LONG RUN EQUILIBRIUM BETWEEN INDIAS'S EXPORTS AND IMPORTS DURING 1949-50 -2004-05

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Abstract

An attempt has been made in the present paper to see is there long run equilibrium relationship between India's exports and imports during the 1949-50 to 2004-05. The empirical results based on unit root tests, co integration and error correction modeling exemplifies that the exports and imports are co integrated showing existence of long run equilibrium between India's exports and imports .The elasticity of India's exports with respect to imports is slightly more than unity revealing that the ratio of exports to imports goes on increasing slightly with the increase in imports. The elasiticity of India's imports with respect to exports is somewhat less than unity implying that the ratio of imports to exports goes on declining with the increase in imports. The economic reforms that have been initiated since 1992 could not facilitate in correcting more percentage of disequilibrium during post economic reform period as the regression coefficient of interaction variable is negatively insignificant. The results based on error correction model of first differenced Y on first differenced X and errors in lagged year show that the system corrects its preceding period's disequilibrium between long run and short run periods by twenty seven percent a year.

JEL classification: C51, F14, O53

Keywords: Foreign Trade in India, Exports, Imports

1. Introduction

There is a need to generate empirical information on the long run equilibrium relationship between exports and imports relationship between India's exports and imports, the short run disequilibrium and the presence of shift in the magnitude of the error correction in the short run in order to examine the efficacy of the trade policy of the government of India in reducing the negative trade. There are a large number of empirical studies on exports and imports and their relationship with income and economic growth in India. Some of them are related to income and price elasticities of exports and imports using the macro time series data without testing the stationarity of series [Some of the studies on income and price elasticities of exports and imports include Brar Jaswinder Singh, Da Costa G C , Kantawala B S , and Wadhva Charan D , Infra, Bibliography] As the consistent statistical inference from the estimates of economic relationships based on macro time series depends by and large on the assumption of stationarity, it is commonsensical to determine whether time series macro variables are individually stationary [absence of unit root] or non-stationary [presence of unit root]. The other studies are related to the issue of causality between export growth and economic growth employing the cointegration and error corection procedure. [Some of the studies on causality issue between export growth and economic growth include Geetanjali Nataraj Pravakar Sahoo , B Kamaiah, M Upender and M Aruna ,Ramesh

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Chandra and Malllick]. These studies have not examined the extent of disequilibrium between long run and short run periods during post economic reform period by estimating differential error correction term with interaction variable. The present exercise is justified on the grounds that not even a single study has been carried out to examine the presence of shift in the magnitude of error correction in the short run to scan the impact of economic reforms that have been initiated since 1992 using a longer time period [fifty six years :1950-2005] data available till date with Augmented Dicky Fuller [ADF] and Phillips-Perron [PP] unit root tests,cointegration [Engel - Granger representation] and error correction modeling with an interaction variable. The results of the present exercise based on unit root tests,cointegration,error correction and shift in the error correction to scan the prognostications of economic reforms shall be an addition to the existing empirical literature on India's exports and imports.More specifically, the present paper examines the presence of long run equilibrium relationship between India's exports and imports through the residuals of the co integration and presence/absence of structural break/shift in the magnitude of error correction in the short run to capture the impact of economic reforms

2. Data and Empirical Methodology

Time series annual macro data on Exports (Y) and Imports (X) from 1949-50 to 2004-05 in nominal terms required to provide empirical content to the objectives of the study have been collected from the Economic Survey [Ministry of Finance, Economic Division] 2005-06 and Basic Statistics relating to the Indian Economy ,reserve Bank of India]The long run equilibrium relationship between India's exports [Y] and imports [X] has been looked at by using annual macro time series data for the period from 1949-50 to 2004-05. The method in analyzing the long run equilibrium relationship between India's exports and imports, requires the determination of the integration order of each variable. This shall be accomplished by unit root testing of the macro time series variables. The unit root test provides the information about the presence/absence of stationarity of the time series variables in levels or first difference If the time series variables,exports and imports, are not stationary in levels, then the series contain unit root. The estimates of economic relationships based on OLS method in the presence of unit root in the levels will be fly-by-night. The non stationary time series data on exports and imports require to be differenced until stationarity has emerged. The popular methods to detect the presence/absence of unit root and for determining the order of integration of each variable, exports and imports are the Augmented Dicky Fuller test and Phillips-Perron test. The order of integration of each time series variable needs to be established first. Briefly stated, a time series variable such as Y and X [exports and imports] is said to be integrated of order d if it is found stationary after differenced d times. This is generally denoted by [Y] ~ I(d) and [X] ~ I(d). According to Engel and Granger representation, the two variables Yand X, despite the fact that they are non stationary in levels, are said to be co integrated, if the residuals from the cointegration regression [linear combination] are integrated of any order less than d. For instance, if [Y] ~ I(1) and [X] ~ I (1), the residuals from the cointegration regressions of Y on X or X on Y have to be I (0) in order to have co integration between Y and X . Then there will be long run equilibrium relationship between Y and X. In the short run there may be disequilibrium between

