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Are exports and imports cointegrated in India and China? An empirical analysis

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Abstract

This study analysis the sustainability of the trade deficits in the two giant economies of Asia, namely India and China with allowance of endogenous structural breaks. We found that trade deficit is sustainable in case of India but not in case of China. This implies that macroeconomic policies of India but not of China have been effective in leading exports and imports to long run steady state equilibrium relationship.

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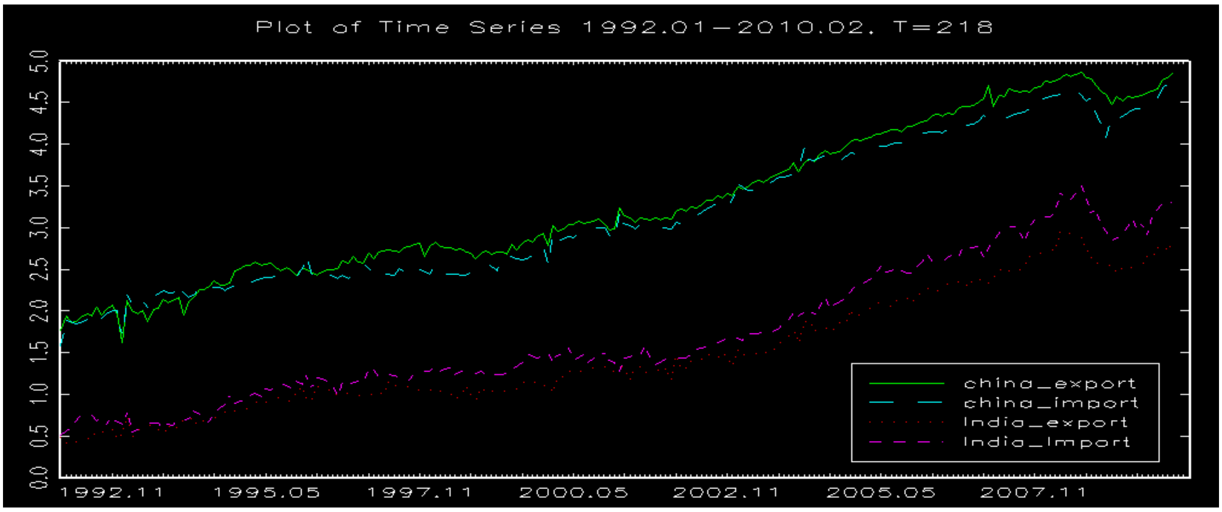
I. Introduction

Imports and exports are two important elements of the Balance of Payments (BOPs) of any country. Developing countries receive a major share of their Gross National Product (GNP) from the export of agricultural, agri-related and other primary commodities. Developing countries are also heavily dependent on the import of diverse capital and consumer goods to feed their industries and satisfy their people's consumption needs. Therefore, these countries have to take adequate care of the movement of their imports and exports and thus have to revise their trade policy from time to time so that the adverse trade balance may not get elusive. A better picture of the foreign trade regime of a country can be obtained if the behavior of imports and exports is investigated by examining their time series properties. External account is an important indicator of a country's economic performance as major external imbalances might predict future changes in a managed foreign exchange regime. There are number of factors that may cause the external deficits or surpluses in the country's external account. Empirical studies attempt to identify the sources of external imbalances by relating the external accounts to key macroeconomic variables: government spending, private consumption, income etc. (Sachs, 1981; Ahmed, 1987; Razin, 1995; Elliott and Fatas, 1996). Some authors (for example Artis and Bayoumi, 1989) argue that fiscal and monetary policies have aimed to reduce the size of external imbalances in a number of countries. Other studies have pointed out that these external balances are the outcome of 'bad policy', at least in relation to the USA during the 1980s (Summers, 1988 and Husted, 1992). That is why sustainability of foreign trade deficits has become the major concern of the policy makers, central banks and the market analysts of the emerging economies. In simple foreign trade multiplier terms an increase in exports leads to an increase in domestic income which increases import. Therefore, a country's import intensity depends on its export ability; nonetheless it is not the only one determining factor. This is why, the objective of this study is to examine whether the foreign trade deficits in India and China are sustainable i.e., whether India's and Chinas exports and imports are cointegrated. For fastest growing countries like India and China, the current account deficit occupies the centre stage in policy discussions, as the persistent discrepancies in current account and rising levels of trade deficit pose risks to the sustainability of high economic growth and macroeconomic stability. From the figure 1 it is evident that exports and imports series of the both countries have sharp fluctuations in the year of 1990.

Figure 1: Exports and imports plots of India and China (measured in bullions of US dollars and expressed in natural log forms.



