Chapter 05- An Analysis of Long-run Relationship Between India's Import and Export with China – A Cointegration Approach

5.1 Introduction:

India has persistent trade deficit with China. If this trade deficit is unsustainable, then this will have negative impact on Indian economy. What is desirable for India is sustainability in trade deficit. This sustainability in trade deficit is ensured by long run equilibrium relationship between imports and exports. Over the years the study of long- run equilibrium relationship between the exports and imports of a country is one of the most important studies in international economics. This study can be overall exports and imports of the country in the world, or it can be a relationship between exports and imports of a country with a specific country or a specific region.

In this chapter we intend to analyze the long run relationship between the exports of India to and its import from China. The objective of our analysis is to find out whether there exists a long run equilibrium relationship between India's exports to and imports from China.

The rest of the chapter is organized as follows: In section 5.2 we will make a review of relevant literatures. It is followed by section 5.3 where we discuss the data and methodology used in our study. After that in section 5.4 we present the results and interpretation of our study and finally we have conclusion in section 5.5.

5.2 Review of Literature:

For our study we have reviewed two types of relevant literatures which has been divided here into two groups. The first group contains the literatures related to various aspects of relationship between exports and imports. And in the second group we have literatures related to various aspects of relationship between exports and imports of India. Let us start with the first group:

A. Studies related to relationship between exports and imports:

S. Husted (1992) made an important study on the long run equilibrium relationship between exports and imports of United States. This study was based on the quarterly data from 1969-1989. The study found that there was cointegrating relationship between exports and imports of United States. According to him the existence of cointegrating relationship between exports and imports implies that country does not violate their

intertemporal budget constraint. The findings of this study support the effectiveness of macroeconomic policies in restoring long -run equilibrium

A. C Arize (2002), examined the cointegration relationship between exports and imports for 50 countries. For this he used quarterly data of respective countries for the period between second quarter of 1973 to first quarter of 1998. Using various econometric techniques, he inferred that out of 50 countries there were 35 countries which exhibited cointegration relationship between their respective exports and imports. He also found that out of these 35 countries 31 of them had positive export coefficient. On the basis of this study, he further concludes that countries in the regions of the Middle East, Latin America, and Europe as compared to other regions had more unstable cointegrating relations.

M. Bahmani-Oskooee (1994), studied the effectiveness of macroeconomic policies of Australia by investigating the long run relation between Australian import and exports. Australia's exports and imports were found to be cointegrated with cointegrating coefficient close to one. On the basis of this result, he concluded that Australia's macroeconomic policies are effective.

M. Bahmani-Oskooee & H. J Rhee (1997)

S Fountas & L Wu (1999) examined the long- run relationship between exports and imports of United States. For this study they used quarterly data for the period of 1967-1994. This study concludes that there exists no long- run cointegrating relationship exists between exports and imports of United States during the stud period.

P. K Narayan & S Narayan (2004) studied the long- run equilibrium relationship between exports and imports of two Pacific Island countries – Fiji and Papua New Guinea. The data used for Fiji was annual data between 1960-2000 and for Papua New Guinea was annual data between 1960-1998. Their study found cointegration relationship between exports and imports for both the countries.

P. K Narayan & S Narayan (2005), again in their study investigated the long run equilibrium relationship between exports and imports of 22 LDC countries mostly from Africa. The data used for this study was for the period of 1960-2000 for 15 countries, 1965-2000 for 1 country, 1967-2000 for 1 country, 1968-2000 for 1 country, 1970-2000 for 3 countries and data was not specified for 1 country. The result of their study shows that out of 22 LDCs, 16 countries show no cointegration relationship between their respective exports and imports and only 6 LDCs showed the evidence of the cointegration relationship between their respective exports and imports.

T Mukhtar and S Rasheed (2010) examined the long run equilibrium relationship between exports and imports of Pakistan. For this purpose, they used the quarterly data for the period between 1972 – 2006. On the basis of this study, they conclude that there exists a long run cointegration between exports and imports of Pakistan for the study period.