actual value of Y [or X] and long run equilibrium values. An Error Correction Modeling helps to examine the presence of equilibrium or disequilibrium in the short run. Further, the estimate of error correction term explains the extent of disequilibrium that can be eliminated/corrected at each period. How quickly disequilibrium can be corrected depends on the magnitude of the estimate of error correction term. Therefore, the coefficient of the error correction term can also be interpreted as the coefficient of speed of adjustment between short run dynamics [actual values] and long run equilibrium values.

Unit root test in the present exercise is based on the following specifications

ADF test_ with trend and intercept :

$\Delta \ln Y_t = \text{intercept} + b_1 t + b_2 \ln Y_{t-1} + b_3 \Delta \ln Y_{t-1} + \text{error}$
$\Delta \ln X_t = \text{intercept} + b_1 t + b_2 \ln X_{t-1} + b_3 \Delta \ln X_{t-1} + \text{error}$

Phillips-Parron test_with trend and intercept:

$\Delta \ln Y_t = \text{intercept} + b_1 t + b_2 \ln Y_{t-1} + \text{error}$
$\Delta \ln X_t = \text{intercept} + b_1 t + b_2 \ln X_{t-1} + \text{error}$

Where Y =Exports X =Imports_Δ = fist difference operator

Cointegration **between Exports and Imports is based on the following specification**

$\ln Y_t = \text{intercept} + b_1 \ln X_t + \text{error}$
$b_1 = d \ln Y_t / d \ln X_t$ = long run [static] percentage effect
$\ln X_t = \text{intercept} + b_1 \ln Y_t + \text{error}$
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ADF tests on residuals are based on the following equations
Residuals/errors [U] : $\Delta U_t = \text{intercept} + b_1 t + b_2 U_{t-1} + b_3 \Delta U_{t-1} + \text{error}$
Residuals/errors [U] : $\Delta U_t = \text{intercept} + b_1 t + b_2 U_{t-1} + b_3 \Delta U_{t-1} + \text{error}$
Where Δ is the fist difference operator

Error correction and shift **is based on the following specification**

$\Delta \ln Y_t = \text{intercept} + b_1 \Delta \ln X_t + b_2 EC_{t-1} + b_3 [\text{dummy} * EC_{t-1}] + \text{error}$

b_2 = Error Correction Term during pre economic reform period
sum of - b_2 and - b3 is the Error Correction Term during post economic reform period
$-b_3$ =differential error correction during post economic reform period
$b_1 = \partial \Delta \ln Y_t / \partial \Delta \ln X_t$ = Percentage effect in short run
$b_2 = \partial \Delta \ln Y_t / \partial EC_{t-1}$ = Proportion of disequilibrium [If it is significantly negative] in t-1 time period can be corrected/eliminated in t period by changes in Y [Speed of correction]
$\Delta \ln X_t = \text{intercept} + b_1 \Delta \ln Y_t + b_2 EC_{t-1} + b3 [\text{dummy} * EC_{t-1}] + \text{error}$

$b_1=\partial\Delta \ln X_t / \partial \Delta \ln Y_t$= Percentage effect in short run
$b_2=\partial\Delta \ln X_t / \partial EC_{t-1}$ = Proportion of disequilibrium [If it is significantly negative] in t-1 time period can be corrected/eliminated in t period by changes in X [Speed of correction]
b_2 = Error Correction during pre economic reform period
sum of $-b_2$ and $- b_3$ is the extent of Error Correction during post economic reform period
$-b_3$=differential error correction during post economic reform period

