI are tested to be integrated zero, I(0) at levels. How when the variables were tested in 1st difference all the variables are found to be integrated of order zero and hence are stationary. But before conducting the statistical tests for stationarity, we also graphed all the variables in their levels and 1st differences. It is seen that the graphs of variables in levels exhibit non-constant variances while graphs in 1st differences exhibit constant variances and are indicative of the series being stationary. The two graphs are exhibited in figures 5.1 and 5.2.

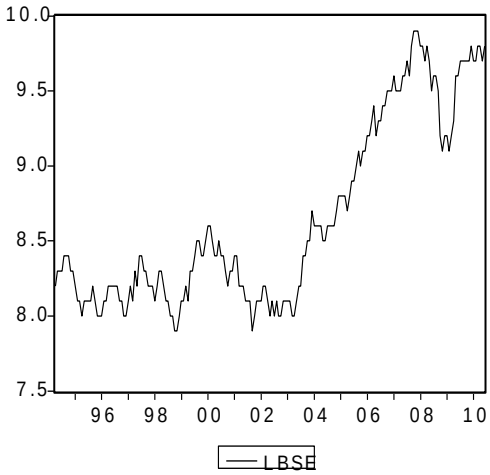
Tables: 5.2 Unit Root Test on Variables

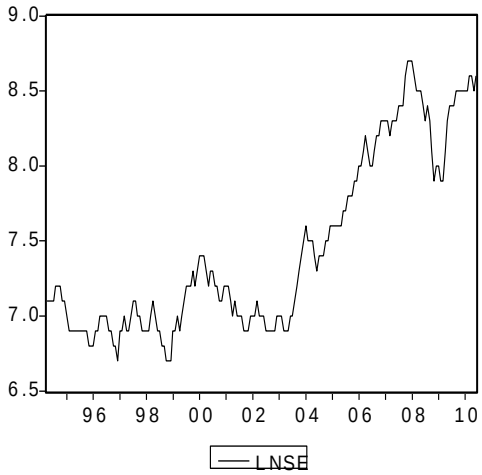
Variables	Model	ADF Test Statistic		PP Test Statistic	
		Level	First Difference	Level	First Difference
LnBSE	Intercept	-0.2552	-5.629*	-0.2606	-14.9097*
		(-3.4660)	(-3.4662)	(-3.4653)	(-3.4655)
	Trend & Intercept	-2.4149	-5.7582*	-2.0403	-14.9720*
		(-4.0091)	(-4.0093)	(-4.0081)	(-4.0084)
LnNSE	Intercept	-0.2163	-5.7218*	-0.1562	-12.4466*
		(-3.4660)	(-3.4662)	(-3.4653)	(-3.4655)
	Trend & Intercept	-2.6747	-5.8633*	-2.2909	-12.5003*
		(-4.0091)	(-4.0093)	(-4.0081)	(-4.0084)
LnIIP	Intercept	-1.1123	-7.8904*	-1.2019	-26.7027*
		(-3.4660)	(-3.4662)	(-3.4653)	(-3.4655)
	Trend & Intercept	-4.7860*	-7.8753	-8.5791	-26.6507*
		(-4.0091)	(-4.0093)	(-4.0081)	(4.0084)
IR	Intercept	-1.9928	-5.0709*	-1.6556	-12.2770*
		(-3.4660)	(-3.4662)	(-3.4653)	(-3.4655)

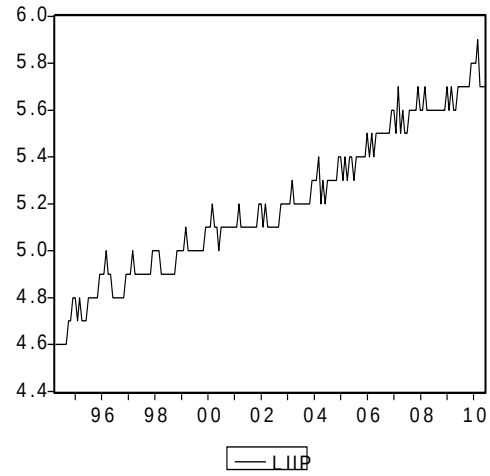
	Trend & Intercept	-3.0339 (-4.0091)	-5.0397* (-4.0093)	-2.7364 (-4.0081)	-12.2434* (-4.0084)
LnWPI	Intercept	-0.3387 (-3.4660)	-7.3499* (-3.4662)	-0.2767 (-3.4653)	-15.6818* (-3.4655)
	Trend & Intercept	-5.3134* (-4.0091)	-7.3307 (-4.0093)	-5.4320 (-4.0081)	-15.6447* (-4.0084)
ER	Intercept	-2.1562 (-3.4660)	-4.2585* (-3.4662)	-1.9634 (-3.4653)	-9.9757* (-3.4655)
	Trend & Intercept	-2.0173 (-4.0091)	-4.3429* (-4.0093)	-1.6669 (-4.0081)	-10.0051* (-4.0084)