M. Z. Rahman (2011) examined the long-run equilibrium relationship between exports and imports for two ASEAN countries viz. Indonesia and Malaysia with 45 years annual data. This study concludes that cointegration between exports and imports exists only in case of Malaysia and no cointegration was found in case of Indonesia. For this analysis the author used Engel – Granger as well as Johanson cointegration test.

M. A Babatunde 2014), studied the long-run equilibrium relationship between exports and imports of Nigeria. This study was based on the annual data for the period between 1960 and 2013. This study found that there was a cointegrating relationship between exports and imports and cointegrating coefficient was found to be close to unity which implies that the country's macroeconomic policies were effective in stabilizing long- run relationship between exports and imports of the country.

B. Studies related to India:

M. Upendra (2007), in his study examined the long -run equilibrium relationship between India's exports and imports for the period between 1949-50 to 2004-05. This study found cointegration between India's exports and imports during the study period. According to this study, on the one hand the elasticity of India's exports relative to its imports was found to be greater than unity implying that with the increase in imports, the ratio of exports to imports keeps increasing. On the other hand, the elasticity of India's imports relative to exports was found to be less than unity implying that with the increase in imports the ratio of imports to exports keeps decreasing. According to this study the economic reforms which was initiated since 1992 was ineffective in correcting the disequilibrium during the post reform period.

L Konya and J. P Singh (2008) also investigated the equilibrium relation between exports and imports with the data between the same period from 1949-50 to 2004-05. For this purpose, they transformed both the variables in their natural logarithm form. Unlike the previous study, their study found that there was no cointegration between India's exports and imports during the study period and they concluded that India's macroeconomic policies were not effective in bringing India's exports and imports in equilibrium and India was in violation of her international budget constraint.

N Sohrabji, (2010), in his study of the sustainability of India's current account position during the post reform period found that there exists a cointegrating relationship between India's exports and imports. The author concludes that there has been an improvement in India's trade pattern. According to him, India's current account was sustainable during the study period despite India was experiencing trade deficit during that period.

A Tiwari (2010) examined the long run sustainability of India's trade deficit. The monthly data for the study considered was form April-1984-85 to March-2009-102. This study concludes that there was cointegration between India's exports and imports and India's macroeconomic policies were effective in facilitating India's exports and imports towards their long-run equilibrium .

A. K Tiwari (2011) investigated the long run relationship between exports and imports of India and China. This study was based on monthly data from January 1992 to February 2010. This study on the basis of Gregory-Hansen cointegration test found that exports and imports were cointegrated for India but not cointegrated for China. Again, cointegration result based on Saikkonen and Lütkepohl test shows that exports and imports of both India and China are cointegrated. On the basis of these results, author concludes that India's macroeconomic policies were strongly effective for long- run equilibrium relationship of its exports and imports.

M. J Holmes, T Panagiotidis, & A. Sharma. (2011), examined India's current account sustainability which requires the cointegration between exports and imports. This study was conducted with the annual data for the period between 1950-2003. According to this study the results were different for two different periods. It shows that India's exports and imports were cointegrated after 1991 and they were found to be not cointegrated during the period before 1991. This means that India's current account were unsustainable prior to 1991 and it became sustainable only after 1991.

M. Sahoo, M.S, Babu, & U Dash (2016)., made a study on long run sustainability of current accounts of India and China by examining the long-run relationship between exports and imports of respective countries. This study was based on annual data from 1980-2014. This study found that exports and imports of China were cointegrated, so its long run current account was sustainable but same is not true for India as results show that India's exports and imports were not cointegrated. This result is just opposite of the results of the study of A. K Tiwari (2011). This may be due to use of different cointegration test or different time period or something else.