II. Literature review

In recent times, in the area of international trade, many empirical studies have been conducted to analyze the existence and the nature of long-run or cointegrating relationship between exports and imports. One of the earliest pioneering works in this area has been the study by Husted (1992). Using quarterly US trade data for the period 1967–1989, Husted has shown that exports and imports are cointegrated in the long run. Husted (1992)[1] has shown that the existence of cointegrating relationship between exports and imports implies that countries do not violate their international budget constraint and therefore supports the effectiveness of their macroeconomic polices in resorting the long-run equilibrium. Herzer and Nowak-Lehmann (2006) and Erbaykal and Karaca (2008) have shown the existence of a cointegrated relationship between exports and imports, which suggest that trade deficits are only short-term phenomenon therefore, sustainable in the long-term. Bahmani-Oskooee and Rhee (1997) used quarterly data to model exports and imports for Korea. They found evidence of cointegration and the coefficient on exports was positive. Narayan and Narayan (2005) investigate whether there is a long-run relationship (cointegration) between exports and imports for 22 least developed countries (LDCs). They analyzed this issue using the bounds testing approach to cointegration. They found that exports and imports are cointegrated only for six out of the 22 countries, and the coefficient of exports is less than one. In the Indian case, Upender (2007) has shown that India's nominal exports and imports were cointegrated by employing data for the period 1949-50 to 2004-05. Arize (2002) used quarterly data for the period 1973–1998 from 50 OCED and developing countries to examine the same question. He found that for 35 of the 50 countries there was evidence of cointegration between exports and imports; and 31 of the 35 countries had a positive export coefficient. Konya and Singh (2008), by employing data for the period 1949-50 to 2004-05 and allowing a structural break in 1992-93, found no evidences of cointegrating relationship between India's exports and imports. The exogenously determined structural break in 1992-93

[1] He has also developed a theoretical model to explain this phenomenon.

incorporates the potential impact of the March 1993 switch from a fixed exchange rate regime to a free floating exchange rate policy.

III. Objective, Data source and estimation methodology

III.I. Objective

The basic objective set in the study is to examine the long-run relationship between exports and imports for the Chinese and Indian economy. To the best of my knowledge there is no study in the context of China and India which has analyzed the cointegration relationship by endogenously determined structural break. Our contribution to the existing literature is twofold. *First*, most of the existing studies have used standard unit root tests for stationarity. However, it is empirically verified that results will be inconclusive if endogenous structural breaks have not been incorporated in the analysis. *Secondly*, as Herzer and Nowak-Lehmann (2006) have shown that standard cointegration tests tend to falsely accept the null of no cointegration when there is a structural break under the alternative hypothesis. Therefore, in this study we have made an attempt to incorporate endogenously determined structural breaks in conducting unit root and cointegration analysis.

III.II. Data source and variables description

The data used are monthly observations of the (nominal)[2] billion United States (US) $ values of exports and imports. The data has been obtained from OECD website and was extracted on 17th June 2010. Time period of the analysis is from January -1992 to February-2010. [3] Both variables have been transformed in natural log form in order to make data series of less order Autoregressive (AR) i.e., to minimize fluctuations in the series.

III.III. Estimation methodology

Traditional unit root tests like Augmented Dickey Fuller (ADF) (1979) and Phillips-Perron (PP) (1988) are found to give misleading results (i.e., biased towards the non-rejection of null hypothesis when structural breaks are present in the data series (Perron, 1989). Therefore, in the present study we have adopted two different test of unit root test to test the stationary property of the data in the presence of structural breaks.[4] First one is Lee and Strazicich (2003, 2004) test and second is Narayan and Popp (2010), a novel test. Lee and Strazicich (2003, 2004) test of unit root allows us to test for at most two endogenous break and uses the Lagrange Multiplier (LM) test statistics. Let us consider the following data generating process (DGP):

$$y = \delta Z_t + e_{t,}\ e_t = \beta e_{t-1} + \varepsilon_t \quad \text{………….(1)}$$

where Z_t is a vector of exogenous variables, δ is a vector of parameters and ε_t is a white noise process, such that $\varepsilon_t \sim NIID(0, \sigma^2)$. First we will consider the case when break there is evidence of one structural break. The Crash model that allows shift in level only is described by $Z_t = [1, t, D_t]'$, and the break model that allows for changes in both level and trend is described as $Z_t = [1, t, D_t DT_t]'$, where D_t and DT_t are two dummies defined as:

$$D_t = 1, if \ \ t \geq T_B + 1$$

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[2] It should be noted that if we take real values of exports and imports the results may get change. Therefore, for the policy purpose the use of the results drawn in this paper should be carefully examined.

[3] It should also be noted that since we are using monthly observations therefore, even though sample size is large but time span of the study is small which may also affect our results so careful examination of results is required is for policy purposes.