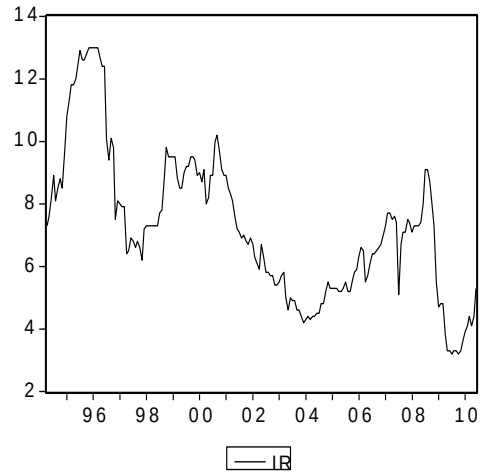
Note: * indicates significant at 1 percent level. Brackets contain critical values.

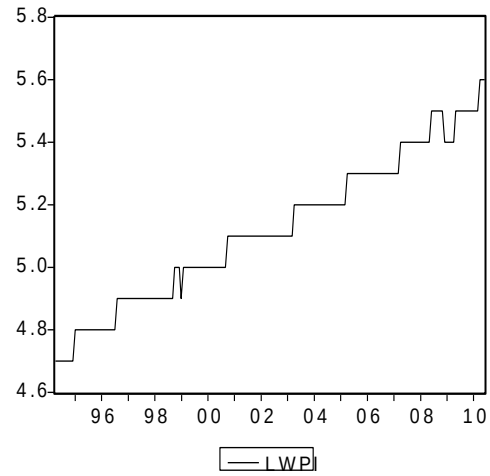
5.1 Graphs for Macroeconomic Variables (Levels)