3. Empirical Results.

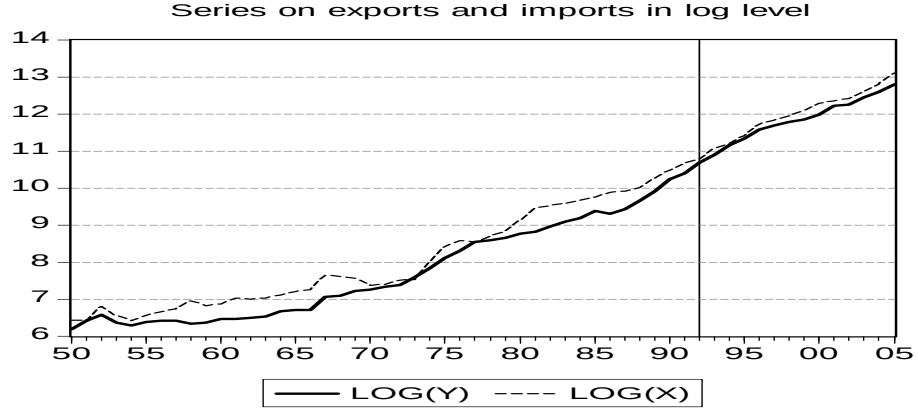
The standard augmented Dickey Fuller Unit Root and Phillips-Parron test statistics have been employed to determine the order of integration of each variable. The results of the same are given in Table-1. The results of the ADF and PP tests given in table - 1 show that the time series variables, exports and imports, are found to be non stationary in log levels. Therefore ADF and Phillips-Parron tests have been performed on first log differenced series to dtect the presence of the stationarity. The results of the ADF test and PP test statistics, show that both the variables are found to be stationary in first differenced form.

Table – 1.Presence of unit Root: ADF and PP Test Statistics

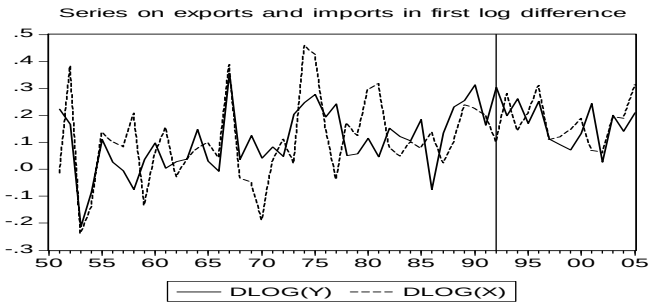
	log level			First log difference		
Variable	ADF test	PP test	Conclusion	ADF test	PP test	Conclusion
1	2	3	4	5	6	7
			Y~ I (1)			Y~ I (0)
Exports	-2.64	-1.84	Non stationary series	-4.98*	-6.57*	stationary series
			X ~I (1)			X ~I (0)
Imports	-1.64	-1.64	Non stationary series	-5.88*	-6.71*	stationary series

Notes: 1.*and ** Negatively Significant at one percent levels respectively, 2. Mackinnon critical values for rejection of null hypothesis of unit root [non stationarity]. 3. Critical levels: -4.1348 (1%), -3.4935 (5%), -3.1753 (10%)

The time series plot in log levels is presented in Figure 1.



The time series plot in first log difference is presented in Figure 2.



The order of integration of exports and imports is the same. The cointegration technique is applied to examine the presence of cointegration of the two variables in the long run. The cointegration regressions of log exports on log imports and log imports on log exports have been run by ordinary least squares method on non stationary time series data. The results of the same are presented in Table-2.

Table 2, ADF and PP Tests on Residuals of the Co integration Regression

Dependent/Independent variable	Cointegration Regression	ADF Statistic	PP Statistic	Conclusion	Growth rate
1	3	4		5	6
Exports/Imports	lnY=-0.45508 + 1.018 lnX [-4.273] [88.520] R^2=0.99315 dw=0.5335	-3.046 ** [1]	-2.922 **	U_t ~ I (0) Presence of long run relationship	12.79 Percent
Imports/Exports	lnX=0.5056 + 0.9753 lnY [5.107] [88.520] R^2=0993156 dw=0.53560	-3.089 ** [1]	-2.919 **	U_t ~ I (0) Presence of long run relationship	12.56 Percent

Notes: 1. Figures within the brackets below the regression coefficients are t values. 2,**=Negatively Significant at five percent level for rejection of null hypothesis of unit root [non stationarity] in residuals. 3. Critical levels: -3.5547 (1%), -2.9157 (5%), -2.5953(10%). 4. dw=Durbin Watson statistic.