[4] It is important to not that we have also used unit root test proposed by Saikkonen and Lütkepohl (2002) and results of Saikkonen and Lütkepohl (2002) unit root test are reported in Table 1 of Appendix 1. Since we do not find any difference in findings when we adopt the seasonal dummies and when we do not incorporate the seasonal dummies therefore, we have reported results of the models which do not incorporate seasonal dummies only. However, results of the model which incorporates seasonal dummies are available from the author upon request.

$= 0, otherwise$

and

$DT_t = t - T_B, if\ \ t \geq T_B + 1$

$= 0, otherwise$

where T_B is the time period of the break date.

Next, let us consider the framework that allows for two structural breaks. The crash model that considers two shifts in level only is described by $Z_t = [1, t, D_{1t}, D_{2t}]'$, and the break model that allows for two changes in both level and trend is described as

$Z_t = [1, t, D_{1t} DT_{1t} D_{2t} DT_{2t}]'$, where D_{jt} and DT_{jt} for j = 1, 2 are appropriate dummies defined as above, viz.,

$D_{jt} = 1, if\ \ t \geq T_{Bj} + 1$

$= 0, otherwise$

and

$DT_{tj} = t - T_{Bj}, if\ \ t \geq T_{Bj} + 1$

$= 0, otherwise$

where T_{Bj} is the j^{th} break date.

The main advantage of (Lee and Strazicich, 2003, 2004) approach to unit root test is that it allows for breaks under the null (β = 1) and alternative (β < 1) in the DGP given in equation (1). This method uses the following regression to obtain the LM unit root test statistics

$$\Delta y_t = \delta' \Delta Z_t + \phi \tilde{S}_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta \tilde{S}_{t-j} + u_t \text{.....................(2)}$$

where $\tilde{S}_t = y_t - \tilde{\Psi}_t - Z_t \tilde{\delta}, t = 2, ..., T; \tilde{\delta}$ denotes the regression coefficient of Δy_t on ΔZ_t and $\tilde{\Psi}_t = y_t - Z_1 \tilde{\delta}$, y_1 and Z_1 being first observations of y_t and Z_t respectively. The lagged term $\Delta \tilde{S}_{t-j}$ are included to correct for likely serial correlation in errors. Using the above equation, the null hypothesis of unit root test $(\phi = 0)$ is tested by the LM t-statistics. The location of the structural break or structural breaks is determined by selecting all possible breaks for the minimum t-statistic as follows:

$\ln f\tilde{\tau}(\bar{\lambda}_i) = \ln_{\lambda} f\tilde{\tau}(\lambda)$, where $\lambda = T_B / T$.

The search is carried out over the trimming region (0.15*T*, 0.85*T*), where *T* is sample size and T_B denotes date of structural break. We determined the breaks where the endogenous two-break LM t-test statistic is at a minimum. The critical values are tabulated in Lee and Strazicich (2003, 2004) for the two-break and one-break cases respectively.

Second test adopted in this study is suggested by Narayan and Poop (2010). The procedure of the test of Narayan and Poop (2010) can be explained as follows. Suppose, we consider an unobserved components model to represent the DGP and the DGP of a time series y_t has two components, a deterministic component (d_t) and a stochastic component (u_t), as follows:

$y_t = d_t + u_t$,.....................(3)

$u_t = \rho u_{t-1} + \varepsilon_t$,.....................(4)

$\varepsilon_t = \Psi^*(L) e_t = A^*(L)^{-1} B(L) e_t$,...................(5)

e_t is a white noise process, such that $e_t \sim NIID(0,\sigma^2)$. By assuming that the roots of the lag polynomials *A*(L)* and *B(L)* are of order *p* and *q*, respectively, lie outside the unit circle NP (2010) considered two different specifications for trending data- one allows for two breaks in level (denoted as model 1 i.e., M1) and the other allows for two breaks in level as well as slope (denoted as model 2 i.e., M2). The specification of both models differs in terms of the definition of the deterministic component, d_t,:

$$d_t^{M1} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t}),\ldots\ldots\ldots\ldots\ldots\ldots..(6)$$

$$d_t^{M2} = \alpha + \beta t + \Psi^*(L)(\theta_1 DU'_{1,t} + \theta_2 DU'_{2,t} + \gamma_1 DT'_{1,t} + \gamma_2 DT'_{2,t}),\ldots\ldots\ldots\ldots\ldots\ldots..(7)$$