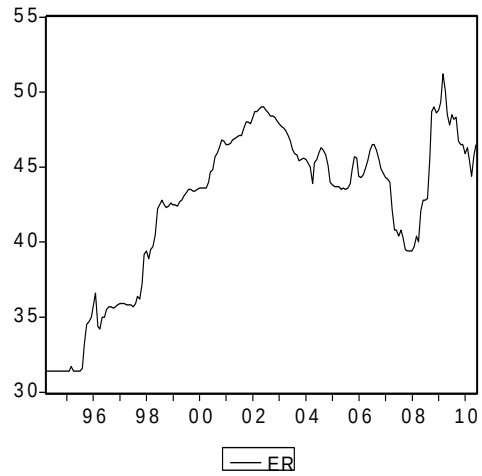




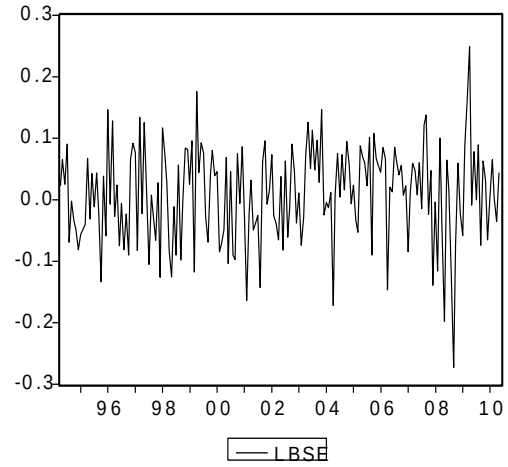


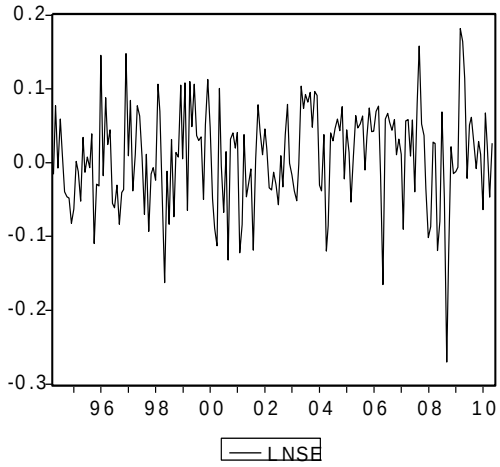


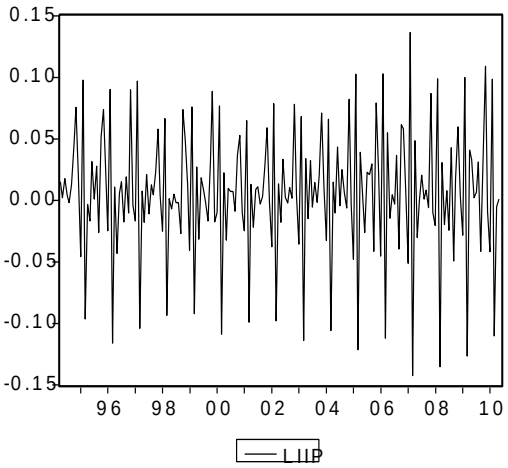


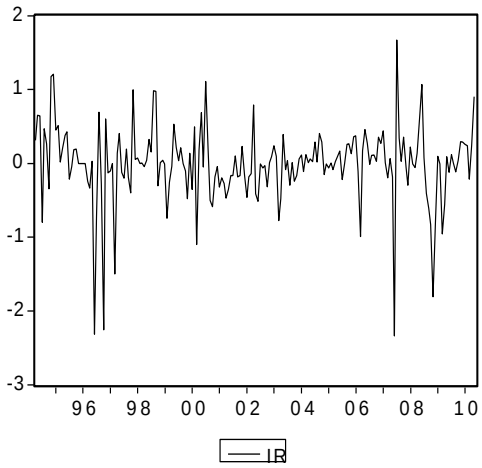


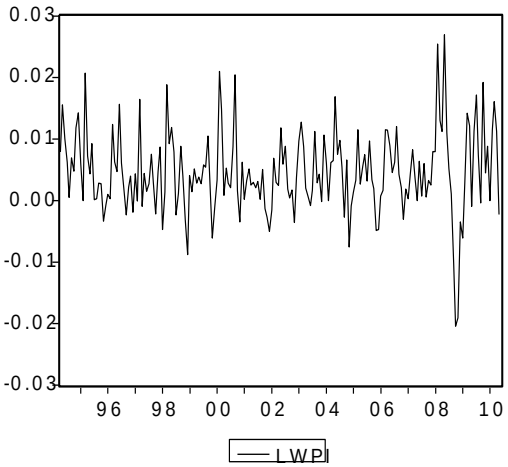
5.2 Graphs for Macroeconomic Variables (1st Difference)

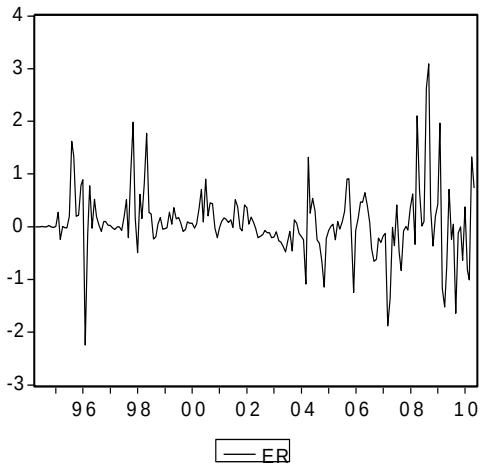












5.3 Cointegration Tests

5.3.1 Results of Co-integration Test (BSE)

To test the existence of co integrating vectors for the five variables LnBSE, LnIIP, IR, LnWPI, and ER, Johanasen λ_{trace} and λ_{max} statistics have been used. In general, there can be up to 4 co-integrating vectors. The test results have been presented in tables 5.3 and 5.4. Table 5.3 shows that the hull hypothesis of no. co-integrating vector is rejected as value of trace statistic (80.86) is greater than the critical value (68.52) at 5 percent level of significance. However, the null hypothesis of less than or equal to 1 co-integrating vector against the alternative hypothesis of greater than one co-integrating vector can not be rejected at 5 percent level of significance as the λ_{trace} statistic value (38.52) is less than the critical value (47.21).

Similarly on the basis of Johansen λ_{max} statistics which are given in table 5.4, the null hypothesis of no co-integration vector against the alternative hypothesis of one co-integrating vector is rejected at 5 percent level of significance as the value of λ_{max} statistic (42.34) is greater than the critical value 33.46. However, the null hypothesis of one co-integrating vector against the alternative hypothesis of two co-integrating vectors can not be rejected as the value of λ_{max} (25.056) is less than the critical value (27.07) at 5 percent level of significance. It means there exists a unique co-integrating vector.