5.3 Data and Methodology:

In this study we have analyzed the relationship between India's exports and imports with China for the period between 1996-2018. The frequency of the time series data for both the variables are quarterly in nature. Our period starts from second quarter of 1996 and ends at 4th quarter of 2018. The source of the data that has been used in this study is the repository of Federal Bank of St. Louis, USA. Data for both the variables has been transformed to their logarithmic form. This is important because logarithmic transformations reduces both skewness and heteroscedasticity in variables (Gujarati & Porter, 2009) .

We have used the Engel and Granger (1987) two step procedure of cointegration for this study. But before using this method, we have to ensure the stationarity of the given variables by finding their order of integration. A non- stationary process is integrated of order 1 or above whereas a stationary process is integrated of order 0 written as I(0). As far as stationarity is concerned "a stochastic process is said to be stationary if its mean and variance are constant over time and the value of the covariance between the two time periods depends only on the distance or gap or lag between the two time periods and not the actual time at which the covariance is computed" (Gujarati and Porter, 2009).

5.4 Results and Interpretations:

i) Unit Root Test:

This test is important to find out whether the variables considered are stationary or . To find out the presence of unit root in our variables we used Augmented Dickey Fuller test. The hypothesis for this test is

H_0 = The variable contains unit root at level

H_1 = The variable does not contain unit root at level

The result of the test is presented in table 5.1.

Table 5.1: Unit Root Test for lx_t and lm_t

Variables	Level	p-value	1st Difference	p-value
lx_t	-1.517	0.5250	-10.070	0.01486
lm_t	-1.403	0.5808	-10.280	0.00

The Dickey-Fuller test shows that , for both the variables i.e., Log_Import denoted by lm_t and Log_Exports denoted by lx_t the test statistics were not significant at level, so we accept the null hypothesis that both lm_t and lx_t contains unit root at level . Then again, we conducted the unit root test for both the variables but at their first differences. In this case we found that the test statistics for both the variables were significant

as shown in Table 5.1. This means that , at their first differences both the variables are stationary. Thus, we conclude that both the variables were I(1) at level and I(0) at first difference.

After testing the stationarity of both the variables now we will go for co-integration test. For cointegration test we have applied two step Engel Granger Test for Cointegration (1987). It is as follows:

ii) Two Step Engel Granger Test for Cointegration:

First, we estimate the cointegration regression equation given by

$$lx_t = \beta_1 + \beta_2 lm_t + \varepsilon_t \qquad (1)$$

The table below gives the estimation of cointegration regression

Table 5.2: Estimation of Cointegration Regression

lx_t	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval)	
lm_t	0.769757	0.025126	30.64	0	0.719832	0.819681
_cons |	0.861916	0.205403	4.2	0	0.453785	1.27004

Note: lx_t is dependent and lm_t is independent

The Table 5.2 shows the estimation of cointegration regression which is nothing but the ordinary least square regression between lx_t and lm_t where lx_t is the dependent and lm_t is the independent variable. After estimating the cointegration regression we will estimate to order of integration of error term, or we will find out the stationarity of error term. We take the following hypothesis for testing the order of integration or error term or the determine the unit root in error term.

H_0 = The error term contains unit root at level

H_1 = The error term does not contain unit root at level.

Table 5.3: Unit Root Test for Error Term

parameter	coefficient	Table value*		
		(1%)	(5%)	(10%)
ε	-4.043**	-4.021	-3.405	-3.092

Note: *Mackinnon (1991); ** Significant at 1%

The result of the unit root test on error term is presented in Table 5.3. It shows that the calculated value (absolute) is higher than the tabulated value at 1% so we reject

the null hypothesis that the error term contains unit root. This means that there exists a long run relationship between lx_t and lm_t . In other words, the two variables are co -integrated.