With

$$DU'_{i,t} = 1(t > T'_{B,i}), DT'_{i,t} = 1(t > T'_{B,i})(t - DT'_{B,i}), i = 1,2. \ldots\ldots\ldots\ldots\ldots.(8)$$

were, $T'_{B,i}$, *i* = 1, 2, denote the true break dates, *θi* and *γi*, indicate the magnitude of the level and slope breaks, respectively. The inclusion of $\Psi^*(L)$ in Equations (6) and (7) enables breaks to occur slowly over time i.e., it assumes that the series responds to shocks to the trend function the way it reacts to shocks to the innovation process e_t (Vogelsang and Perron, 1998). This process is known as the Innovational Outlier (IO) model and the IO-type test regressions to test for the unit root hypothesis for M1 and M2 can be derived by merging the structural model (3)–(8). The test regressions can be derived from the corresponding structural model in reduced form as follows:

$$y_t^{M1} = \rho y_{t-1} + \alpha_1 + \beta^* t + \theta_1 D(T'_B)_{1,t} + \theta_2 D(T'_B)_{2,t} + \delta_1 DU'_{1,t-1} + \delta_2 DU'_{2,t-1} + \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t,\ldots(9)$$

With $\alpha_1 = \Psi^*(1)^{-1}[(1-\rho)\alpha + \rho\beta] + \Psi^{*\prime}(1)^{-1}(1-\rho)\beta, \Psi^{*\prime}(1)^{-1}$ being the mean lag, $\beta^* = \Psi^*(1)^{-1}(1-\rho)\beta, \phi = \rho - 1, \delta_i = -\phi\theta_i and D(T'_B)_{i,t} = 1(t = T'_{B,i} + 1), i = 1,2.$

$$y_t^{M2} = \rho y_{t-1} + \alpha^* + \beta^* t + \kappa_1 D(T'_B)_{1,t} + \kappa_2 D(T'_B)_{2,t} + \delta_1^* DU'_{1,t-1} + \delta_2^* DU'_{2,t-1} + \gamma_1^* DT'_{1,t-1} + \gamma_2^* DT'_{2,t-1}$$

$$+ \sum_{j=1}^{k} \beta_j \Delta y_{t-j} + e_t,\ldots(10)$$

where equation (9) and (10) are Innovational Outlier (IO)-type test regression for M1 and M2 respectively, $\kappa_i = (\theta_i + \gamma_i), \delta_i^* = (\gamma_i - \phi\theta_i), and\ \gamma_i^* = -\phi\gamma_i, i = 1,2.$

In order to test the unit root null hypothesis of *ρ* = 1 against the alternative hypothesis of *ρ* < 1, we use the *t* -statistics of $\hat{\rho}$, denoted $t_{\hat{\rho}}$, in Equations (9) and (10).

Since it is assumed that true break dates are unknown, $T'_{B,i}$ in equations (9) and (10) has to be substituted by their estimates $\hat{T}_{B,i}$, *i* = 1, 2, in order to conduct the unit root test. The break dates can be selected simultaneously following a grid search procedure or a sequential procedure comparable to Kapetanios (2005). Narayan and Poop (2010) have preferred sequential procedure as because it is far less computationally demanding therefore; we have also followed sequential procedure.

In this case in the first step search for a single break which we select according to the maximum absolute *t*-value of the break dummy coefficient θ_1 for M1 and κ_1 for M2. Thereafter, we impose the restriction $\theta_2 = \delta_2 = 0$ for M1 and $\kappa_2 = \delta = \gamma = 0$ for M2 and hence, we have:

$$T_{B,1}^{'} = \begin{cases} \arg\max_{T_{B,1}} \left| t_{\hat{\theta}_1}(T_{B,1}) \right|, \ for & M1, \\ \arg\max_{T_{B,1}} \left| t_{\hat{\kappa}_1}(T_{B,1}) \right|, \ for & M2 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

So, in the first step, the test procedure reduces to the case described in (Popp, 2008). Imposing the first break $\hat{T}_{B,1}$ in the test regression, we estimate the second break date $\hat{T}_{B,2}$. Again we maximize the absolute *t*-value; this time θ_2 for M1 and κ_2 for M2. Hence, we have:

$$T_{B,1}^{'} = \begin{cases} \arg\max_{T_{B,2}} \left| t_{\hat{\theta}_2}(\hat{T}_{B,1}, T_{B,2}) \right|, \ for & M1, \\ \arg\max_{T_{B,2}} \left| t_{\hat{\kappa}_2}(\hat{T}_{B,1}, T_{B,2} \right|, \ for & M2 \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

After determining the order of integration of each variable, we tested for cointegration to find out whether any long-run relationship exists among the variables (if cointegration exists it will imply the sustainability of trade). Standard cointegration techniques are biased towards accepting the null of no cointegration and if there is a structural break in the relationship as Kunitomo (1996) mentioned that these tests may produce ‘spurious cointegration results’. Further, test based on exogenously determined structural breaks also may not provide fruitful results therefore; we apply the Gregory and Hansen (1996) cointegration procedure that allows for an endogenously determined structural break in single equation framework. The test presents three models, whereby the shifts can be in either the intercept alone (C):

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha^T y_{2t} + e_t \ldots\ldots\ldots\ldots\ldots(13)$$ where t= 1, …n.

