Chapter- 6

Empirical Analysis

6.1 Introduction

The purpose of the chapter is to make a statistical analysis in order to examining the existence of a long-run relationship between agriculture sector and FPI. In other worlds whether, the development of agriculture is linked with the development of FPI or not. The performance of agriculture sector has been measured by the output of AAS, while the performance of FPI has been measuring by Net Value Added (NAV) of the FPI at constant prices with base year 200-05. The data on real output of agriculture and allied sector and FPI shown in the table 6.1**.**The figure in the table denote GDP of AAS (A_t) and Net Value Added of FPI (F_t) at constant prices (base on 2004-06) in billion rupees.

6.2 Method of Analysis

One of the problems of applying the regression analysis on time series data is that the standard OLS regression procedures can easily lead to incorrect conclusion. It can be shown that in the cases of time series data, the regression results shown very high and significant value of R-Square and t-values while the variables used in the analysis have not interrelationship. In this phenomenon, result of OLS estimation will earn of spurious regressing, if the variables used in the regression are non-stationary. Hence, researcher should be careful on conducting regression analyses for time series data. Thus, a time series data should be tested check for behaviour of unit root before applying any time series estimation techniques. In the present case, two teats namely 'Augmented Dickey-Fuller (ADF)' and Phillips-Parron Test' have used for testing the presence of unit roots.

6.3 Unit Root Tests

It is necessary to carry out a univariate analysis to ensure whether a stationary co-integration relationship among variables to avoid the problem of spurious regression before employing the Error Correction Model (ECM). The results will have no economic meaning if that are estimated the relationship without identify the stationary of data. Unit root tests are performed to test the stationary of series. The present study employs the Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test to check the unit root of time-series yearly data. These tests are performed to the level variables as well as to their first difference in logarithms term of the series for intercept and trend & intercept model.

6.3.1 Augmented Dickey-Fuller (ADF) Test

Dickey and Fuller extended their test procedure suggesting an augmented version of the test which includes extra lag terms of the dependent variables in order to eliminate auto-correlation. The unit root test actually applied in the present case is the simply Augmented Dickey-Fuller test with the intercept only and with intercept and trend shows in the following equations where 'Y_t' represents a time series.

$$\Delta y_t = ß_1 + \lambda y_{t-1} + \alpha \Delta y_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots\text{(1)}$$

$$\Delta y_t = ß_1 + ß_2 + \lambda \Delta y_{t-1} + \alpha \Delta y_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots 2$$

Where, it is time period are coefficients

The first equation shows the regression of first difference on logged variables of the time series with intercept (ß1) only while second equation shows the regression of the first difference on lagged values of the time series and time (t). The null hypothesis that there is a non-stationary time series:

$$H_0 : \lambda = 0$$

$$H_0 : 0 = \lambda$$

The decision rule is that if the computed absolute value of tau (τ) Statistic is less than the critical t-value, it can be concluded that the time series is stationary. Hence, the time series variable is following stationary behaviour.

The result of ADF unit root test pertaining to the time series of the GDP of AAS (At) and FPI (Ft) are presented in the table 6.2. The test has been conducted for both the model namely, model only with intercept and model with intercept and trend. The table shows that in case at the computed tau (τ) value (-2.613) is greater than the critical value -3.75 or in absolute terms |-2.6131| = 2.613, is less than |-3.75| =3.75. This implies that the null hypothesis, 5=0 cannot be rejected. Hence, it is concluded that, the variable At is non-stationary; it implies that the variable is following non unit root behavior.

Similarly, same procedure has been followed for the model with trend and intercept, the computed tau value (absolute) 3.546 is less than the absolute critical value 4.38 at 1 present level of significance, this is implies that the null hypothesis, S=0, cannot be rejected. Therefore, the series is non-stationary.

The result of ADF test explored that the null hypothesis of non-stationary (λ=0) behaviour of the variable FPI (Ft) cannot be rejected at one percent level of significance. Thus, it can be concluded that the variable at and Ft are non-stationary series at zero order difference.