Table: 5.3 Johansen Co-integration Test Statistic λ_{trace} (BSE)

Null Hypothesis	Alternative Hypothesis	Eigen Value	Trace Statistic	Critical Value	Log Likelihood
r = 0	r >0		80.8636	68.52	627.64505
r ≤ 1	r >1	0.19791	38.5210*	47.21	648.81635
r≤ 2	r >2	0.12234	13.4649	29.68	661.3442
r≤ 3	r >3	0.03171	6.2452	15.41	664.95424
r≤ 4	r >4	0.00031	0.0590	3.76	668.04733

Note: (1) Trace test indicates one co-integration equation at the 0.05 level.

(2) r is the co-integration rank or the number of co-integration vectors.

Table: 5.4 Johansen Co-integration Test Statistic λ_{max} (BSE)

Null Hypothesis	**Alternative Hypothesis**	**Eigen Value**	**Max Statistic**	**Critical Value**	**Log Likelihood**
r = 0	r = 1		42.3426	33.46	627.64505
r = 1	r = 2	0.19791	25.0561*	27.07	648.81635
r = 2	r = 3	0.12234	7.2196	20.97	661.3442
r = 3	r = 4	0.03171	6.8162	14.07	664.95424
r = 4	r = 5	0.00031	.0590	3.76	668.04733

Note: (1) Trace test indicates one co-integration equation at the 0.05 level.

(2) r is the co-integration rank or the number of co-integration vectors.

5.3.2 Results of Co-integration Test (NSE)

The value λ_{trace} statistics and λ_{max} statistics for testing the number of co-integrating relationships among the economic variables LnNSE, LnIIP, LnIR, LnWPI, and ER along with their critical values are presented in tables 5.5 and 5.6 respectively. The tables 5.5 shows that the null hypothesis of no co-integrating vector is rejected against the alternative hypothesis at 5 percent level of significance as the value of λ_{trace} statistic (84.9) is greater than the critical value (68.52). However, the null hypothesis of $r \leq 1$ against the alternative hypothesis $r > 1$ can not be rejected as the value of the statistic (42.8) is less than the critical value (47.21). The values of λ_{max} test statistics which are shown in table 5.6 reveals that the null hypothesis $r = 0$ is rejected against the alternative hypothesis $r = 1$ as the value of λ_{max} statistic (42.03) is higher than the critical value (33.46). However, the null hypothesis $r = 1$ can not be rejected against the alternative hypothesis of $r = 2$ at 5 percent level as the value of the statistic (23.88) is less than the critical value (27.07).

Table: 5.5 Johansen Co-integration Test Statistic λ_{trace} (NSE)

Null Hypothesis	**Alternative Hypothesis**	**Eigen Value**	**Trace Statistic**	**Critical Value**	**Log Likelihood**
r = 0	r >0		84.9060	68.52	657.0834
r ≤ 1	r >1	0.1966	42.8739*	47.21	678.0994
r≤ 2	r >2	0.1396	13.9884	29.68	692.5421
r ≤ 3	r >3	0.0409	5.9669	15.41	696.5529
r ≤ 4	r >4	0.0302	0.0628	3.76	699.5050

Note: (1) Trace test indicates one co-integration equation at the 0.05 level.

(2) r is the co-integration rank or the number of co-integration vectors.

Table: 5.6 Johansen Co-integration Test Statistic λ_{max} (NSE)

Null Hypothesis	**Alternative Hypothesis**	**Eigen Value**	**Max Statistic**	**Critical Value**	**Log Likelihood**
r = 0	r = 1		42.0321	33.46	657.0834
r = 1	r = 2	0.1966	23.8855*	27.07	678.0994
r = 2	r = 3	0.1396	8.0215	20.97	692.5421
r = 3	r = 4	0.0409	5.9041	14.07	696.5529
r = 4	r = 5	0.0302	0.0628	3.76	699.5050

Note: (1) Trace test indicates one co-integration equation at the 0.05 level of significance

(2) r is the co-integration rank or the number of co-integration numbers.