In both trend and level shift (C/T)

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \beta t + \alpha^T y_{2t} + e_t \ldots\ldots\ldots\ldots\ldots(14)$$

And a full shift of the regime shift model (C/S)

$$y_{1t} = \mu_1 + \mu_2 \varphi_{t\tau} + \alpha_1{}^T y_{2t} + \alpha_2{}^T y_{2t} \varphi_{t\tau} + e_t \ldots\ldots\ldots\ldots\ldots(15)$$ where t=1,…n and μ_1, β_1 and α_1 are the intercept, trend and slope coefficients respectively before the regime shift and μ_2, β_2 and α_2 are the corresponding changes after the break. The dummy variable $\varphi_{t\tau}$ is defined as:

$$\varphi_{t\tau} = \begin{cases} 0, if & t \le \{\eta\tau\} \\ 1, if & t > \{\eta\tau\} \end{cases}$$

Where unknown parameter $\tau \in (0,1)$ denotes the (relative) timing of the change point, and { } denotes integer part.

Following the procedure suggested by Herzer and Felicitas (2006), all the models we estimated for each possible break date in the data set (for each τ). Then we perform a unit root test on the estimated residuals $\hat{e}_{t\tau}$ and the smallest value of the unit root test statistics are used for testing the null hypothesis of no cointegration between exports and imports, against the alternative hypothesis of cointegration in the presence of an endogenous structural break. The asymptotic critical values are tabulated in Gregory and Hansen (1996) Lag-length in cointegration equation is based on SIC and AIC.

III. Data analysis and results interpretation

First, we present the results of unit root analysis based on endogenously determined structural breaks in Lee-Strazicich unit root test (2003, 2004) and Narayan and Poop test (2010) procedure in Table 1.

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Table 1: Univariate unit root tests: Constant and trend included in the model with structural breaks

Lee-Strazicich's LM unit Root Test								
Series in level form					Series in first difference form			
	T_{B1}	T_{B2}	k	Test statistics	T_{B1}	T_{B2}	k	Test statistics
Results for univariate LM unit root test with one and two structural break in intercept/constant only								
India's exports	2004:01		1	-2.2929	2001:11		3	-2.8522
	1998:08	2004:01	1	-2.6132	1999:12	2004:06	3	-3.6815
India's imports	1996:01		1	-2.0354	2007:08		0	-18.7925***
	1996:01	2007:01	1	-2.2494	2004:05	2007:08	0	-18.9084***
China's exports	1999:11		5	-2.1948	2001:12		4	-3.0643
	1997:11	2002:12	5	-2.5899	1999:01	2003:06	4	-3.4433
China's imports	1996:01		1	-2.7752	2002:12		3	-2.2230
	1997:01	2004:01	1	-3.0129	1998:01	2002:12	2	-3.1761
Results for univariate LM unit root test with one and two structural break in intercept/constant and trend both								
India's exports	2002:12		1	-3.2193	2006:10		0	-19.8882***
	2002:12	2008:03	5	-5.0347	1995:05	1995:05	0	-20.4058***
India's imports	2001:01		1	-3.3053	1999:05		0	-18.7215***
	2001:06	2008:04	0	-5.7012	2001:01	2008:05	0	-19.6120***
China's exports	1999:11		5	-2.7452	2007:04		0	-19.7248***
	2001:01	2007:02	7	-4.5138	1996:04	2008:05	0	-21.6217***
China's imports	2002:10		1	-2.5527	1994:12		0	-20.9968***
	1997:01	2003:06	5	-3.5369	1994:12	1998:03	0	-20.9980***
NP (2010) results of unit root with structural breaks for model M1 and M2								
	Model M1							
India's exports	2001:M12	2004:M1	2	-2.2291275	1997:4	2005:1	0	-15.047075 ***
India's imports	1996:M6	2001:M8	1	-2.3818130	1997:4	2005:1	0	-15.047075***
China's exports	1997:M11	2001:M1	2	-1.9844316	1997:4	2005:1	0	-15.047075***
China's imports	2001:M1	2004:M1	1	-2.6243051	1997:4	2005:1	0	-15.047075***
	Model M2[@]							
India's exports	2001:M12	2004:M1	2	-2.6170098				
India's imports	1996:M1	1996:M7	1	-2.5000764				
China's exports	1997:M11	2001:M1	2	-1.9567693				
China's imports	1999:M12	2001:M1	1	-3.1708118				
Note: (1) Critical values for NP (2010) are: -4.731, -4.136 and -3.825 at 1%, 5% and 10% level of significance respectively for model M1 and -5318, -4.741 and -4.430 at 1%, 5% and 10% level of significance respectively for model M2; (2) [@]Model M2 for first difference we could not estimate because of the problem of near singular matrix in the data series; (3) T_{B1} and T_{B2} are the dates of the structural breaks; (4) "*k*' is the lag length; (5) Critical values of both test statistics (that is when breaks occur in intercept only and intercept and trend jointly are reported in Lee-Strazicich (2003, 2004) two-break and one-break cases respectively; (6) * (**) *** denote statistical significance at the 10%, 5% and 1% levels respectively; (7) Mi (where i=1,2,…,12) reported under T_{B1} and T_{B2} test statistics denotes number of months.								
Source: Author's calculation								