Since the variables are non-stationary at zero order difference, the first order difference has been taken. Both the series Ft and At are found to be stationary at 1 percent level of significance. It implies that both the series are integrated order one.

6.3.2 Phillips-Perron Test

The different between the ADF test and the PP-test lies in the fact the former test consider the case of possible serial correlation in the error terms by adding lagged different terms of the regress, while PP-test use non-parametric statistical methods to assume there is no serial correlation exist in the error term. The empirical results regarding the PP-test are shown in table: 6.3, the simple critical t (tau) values are applicable in the context at of both the models. The table shows that in case of At, the computed tau (τ) values pertaining to 'intercept model', and the 'intercept and trend model' are -2.611 and -4.241 respectively which are greater than the corresponding values of critical tau (τ) values which are -3.75 and -4.38 respectively. Hence, the series is said to be non-stationary.

In case of the variable Ft, the computed values of tau (τ) for the 'intercept' and 'intercept and trend' model are-2.611 and -3.542 respectively. These values are greater than the corresponding values of critical tau (τ) values which are -3.75 and -4.38 respectively. This shows that the PP test of unit root test confirms that the two series At and Ft are non-stationary.

Similar to the ADF test, the first order difference has been taken for PP test also. Both the series Ft and At are found to be stationary at 1 percent level of significance. It implies that both the series are integrated order one, hence, the time series estimation techniques are applicable.

6.4 Co-integration Test

As it has been discussed in the Unit root section; regression of a non stationary time-series with another non stationary time series would give spurious results. The estimated results of ADF and PP test also revealed that both the time series At and Ft are stationary at first order differences. There is a possibility that residual of stationary variables may not be following common trend. Hence, it needs to check whether the residual of two variables At and Ft are following common trend or not. Therefore, Jonson co integration estimation has been applied to check whether the variables are co integrated or not. The estimated result presented in Table 6.4 shows that, there is only one co integration equation exist between At and Ft. The absolute tau value is greater than the critical tau value at the 5 percent level of significance. Hence, there is one co integration equation is exist.

6.5 Co-integration and Error Correction Mechanism (ECM)

We have just conducted a Co-integration test and found that LAt and LFt are Co-integrated time series i.e., there is long-term relationship between these two variables. But it is possible that there is disequilibrium in the short-run. The error term in the regression can be treated as equilibrium error. The ECM was first used by Saran and popularized by Engle and Granger. It corrects for disequilibrium. Granger representation theorem states that, if two variables are Co-integrated be expressed as ECM. The ECM between LAt and LFt can be expressed as

$$DLA_t = \beta 0 + \beta 1 DLF_t + \beta 2 LXV_t - 1$$

Where, DLAt and DLFt are the first differences of LAt and LFt respectively. This is the long values of the error term. The above ECM equation states that DLAt depends on DLFt and also on the equilibrium error term. The error correction coefficient which measures the speed of adjustment to bring back to the equilibrium level. The coefficient of error term is expected to be negative. The table 6.4 shows the estimates coefficient of the ECM, -0.236 is significantly different from zero. The results show that the disequilibrium between two variables adjusts 23.6 percent.

6.6 Conclusion

The stationary nature of the variables At and Ft was checked with the help of ADF and PP test. The result of ADF and PP explored that both the variables are integrated order one. In case of time series data, variables may individually follow stationary behaviour but they might not be having stochastic trends. Hence, to check whether the variables At and Ft are co integrated or not, Jonson co integration is employed. The co integration result revealed that the residual of At and Ft are stationary. It means, there is a long run relationship exists between these two variables.