The order of the integration of two time series macro variables [exports and imports] is the same i.e.,Y and X ~ I (1), the cointegration technique has been applied to the non stationary time series variables. With a view to find the degree of integration of the residuals from the cointegration regression of exports on imports and imports on exports, ADF and PP test statistics have once again been estimated for residuals. Table-2 reports the calculated ADF and PP test statistics for the level of the residuals. The calculated

ADF and PP test statistics are higher than the MacKinnon critical values showing that the residuals in level form are on a stationary process i.e., they are U~ I(0). The exports and imports series have unit root in levels while the residuals from co integrated regression have no unit root in levels. Therefore, though the exports and imports series are non stationary in log level form, their linear is stationary in level form evincing the fact that India's exports and imports are co integrated in the long run. This empirical content [through the Engel - Granger Representation] leads to conclude that there is a long run equilibrium relationship between exports and imports in India during the period under consideration.Further, the regression coefficients on log imports and log exports in two cointegration regressions, constant elasticities, are close to unity with trifling difference, which can be expected in the long run, indicating that in the long run one percent of India's imports is synchronized by one percent of India's exports and vice-versa resulting long run trade balance in India. The annual growth rate of the exports is slightly higher than that of imports during the period under consideration. he elasticity of India's exports with respect to imports is slightly more than unity revealing that the ratio of exports to imports goes on increasing slightly with the increase in imports.The elasiticity of India's imports with respect to exports is somewhat less than unity implying that the ratio of imports to exports goes on declining with the increase in imports. Even if exports and imports have a tendency to converge towards an equilibrium path in the long run they may diverge from equilibrium path in the short run. The disequilibrium between short run and long run values in lagged year can be corrected/adjusted quickly or slowly by the changes in exports or imports through the trade policies. The effectiveness of trade policies in correcting the disequilibrium has been scanned on the basis of ECM. The effective trade policies in correcting the disequilibrium reflects the responsiveness of the changes in exports or imports to previous deviations of actual exports or imports from long run equilibrium. In other words the equilibrium term that entered the ECM as explanatory variable allows to examine the effectiveness of the trade policies to move toward a new equilibrium. With a view to provide an empirical content to this an error correction modeling [ECM] which combines a long run co integration relationship and short run corrections/adjustments of co integrated variables toward the long run equilibrium] has also been attempted to first differenced variables and error correction variable, which are stationary. An interaction variable is also inducted in the model to scan whether the economic reforms helped in reducing the disequilibrium between short run dynamics and long run values . The results of the same are presented in Table –3.

The time series plot of residuals is presented in Figure 3

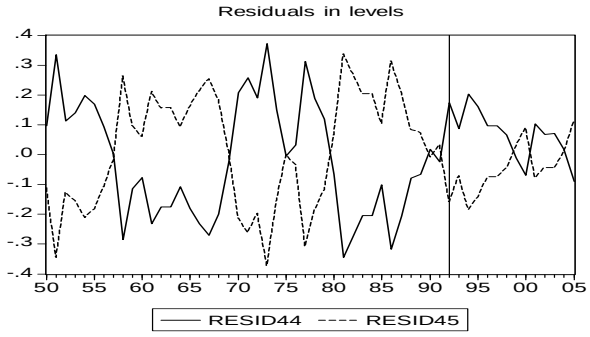


Table-3.Test Statistics for Error Correction Model with interaction variable

Dependent Variable: dlog(Y)
Method: Least Squares
Sample(adjusted): 1951 2004
Included observations: 54 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
constant	0.063741	0.018134	3.515023	0.0009
dlog(X)	0.448914	0.100946	4.447067	0.0000
residuals(-1)	-0.122218	0.082394	-1.483342	0.1443
dummy*residual(-1)	0.111300	0.283941	0.391984	0.6967
R-squared	0.293946			
Adjusted R-squared	0.251583			
Durbin-Watson stat	1.690907			

The estimates based on first differenced exports on first differenced imports, residuals lagged by one year and interaction variable,product of dummy and residuals lagged by one year furnished in table 3 show that the regression coefficient the differential variable is not significant implying that the economic reforms could not help to correct the more percentage of disequilibrium between equilibrium both in short run and long run periods during post economic reform period. In other words the coefficients of error correction terms are the same both in pre and post economic reform periods.