It is evident from table 1 that in case of LM unit root test of Lee-Strazicich exports and imports of the both countries are first difference stationary when model include one or two breaks which occurs in the model of intercept and trend. Model M1 of NP (2010) test also reports the same results and hence confirms the conclusion which we can draw from the LM unit root test of Lee-Strazicich (2003, 2004)[5]. After confirming that both variables of both countries follows first order autoregressive scheme (i.e., AR(1)) we have proceeded to carry out cointegration analysis with Gregory-Hansen cointegration test[6]. Results of cointegration analysis are reported in the following Table 2.

Table 2: Cointegration analysis

Cointegration test : Gregory-Hansen Cointegration Tests					
China			India		
Break in Intercept. No Trend (1994:M11)		Test statistics (k)	Break in Intercept. No Trend (2000:M07)		Test statistics (k)
Yes	----	-3.71163 (1)	Yes	----	-6.83741 (1)
Break in Intercept. Trend Included (2000:M04)			Break in Intercept. Trend Included (1998:M01)		
Yes	----	-3.86158 (1)	Yes	----	-6.67106 (1)
Full Structural Break (2000:M03)		-4.07929 (1)	Full Structural Break (2000:M06)		
Yes	----		Yes	----	-6.90165 (1)
Note: (1) "k" Denotes lag length; (2) Critical values are -5.13 and -4.61 at 1% and 5% respectively for Break in Intercept and no trend model; (2) Critical values are -5.45 and -4.99 at 1% and 5% respectively for break in intercept when trend is included in the model and critical values are -5.47 and -4.95 at 1% and 5% respectively for full structural break model; (3) Mi (where i=1,2,…,12) denotes number of months.					
Source: Author's calculation					

It is evident from table 2 that in all the cases there are strong evidences for the presence of a cointegrating vector between exports and imports series of India but not for China. To put it differently, we find that there is strong evidence for sustainability of BOT deficits in the Indian context but not the Chinese context.

IV. Conclusion

This study examines the nature of the long-run relationship between exports and imports for the Chinese and Indian economy from the period January -1992 to February-2010. It employs recent time series econometric methods like unit root test in the presence of endogenous structural breaks and seasonal adjustments and cointegration techniques that allow for structural breaks and seasonal adjustments for the analysis.

The results suggest that individually exports and imports (evaluated in nominal billon US $ and expressed in logarithms) have multiple breaks. Cointegration analysis based on Gregory-Hansen cointegration test reveals that exports and imports of India are cointegrated while that of China not. However, cointegration results based on Saikkonen and Lütkepohl (2000a,b,c) reveals that exports and imports of both countries are cointegrated. Hence, we can say that we have strong evidence of cointegration relationship of India's exports and imports series while weak evidence for Chinas exports and imports series. This indicates that Indian governments have been playing a crucial role in strongly stabilizing the trade balance and all of India's macroeconomic policies

[5] Results of Saikkonen and Lütkepohl (2002) unit root test also confirm the same findings.

[6] Apart from Gregory-Hansen cointegration test we have also conducted cointegration test proposed by Saikkonen and Lütkepohl (2000a,b,c) and results are reported in Table 2 of Appendix 1. Cointegration test of Saikkonen and Lütkepohl (2000a,b,c) reveals that exports and imports of both countries are cointegrated, contrary results as obtained from Gregory-Hansen cointegration test.

have been strongly effective in leading export and import to long run steady sate equilibrium relationship. While Chinas government have been playing a role in stabilizing the trade balance and all of China's macroeconomic policies have been just effective in leading export and import to long run steady sate equilibrium relationship. Long run convergence between export and import also implies that the short run fluctuation between export and import are not at all sustainable in the context of India while in the context of China they have a little effect. In the sense of Husted (1992), India does not violate her international budget constraint in strong sense and therefore, supports the effectiveness of her macroeconomic policies in resorting the long-run equilibrium.

