

Do Exchange rates affect Exports in India?

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Abstract

It is shown that the 36 country real effective exchange rate of India, which is I(1), becomes stationary once a single exogenous shock (corresponding to the implementation of the liberalization policy by the government of India) is separated from its stochastic component and modeled as a break in the deterministic trend. The implication of this for the export supply function is enormous. While without the break real export has a long run relationship with real effective exchange rate and gross domestic product, with the break the relationship no more exists.

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I. Introduction:

The past two decades have been decades of extensive policy reforms in India. These reforms were gradually implemented since 1991 at the behest of the International Monetary Fund and touched upon almost every aspect of India's economy. One of the primary areas targeted by the reforms was the foreign exchange market. Another prime target was India's international trade¹. With such momentous changes happening in both these sectors, it is to be expected that the reforms will cast their spell on the variables associated with these sectors and on any interrelationship that may exist between them.

One aspect of this interrelationship is the relationship between export and its relative price in terms of the foreign currency represented by the real exchange rate². Empirical studies across the globe have yielded mixed results for the exchange rate variable both in export demand and export supply equations. The results are sensitive to the choices of sample period, model specification and countries considered³. The primary reason for this is that relative price is one of a long list of factors that potentially affects export. In the Indian context, studies conducted over different periods of time and over several categories of models (with different sets of co-independent variables) have reported both presence and absence of possible links between exchange rates and exports. For instance, using the data for the period 1962-87, Joshi and little (1994) have found the price elasticity of demand for exports to be about 1.1 in the short run and about 3 in the long-run. Their study has also shown higher export growth during 1970s and from the mid 1980s when the real devaluation of rupee was maintained, and slow down in export

¹ India was traditionally one of the least open economies of the world (For example, if we consider the beginning of the decade data for PENN's (PWT 6.2) 'openness in constant prices' variable, the best rank India ever had in terms of openness during this period was in 1970 when it was ranked 9th among the least open economies). In the trade sector, reforms mostly consisted of dismantling restrictions to import. However several export incentives were also conceived and implemented in this period.

² The Reserve Bank of India defines the nominal and real effective exchange rates (NEER and REER) in terms of rupees (see below).

³ See, for example, Wilson and Tat (2001) and Bahmani-Oskooee and Kara (2003) for two recent studies.

growth during the real appreciation of rupee in the early 1960s and the first half of 1980s. Using a non-structural eclectic model for the period 1963-94, Srinivasan (1998) have also reported relative prices as a significant export determinant in India. Veeramani (2008), using a longer time period from 1960-2007, have found that the appreciation of the REER leads to a fall in the dollar value of India's merchandise exports. However, the degree of such negative association between exports and the REER has declined since 2002; while the role of the rate of growth of India's real GDP and that of the world exports have assumed greater importance. His analysis also suggested that the strong growth of India's merchandise exports during 2002-07 is likely to continue for at least five years after the period considered by him (2008-12). However, Nayyar (1988), Ghosh (1990), Sarkar (1994), and Sinha Roy (2001) have taken the opposite stand on whether relative prices are significant as a determinant in explaining export performance and argue for instance, that Indian exports are not necessarily price responsive as turning points in India's export performance were not often led by the movements in exchange rate.

None of these papers however consider the regime shift due to the implementation of the liberalization policies explicitly in their data analysis. As we will see below, a mere visual examination of a plot of (at least some of) the relevant series clearly reveal breaks in the trend curve around the time the liberalization policies were implemented. Our main focus in this paper is to determine the influence of these breaks on the outcome of the unit root as well as cointegration tests involving the series.

Even disregarding the issue of structural breaks due to liberalization, it is hard to form an a priori hypothesis about the export-exchange rate link. As several authors have argued, India's imports are expected to be less responsive than India's exports to changes in relative price. This is because a large part of India's imports (especially oil) are necessities with low elasticity of demand. On the other hand, India's major exports have traditionally been less sophisticated unskilled labour or resource intensive goods which many other countries produce. Thus the exporters have an option of turning to other markets if the international prices of Indian goods rise. Pitted against this is the fact that most Indian exporters quote the price of their products in terms of local currencies (mostly Dollars or Euros). This raises the possibility of zero pass-

through of exchange rates to export prices. In fact, it has been found that the pass-through of exchange rates to goods imported by the US priced in terms of dollars is only about 25% as against 95% for goods priced in non-dollars (see Gopinath et al, 2010). If this is true for Indian exporters then the effect of exchange rate is expected to be low for them. What this means is that since the possibility of losing international markets to competitors looms large for Indian exporters, they may be more willing to absorb price fluctuations to keep their markets intact. In these situations the relationship between exports and exchange rates is likely to break down. Finally the post reform period for India coincided with the period of globalization the world over with trade flows reaching unprecedented heights. This ‘world trade effect’ reached India’s shores as well raising the possibility of washing away any negative effects that exchange rates might have created⁴. Logically therefore the conclusion is far from being foregone – an ideal situation for the issue to be settled empirically.