Table-4. Test Statistics for Error Correction Model with interaction variable

Dependent Variable: dlog(x)
Method: Least Squares. Sample (adjusted)1951-2004. Observations:54

Variable	Coefficient	Std. Error	t-Statistic	Prob.
constant	0.036991	0.023249	1.591094	0.1179
dlog(Y)	0.642054	0.141702	4.531030	0.0000
residual(-1)	-0.246430	0.094492	-2.607949	0.0120
dummy*residuals(-1)	-0.299032	0.372379	-0.803032	0.4258
R-squared	0.378879			
Adjusted R-squared	0.341611			
Durbin-Watson stat	1.816078			

The estimates based on first differenced imports on first differenced exports, residuals lagged by one year and interaction variable ,product of dummy and residuals lagged by one year furnished in table 4 as well show that the regression coefficient the differential variable is not significant implying that the economic reforms could not help to correct the more percentage of disequilibrium between equilibrium both in short run and long run periods during post economic reform period. In view of absence of any shift in the regression coefficient of error correction, the results are the same both in pre and post economic reform periods, the ECM has been re-estimated without interaction variable to

gauge the extent of disequilibrium between equilibrium both in short run and long run periods. The results are furnished in table 5

Table-5. Test Statistics for Error Correction Model

ECM Specification	Coefficients on			R^2	dw	Eq. in short run	Diseq. in short run	Proportion of Error Correction every year
	Intercept	$\Delta \ln X_t$	EC_{t-1}					
ECM - I Δ lnY on Δ lnX and EC_{t-1}	0.0651 [3.73]	0.4552 [4.72]	-0.1139 [-1.46]	0.30	1.658 ***	Present	Absent	--
ECM - II Δ lnX on Δ lnY and EC_{t-1}	0.0400 [1.74]	0.6715 [4.79]	- 0.2668* [-2.94]	0.38	1.794 ***	Absent	Present	27%

Notes: Eq.: Equilibrium, Diseq: Disequilibrium. Figures within the brackets below the regression coefficients are t values, * Significant at one percent level. 2. dw = Durbin-Watson statistic, 3. ** * Absence of Autocorrelation

The regression results based on ECM show that the coefficients on Δ log Y and Δ log X , [derivative of first differenced variable, exports or imports, with respect to first differenced variable, imports or exports] short run elasticities, are significantly positive and less than the coefficients on log Y and log X [level variables], long run elasticities, in cointegration regression evincing the positive effect of additional unit of exports on imports and imports on exports in the short run. i.e. short run percentage effect. The coefficient on Error Correction term [which gives an indication of short run deviations from the long run equilibrium] in ECM equation-I is negatively insignificant evincing the fact that the degree of disequilibrium between short run values and long run values in lagged periods is neither corrected nor extended each period showing that there are no disturbances present. In other words, the changes in exports adjust to the changes in imports in the same year. Thus, there is equilibrium both in short run and long run periods, evincing the fact that trade policy in India has been effective in maintaining the balance between actual exports and target exports both in the short run and the long run.

In the Equation II of ECM, the coefficient on error correction term is negatively significant This provides an important information on the short run relationship between exports and imports in India. The estimate of coefficient of error correction term, known as constant elasticity, specifies that the changes in imports respond to a deviation from the

long run equilibrium. This shows that twenty seven percent of disequilibrium in t-1 period is corrected in t period. Thus, though there is disequilibrium between short run and long run about twenty seven percent of the disequilibrium in t -1 period is corrected/ adjusted every year by the changes in imports. The differential coefficient of EC term is not negatively significant revealing the fact that the economic reforms could not facilitate to correct more percentage of disequilibrium in the short run. This piece of evidence suggests a need for a review of the trade policy in such a manner that the extent of disequilibrium between short run and long run periods could be eliminated quickly to maintain the equilibrium both in short run and long run.

4. Conclusion

The present empirical exercise is to perceive the presence of long run equilibrium relationship between India's exports and imports. The empirical evidence based on ADF and PP unit root tests illustrate that the aggregate exports and imports are stationary in first log difference. The estimates based on cointegration and error correction modeling show that India's exports and imports are co integrated showing the existence of long run equilibrium relationship between them during 1949-50 to 2004-05 The results based on error correction modeling based on Δ lnY on Δ lnX and EC_{t-1} illustrate that there is a short run equilibrium as well, indicating that the changes in exports adjust to the changes in imports in the same year. There is a disequilibrium between actual values of imports and equilibrium values of imports in the short run. However, twenty seven percent of disequilibrium between long run and short run periods is eliminated every year. It should be noted that the differential error correction term during post economic reform period is not significant showing absence of shift implying that the economic reforms could not facilitate to eliminate the degree of disequilibrium quickly in the short run.

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