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Appendix 1

To test the stationarity property of the data we have also carried out unit root analysis following Saikkonen and Lütkepohl (2002) and Lanne et al. (2002) for the equation $y = \mu_0 + \mu_1 t + f_t(\theta)^{'}\gamma + x_t$...................(1). Where $f_t(\theta)^{'}\gamma$ is a shift function and θ and γ are unknown parameters or parameter vectors and x_t is generated by AR(p) process with possible unit root. We used a simple shift dummy variable with shift date T_B. $f_t^{'} = d_{1t} : \begin{cases} 0, t < T_B \\ 1, \geq T_B \end{cases}$ The function does not involve any parameter θ in the shift term $f_t(\theta)^{'}\gamma$, the parameter γ is scalar. Differencing this shift function leads to an impulse dummy.

Dates of structural breaks have been determined by following Lanne, Lütkepohl and Saikkonen (2001). They recommended to chose a reasonably large AR order in a first step[7] and then pick the break date which minimizes the Generalized Least Square (GLS) objective function used to estimate the parameters of the deterministic part.

After checking that all variables are nonstationary by incorporating the potential structural breaks the next step is to go for cointegration. There are two different tests proposed by Johansen et al. (2000) and Saikkonen and Lütkepohl (2000a,b,c). Saikkonen and Lütkepohl (2000a,b,c) have proposed a test for cointegration analysis that allows for possible shifts in the mean of the Data-Generating Process (DGP). Since many standard types of DGP exhibit breaks caused by exogenous events that have occurred during the observation period, they suggest that it is necessary to take into account the level shift in the series for proper inference regarding the cointegrating rank of the system. Therefore in this study we have taken into account the level shift in carrying out cointegration analysis.

The Saikkonen and Lütkepohl (SL) test investigates the consequences of structural breaks in a single equation framework. According to Saikkonen and Lütkepohl (2000b) and Lütkepohl and Wolters (2003), an observed n-dimensional time series $y_t = (y_{1t},\ldots, y_{nt})$, y_t is the vector of observed variables (t=1,…, T) which are generated by the following process:

$$y = \mu_0 + \mu_1 t + \gamma_1 d_{1t} + \gamma_2 d_{2t} + \gamma_3 d_{3t} + \delta_1 DT_{ot} + \delta_2 DU_{1t} + x_t \text{.....................(2)}$$

where DT_{0t} and DU_{1t} are impulse and shift dummies respectively, and account for the existence of structural breaks. DT_{0t} is equal to one, when $t=T_0$, and equal to zero otherwise. Step (shift) dummy (DU_{1t}) is equal to one when ($t>T_1$), and is equal to zero otherwise. The parameters γ_i (i=1, 2, 3), μ_0,, μ_1, δ_1 and δ_2 are associated with the deterministic terms. The variable d_{1t}, d_{2t}, and d_{3t}, are seasonal dummy variables. According to SL (2000b), the term x_t is an unobservable error process that is assumed to have a VAR (p) representation as follows:

$$x_t = A_i x_{t-1} + \ldots + A_p x_{t-p} + \varepsilon_t \text{.....................(3)}$$

where ε_t is assumed to follows N.I.D. $(0,\Omega)$. By subtracting x_{t-1} from both sides of the above equation and rearranging the terms, the usual error correction form of the above equation is given by

[7]Here, we have fixed largest lag length 3 as time duration is too short nonetheless the sample size is large since in time series analysis sample size does not matters while time period/span matters.

$$\Delta x_t = \Pi x_{t-1} + \sum_{j=1}^{p-1} \Gamma_j \Delta x_{t-j} + u_t \text{....................}(4)$$

where u_t is assumed to follows N.I.D. $(0,\Omega)$.This equation specifies the cointegration properties of the system. In this equation, u_t is a vector white noise process; x_t= y_t -Dt and Dt are the estimated deterministic trends, seasonality and other dummies. The rank of Π is the cointegrating rank of x_t and hence of y_t (SL, 2000b).

There are three possible options in the SL procedure, as in Johansen, a constant, a linear trend term, or a linear trend orthogonal to the cointegration relations. In this methodology, the critical values depend on the kind of the above-mentioned deterministic trend that included in the model. SL have mentioned that the critical values remain valid even if dummy variables are included in the model, while in the Johansen test; the critical values are available only if there is no shift dummy variable in the model. The SL approach can be adopted with any number of (linearly independent) dummies in the model. It is also possible to exclude the trend term from the model; that is, μ_1=0 maybe assumed a priori. In this methodology, as in Johansen's, the model selection criteria (SBC, AIC, and HQIC) are available for making the decision on the VAR order. In the following section, we have applied SL tests for the cointegration rank of a system in the presence of structural breaks.