Now, following the Granger Representation Theorem (GRT) which states that, if two variables are cointegrated the relationship between the two can be expressed as Error Correction Model, we now consider the Error Correction Model.

iii) Error Correction Model:

The ECM model is the short- run dynamics of the model. This model only includes I(0) variables. So, all our non-stationary variables are required to first differenced to produce I(0) or stationary variables. In this model we will incorporate error correction term (ECT). ECT are nothing but one- period lagged residual of long run equation (5.1). It is derived as follows:

$$e_{t-1} = lx_t \ - \ \beta_0 - \beta_1 lm_{t-1} \qquad (5.2)$$

After differencing lx_t and lm_t

$$\Delta lx_t = \beta_0 + \beta_1 \Delta lm_t + \beta_2 e_{t-1} + v_t \qquad (5.3)$$

Combining (5.2) and (5.3) we get

$$\Delta lx_t = \beta_0 + \beta_1 \Delta \ lm_t + \beta_2 (lx_t \ - \ \beta_0 - \beta_1 lm_{t-1}) + v_t \qquad (4)$$

The equation (4) is the Error Correction Model.

Table 5.4: **Estimation of Error Correction Model**

Source	SS	df	MS	Number of obs	90
Model	0.75629	2	0.378145	F(2 , 87)	4.84
Residual	6.792481	87	0.078074	Prob> F	0.0101
Total	7.548771	89	0.084818	R-squared	0.1002
				Adj R -squared	0.0795
				Root MSE	0.27942

D. lx_t	Coef.	Std. Err.	t	P>|t|	[95% Conf. Interval]	
d. lm_t	0.2437	0.26476	0.92	0.36	-0.282546	0.76995
l.error	-0.25269	0.08136	-3.1	0.003	-0.414408	-0.09097
_cons	0.02778	0.03226	0.86	0.392	-0.036353	0.0919

Note: Period: 1996:4-2018:4 (T = 90).
Dependent variable: d_lx_t

The ECT shows how fast our model returns to equilibrium following an exogenous disturbance. It is to be noted that the coefficient of error correction term should be negative, which indicates that the model is moving back to equilibrium. On the contrary if the

coefficient of error correction term is positive, it indicates movement of the model away from its equilibrium. Also, the value of the coefficient of error term lies between 0 and 1 (both inclusive). When its value is 1 it means there was full adjustment in one period later (in our case in one quarter later) and if its value is 0 it means there was no adjustment.

Any deviation from the long run equilibrium is corrected by error correction term through a series of short- term adjustments.

We estimated the Error Correction model with 90 observations. The estimated result of the Error Correction Model is given in Table 5.3 below. According to the table 5.3, the coefficient of error correction term is -0.25, and is statistically significant. As the value of the coefficient of ECT is negative, this means that model is moving back to equilibrium and as the absolute value of the coefficient is within the range of 0 and 1, this means that around 25% of the discrepancy between the long-run and short run is corrected within a quarter.

From our results we can write the long run and short run models as below::

Long run model
$$lx_t = 0.86 + 0.77 \; lm_t + e_t \tag{5}$$

Short run model
$$lx_t = 0.03 + 0.24 \; lm_t - 0.25 \; (lx_t \; - \; \beta_0 - \beta_1 lm_{t-1}) + v_t \tag{6}$$

or,
$$lx_t = 0.03 + 0.24 \; lm_t - 0.25 \; e_{t-1} + v_t \tag{7}$$

5.5 Conclusion:

In this chapter we examined the relationship between India's exports and imports with China. Our very specific objective in this chapter was to find out the long-run relationship between the two variables of India's exports to and imports from China. The method that we had applied in this analysis was that of Engle – Granger Two Sep co-integration method. After conducting the analysis, we come up with the following findings. The cointegration test revealed that there exists cointegration between the two variables during the given period. After that, we further go for error correction model to see whether the discrepancy between long- run and short- run is corrected. Our study revealed that, even though India's imports and exports with China had a stable long-run relationship but this stability is so weak in nature that only about 25 percent of the disturbances between the long run and short run was corrected within the quarter of the period. On the basis of this result it is important for

India to focus on reducing trade deficit with China before it become unsustainable and unmanageable for India.

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