II. Data and Methodology

2.1 The Exchange Rate Series

Figure 1 plots the nominal and real effective exchange rate (NEER and REER) for India between 1970 and 2007⁵ where the two exchange rates are defined as:

$$NEER = \prod_{i=1}^n \left(\frac{e}{e_i} \right)^{w_i} \text{ and}$$

$$REER = \prod_{i=1}^n \left[\left(\frac{e}{e_i} \right) \left(\frac{P}{P_i} \right) \right]^{w_i}$$

where e: Exchange rate of Indian Rupee against Special Drawing Rights (SDRs) (SDR per rupee); e_i : Exchange rate of the i-th country’s currency against SDRs (SDR per ith currency); w_i :

⁴ A decomposition of India’s growth rate of exports show that ‘world trade effect’ usually dominates other effects (see Veeramani, 2007).

⁵ All the data used in this paper has been compiled from Handbook of Statistics on Indian Economy (2008-09), published by Reserve Bank of India. All the variables are expressed in natural logarithms and are calculated at constant prices.

$\frac{X_i + M_i}{\sum(X_i + M_i)}$ (trade based weights) such that $\prod_{i=1}^n w_i = 1$, where X_i is export and M_i is import

from the i th country; P : India's wholesale price index; P_i : CPI of the i th country; n : 36 (Number of countries involved in constructing the index). The indices are expressed per unit of rupee so that a rise implies appreciation of the rupee (see, RBI, 2005 p 1063).

NEER shows a sharp fall over the period with an almost horizontal portion from 1999-2000. REER (dotted line) on the other hand shows a sharp fall until 1993-94 and rising trend thereafter⁶. Taking REER alone there are two opposing phases in its evolution over time (this, cannot be said of the NEER):

- A depreciating part (up to 1993-94)
- An appreciating part (after 1993-94)

These segments of the REER curve are drawn separately in Figures 2 and 3. It can be seen from the diagrams that for the downward sloping phase the coefficient of the time trend is -0.03, whereas that of for the upward rising phase it is 0.01. Comparing the movement of the nominal rupee dollar exchange rate (not reported here) with those of NEER and REER we find that it behaves almost exactly as NEER and unlike REER with a clear depreciation up to 2000-01 and a slight appreciation thereafter⁷. To the extent that India's economic reforms were initiated in 1991 and trade and current account convertibility of the rupee was initiated in 1993 and 1994, visual observations are strongly suggestive of an indelible effect of policy reforms on all the three exchange rates. A visual examination of the (log values) of real export and real GDP series (to be plotted below in section 3 figures 5 and 6), reveal an upward trend for the period 1970-71 to 2006-07⁸.

Figures 1 - 3 about here

2.2 Exchange Rates and Exports: The Casual Link

⁶ Interestingly NEER depreciated at a higher rate than REER for the whole period under consideration. After 1993-94 REER started rising (appreciated). However NEER continued to fall (depreciate) till 2000-01. There is thus a degree of asymmetry in their behavior during the period after 1993-94 implying a higher inflation rate for India compared to its major trading partners.

⁷ In fact the correlation of the dollar rupee exchange rate with NEER is 0.94, and that with REER is 0.82.

⁸ The presence of structural breaks, though not so momentous, is noticeable around the period of India's policy reforms for these two variables as well (see below).

Before turning to the relationship between the exchange rate and exports formally let us take a quick look at the kind of problem that we are likely to face while trying to explain India's export with the exchange rate disregarding the role of economic reforms. The plot of the two series reveal that the significant change in trend of the REER series has not been observed for exports (trend is positive throughout). We can thus immediately identify two eras in the relationship between the variables. In the first era lasting up to 1993-94, the relationship between the two is exactly what the textbook argues: exchange rate depreciation having a positive effect on exports. In the second era starting from 1993-94 the expected relationship between REER and exports has however reversed. The dichotomy is revealed in terms of correlations in Table 1. Even though magnitudes of correlations for two variables over time are meaningless as they are always expected to be high, the signs are still meaningful. It can be seen in the last row of the Table 1, the sign of the correlation coefficient between export and exchange rate has reversed in the 1994-95 to 2007-08 periods. This is true both for levels and growth rates (first difference of logs of the variables) as far as REER is concerned and only for growth rates for NEER. A cursory look at the data is thus strongly suggestive of a break in the *relationship* (in contrast to the variables themselves) between the variables. Does the overall relationship in the entire period survive this break? This is the question that we turn to now.