Saikkonen and Lütkepohl (2000b) derived the likelihood ratio (LR) test in order to determine the number of cointegrating relations in a system of variables, by allowing for the presence of potential structural breaks. We now apply a maximum likelihood approach, based on SL, for testing and determining the long-run relationship in the model under investigation. As mentioned earlier, in this procedure SL assumed that the break point is known a priori therefore, by using those structural breaks dates as was obtained in the unit root analysis we have proceeded to carry out cointegration analysis.

Since there is no lag structure for the dummy series, therefore dummy variable is included in the system, but not in the cointegration space. For this reason, the dummy result is not present in the cointegration results. Following the SL procedure we consider the case of shift dummy and impulse dummy for different break dates when trend, intercept and when orthogonal trend included. In this case also optimum number of lags has been based on AIC.

Table 1: SL Unit root analysis

Variables	Unit Root Test with structural break {searched range: [1992 M6, 2009 M12]}					
China				India		
	Time trend (impulse dummy and used break date is 1993 M1)	Time trend included (shift dummy and used break date is 1993 M2)	Saikkonen and Lütkepohl (k)	Time trend (impulse dummy and used break date is 2002 M1)	Time trend (shift dummy and used break date is 2008 M9)	Saikkonen and Lütkepohl (k)
Ln(Export)	Yes	-----	-1.689 (2)	-----	-----	-1.530 (2)
Ln(Export)	------	Yes	-1.641(2)	-----	-----	-1.165 (2)
DLn(Export)	Yes	----	-13.02 (1)			-10.818 (1)
DLn(Export)	-----	Yes	-2.645 (1)			-8.888 (1)
	Time trend (impulse dummy and used break date is 1993 M2)	Time trend (shift dummy and used break date is 2008 M10)	Saikkonen and Lütkepohl (k)	Time trend (impulse dummy and used break date is 1993 M2)	Time trend (shift dummy and used break date is 2008 M10)	
Ln(Import)	Yes	-----	-1.911 (2)	Yes	-----	-1.913 (1)
Ln(Import)	------	Yes	-1.575 (2)	-----	Yes	-1.693 (1)
DLn(Import)	Yes	-----	-5.963 (1)	Yes	-----	-18.702 (0)
DLn(Import)	------	Yes	-7.822 (1)	-----	Yes	-17.365 (0)
Note: (1) "k" Denotes lag length. (2) Critical values -3.55, -3.03 and -2.76 are obtained from Lanne et al. (2002) at 1%, 5%, and 10% respectively. (3) Mi (where i=1,2,…,12) denotes number of months.						
Source: Author's calculation						

Table 2: Results of cointegration analysis

Saikkonen and Lütkepohl cointegration test								
China								
Intercept {impulse: 1993 M1 and shift : 1993 M2} (3)			Intercept and trend {impulse: 1993 M1 and shift : 1993 M2} (3)			Orthogonal trend {impulse: 1993 M1 and shift : 1993 M2} (3)		
r	LR	P-value	r	LR	P-value	r	LR	P-value
0	35.22	0.0000	0	14.35	0.0845	0	11.46	0.0247
1	3.27	0.0838	1	3.89	0.2236	--	------	-------
Intercept {impulse: 1993 M2 and shift: 2008 M10} (3)			Intercept and trend {impulse: 1993 M2 and shift: 2008 M10} (3)			Orthogonal trend {impulse: 1993 M2 and shift : 2008 M10} (3)		
r	LR	P-value	r	LR	P-value	r	LR	P-value
0	33.57	0.0000	0	15.21	0.0615	0	11.84	0.0209
1	3.95	0.0558	1	1.82	0.5799	--	----	----
India								
Intercept {impulse: 2002 M1 and shift: 2008 M9} (3)			Intercept and trend {impulse: 2002 M1 and shift: 2008 M9} (3)			Orthogonal trend {impulse: 2002 M1 and shift: 2008 M9} (3)		
r	LR	P-value	r	LR	P-value	r	LR	P-value
0	36.21	0.0000	0	15.37	0.0579	0	22.93	0.0001
1	11.42	0.0008	1	1.06	0.7758	----	-----	-----
Intercept {impulse: 1993 M2 and shift: [2008 M10} (3)			Intercept and trend {impulse: 1993 M2 and shift: 2008 M10} (3)			Orthogonal trend {impulse: 1993 M2 and shift : 2008 M10} (3)		
R	LR	P-value	r	LR	P-value	r	LR	P-value
0	36.19	0.0000	0	21.52	0.0045	0	21.81	0.0002
1	8.70	0.0037	1	1.05	0.7776			
Note: (1) "r" and "LR" denotes number of cointegrating relations/vectors and log likelihood ratio respectively. (2) Values in ( ) denotes the number of lag length used in cointegration analysis. (3) Mi (where i=1,2,…,12) denotes of number months.								
Source: Author's calculation								