5.4 Vector Error Correction Model

5.4.1 Estimates of Vector Error Correction Model (BSE)

The study analyzes the impact macroeconomic variables on stock price in India. The variables of the study have been discussed in methodology chapter. The existence of at least one co-integrating vector among the variables implies that an ECM can be estimated to investigate the short-run as well as long run relationship. The normalized co-integrating coefficient estimates along with their standard error and z statistics are shown in table (5.7). We can, therefore, write our co-integrating relationship as:

LnBSE = 2.68 + 5.39 LnIIP = 0.012 IR – 4.04 LnWPI – 0.04 ER

All the coefficients except interest rate (IR) are significant at 1 percent level of significance the positive and significant impact of industrial output on stock negative and significant effect of inflation and exchange rate are also on expected line. However, the impact of interest rate on stock market price shown to be positive, but insignificant, thus VECM that long run relationship between the macro variables is on expected lines and significant. The estimates of coefficients of error correction term have been given in table 5.8. The table shows the estimated coefficients of the error correction term (-0.059) is statistically significant at 8.7 percent level of significance with appropriate (negative) sign indicating the existence of long run relationship and about 6 percent of disequilibrium is corrected every month. Another error correction estimate (-0.028) which is significant and appropriately signed is LnWPI. This shows that Ln WPI tends towards its long term equilibrium position and corrects the error to the tune of 2.8 percent per month. The estimates of the remaining error correction terms are either insignificant or inappropriately signed which indicate the absence of long term relationship.

Table: 5.7 Estimates of Normalized Co-integrating Coefficients (BSE)

Variable	Coefficient	Standard Error	Z statistic	Probability
LnBSE	1.000			
LnIIP	-5.3924*	0.6484	-8.32	0.000
IR	-0.0120	0.0201	-0.60	0.550
LnWPI	4.0333	0.9350	4.31	0.000
ER	0.0383	0.0083	4.61	0.000
Constant	2.6765			

* Indicates significance at 1 percent level.

Table: 5.8 Estimates of coefficients of error correction (BSE)

Variable	Coefficient	Standard Error	Z statistic	Probability
LnBSE	-0.059*	0.034	-1.71	0.087
LnIIP	0.116	0.019	5.91	0.000
IR	0.339	0.189	1.74	0.034
LnWPI	-0.028**	0.009	-3.00	0.003

ER	0.076	0.225	0.34	0.736

*****Indicates significance at 8.7 percent.

*Indicates significance at 0.3 percent.

5.4.2 Estimates of Vector Error Correction Model (NSE)

The estimates of vector error correction model consisting of the estimates of normalized co-integrating coefficients, and the estimates of error correction coefficients along with their respective standard errors, z- statistics and probability levels are shown in table (5.9)

We can, therefore, write the co integrating relationship as:

LnNSE = 0.78 + 4.22 LnIIP + 0.03 IR – 2.49 LnWPI – 0.03 ER

All the coefficients except interest rate (IR) which is significant only at 11 percent are significant at one percent level and are rightly signed the industrial output has as expected has a positive and significant impact on NSE stock price. Similarly, the increase in inflation and exchange rate show expectedly negative and significant effect on the NSE stock prices. Interest rate, however, like earlier case has a positive sign but its impact is significant only at 11 percent level. Thus the VECM results macro variables is on expected lines and significant.

The estimates of coefficients of error correction terms along with their standard errors and z-statistics have been shown in table 5.10. The table also contains the estimates of the coefficients of error correction terms. The estimates of coefficients of error correction terms corresponding LnNSE and LnWPI are appropriately (negative) signed and are significant at 5 percent level of significance. Their values are (-0.073) and (-0.023) respectively, which means the speeds of error correction are 7.3 and 2.3 percent per month respectively and confirm long run relationship. The estimates of other coefficients are either inappropriate in sign or are insignificant which indicate

absence of long run equilibrium. The detailed estimates of short term effects (impact multipliers) along with their standard errors and z-statistics have been shown in appendix -B and appendix -N

Table: 5.9 Estimates of Normalized Co-integrating Coefficients (NSE)

Variable	Coefficient	Standard Error	Z statistic	Probability
LnNSE	1.0000			
LnIIP	-4.2251*	0.5962	-7.09	0.00
IR	-0.0293**	0.0184	-1.59	0.112
LnWPI	2.4906	0.8594	2.90	0.004
ER	0.0300	0.076	3.95	0.00
Constant	0.7858			

*****Indicates significance at 1 percent level.

**Indicates significance at 11 percent level only

Table: 5.10 Estimates of coefficients of error correction (NSE)

Variable	Coefficient	Standard Error	Z statistic	Probability
LnNSE	-0.073*	0.034	-2.15	0.031
LnIIP	0.123	0.022	5.41	0.000

IR	0.545	0.216	2.52	0.012
LnWPI	-0.023**	0.011	-2.06	0.039
ER	0.132	0.263	0.50	0.123

*, ** Indicates significance at one and 3.9 percent level of significance respectively.