Since the result of Jonson co integration confirm the existence of long run relationship between two variables ECM model is applied to check the short run adjustment in this two variables. The ECM coefficient of the variable At is negative and of Ft is positive. The opposite sign of the two variables explain that the equilibrium might be restored when FPI variable will more rapidly increase than AAS variable. Moreover, the speed of adjustment in the variable At is 26 percent. It conveys that 26 percent of disequilibrium in At is adjusted by Ft in each period.

Table: 6.1

Output of Agriculture and Allied Sector and Output of Manufacturing Food Products: 1974-76 to 2010

Year	X_t	Z_t
1974-76	2417.4	42.0
1976-76	2728.99	41.4
1976-77	2671.31	61.1
1977-78	2829.37	66.2
1978-79	2894.62	66.2
1979-80	2624.76	64.4
1980-81	2860.16	38.4
1981-82	2981.3	49.8
1982-83	2972.93	68.6
1983-84	3273.82	90.1
1984-86	3326.71	80.8
1986-86	3336.16	78.8
1986-87	3322.6	80.8
1987-88	3269.76	82.3
1988-89	3781.13	120.6
1989-90	3826.09	127.6
1990-91	3979.71	119.6
1991-92	3902.01	126.1

1992-93	4161.63	168.6
1993-94	4299.81	116.6
1994-96	4602.68	238.6
1996-96	4471.27	179.1
1996-97	4914.84	184.6
1997-98	4789.33	196.3
1998-99	6092.03	141.8
1999-00	6227.96	201.3
2000-01	6227.66	187.8
2001-02	6641.67	196.8
2002-03	6176.69	180.4
2003-04	6643.91	162.9
2004-06	6664.26	180.6
2006-06	6944.87	230.6
2006-07	6191.9	326.1
2007-08	6660.8	314.6
2008-09	6666.89	281.9
2009-10	6626.09	269.0

Note: Figure in the table denote GDP of agriculture and allied sector (A_t) and Net Value Added of FPI (F_t) at constant prices (Base on 2004-06) in billion rupees.

Table 6.2

Augmented Dickey-Fuller Unit Root Test Results

Variables	**Model**	**Level**	**1st Difference**
LX_t	Intercept	-0.013	-6.668*
		(-2.613)	(-3.642)
	Trend & Intercept	-3.973*	-6.640
		(-3.646)	(-4.260)
LZ_t	Intercept	-1.247	-4.927*
		(-2.613)	(-3.642)
	Trend & Intercept	-3.066	-4.927*
		(-3.646)	(-4.260)

Note: The critical t values for 26 degrees of freedom (which is closest to our sample size) are –3.76 for 'intercept only' and -4.38 for 'intercept and trend' forms of the equation respectively.

* indicates that data are stationary at 1 percent level of significance.

Table 6.3

PP Unit Test Results

Variables	**Model**	**Level**	**1st Difference**
LX_t	Intercept	-0.617*	-12.960
		(-2.611)	(-3.636)
	Trend & Intercept	-6.782*	-12.862
		(-4.241)	(-4.260)
LZ_t	Intercept	-1.196*	-8.888
		(-2.611)	(-3.636)
	Trend & Intercept	-3.860*	-8.776
		(-3.642)	(-4.260)

Note: The critical t values for 26 degrees of freedom (which is closest to our sample size) are –3.76 for 'intercept only' and -4.38 for 'intercept and trend' forms of the equation respectively.

* indicates not significantly different from zero at one percent level of significance.

Table 6.4

Johansen test for co-integration

				Number of observation 35 **Number of lag 1**	
Maximum rank	parms	LL	Eigen value	Trace statistics	Critical value at 5 percent
0	0	-416.12			
1	3	-410.98	0.25	17.01	12.53
2	4	-470.61	0.18	6.74	3.84

Table 6.5

Error Correction Mechanisms (ECM)

Dependent Variable: DLX_t

Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DLZ_t	0.089611	0.049088	1.823486	0.0776
LXV_{t-1}	-0.236440	0.124916	-1.892801	0.0676
C	0.023689	0.009761	2.419171	0.0214
R-squared	0.121886			