Table 1 about here

2.3 Methodology

There are a plethora of unit root tests with varied properties to choose from. Unit root test against a single-break stationary alternative was proposed by Perron (1989) and Zivot and Andrews (1992). It was extended to a two-break stationary alternative by Lumsdaine and Papell (1997) and up to five-break alternative, with an a priori unknown number of breaks, by Kapetanos (2005). However, as pointed out by Bec and Bassil (2009), these tests maintain the linearity assumption under the unit root null hypothesis. If a break exists under the null of unit root, they will exhibit size distortions (over rejection of the null) as well as the wrong estimation of the break point (see also Nunes, Newbold and Kuan, 1997, Altinay, 2005, Kim and Perron, 2009). To overcome this problem, Lee and Strazicich (2003, 2004) have developed an alternative (at

most two) endogenous break unit root test that uses the Lagrange Multiplier (LM) test statistics, and allows for breaks both under the null and the alternative hypothesis. Thus, any conclusion on the rejection of unit root null based on this LM test provides quite strong evidence of stationarity. We thus choose Lee and Strazicich (2003, 2004) over other tests, though we consider a single break in the series.

The strategy of cointegration will be specified after the results for the unit root tests are presented.

III. Results

A fundamental decision that has to be taken before we proceed with determining the order of integration of the variables is the number of breaks/kinks we intend to internalize. Most data series experience multiple changes in slope and intercept over a period of time like for instance the LREER series plotted in the previous section, all of which can be reported as breaks (either in intercept or slope or both) on the basis of statistical tests. On the other hand, during a regime shift we should expect multiple changes in policies as markets are gradually deregulated. All of these policy changes do not amount to breaks in the series. Thus choosing the number of breaks for the data analysis is ultimately subjective. Domain knowledge dictates that there was *one* regime shift for India (implementation of liberalization), that it started informally from the mid 1980s and formally from 1991 and that the regime shift was ushered in by a series of policy changes all of which can be interpreted as small steps in a single direction. Take the example of the nominal exchange rate. Policy changes began with the rupee being devalued by 8 % in July 1, 1991 and by 11% in July 3, 1991. It was made partially convertible on March 1992 in the trade account with the introduction of the (dual) liberalized Exchange Rate Management System (LERMS). The dual exchange rate system of March 1992 was unified and the rupee was made fully convertible on the trade account on February 1993. And finally the rupee was made fully convertible in the current account in August 1994 thus achieving the Article VIII status of IMF. In spite of multiple policy changes as we have shown in the previous section, the data for nominal and real exchange rates show just one regime shift in the period after 1991. Further

though there are multiple kink points, the kink points do not necessarily coincide with the dates of the policy changes. We therefore conclude that in spite of the multiple policy changes as well as multiple kinks, it is appropriate to interpret domain knowledge to be supportive of a single break for the real exchange rate corresponding to the implementation of the liberalization policies. For analogous reasons we allow for single breaks for the gross domestic product and the real export series as well.

Tables 2 - 5 estimates the following export supply function for the Indian economy between 1970 and 2007:

$$LREX_t = \alpha + \beta_0 LREER_t + \beta_1 LY_t + u_t$$

where LREX is India's real value of export, LREER is India's real effective exchange rate and LY is India's Gross Domestic Product (GDP) all in their natural logs. Tables 2 and 3 confirm the existence of one structural break for all the three series. As expected the break date for LREER coincides with the policy of devaluation. Interestingly the breaks in LREX and LY are *before* the formal implementation of the liberalization polices.

Tables 2 and 3 about here

After accounting for one break in the deterministic trend the outcome of the unit root test shows that while LREER is I(0), LREX and LY are both I(1). Clearly therefore standard methods of cointegration of I (1) variables are not applicable in this case. The strategy that we use is (a) to reduce all the variables to I (0) by a single differencing of LREX and LY and run OLS and (b) to use the ARDL method on the level variables. The corresponding equations for the two cases are:

$$(a) \Delta LREX_t = \alpha_0 + \phi_0 t + (\alpha_{1+i} - \alpha_0) D_{1985+i} + (\phi_{1+i} - \phi_0) D_{1985+i} t + \beta_0 LREER_t + \beta_1 \Delta LY_t + u_t$$

$$(b) \Delta LREX_t = \alpha_0 + \phi_0 t + (\alpha_{1+i} - \alpha_0) D_{1985+i} + (\phi_{1+i} - \phi_0) D_{1985+i} t + \sum_{k=1}^p \beta_k \Delta LREX_{t-k} + \sum_{l=1}^p \chi_l \Delta LREER_{t-l} + \sum_{m=1}^p \delta_m \Delta LY_{t-m} + \lambda_1 LREX_{t-1} + \lambda_2 LREER_{t-1} + \lambda_3 LY_{t-1} + u_t$$

for each i=0...10,

where Δ is the first difference operator⁹ and the optimal lag length for the ARDL method turns out to be (1,0,0,0)¹⁰. We assume that the break in the relationship between the variables could have occurred at a maximum of ten lags from the date of informal implementation of the liberalization policies in 1985. Thus D_{1985+i} ($i=0\dots 10$) is defined as follows:

$$D_{1985+i}=0 \text{ for } t < 1985+i$$

$$=1 \text{ for } t \geq 1985+i$$

The crash (break only in intercept) and growth (break only in slope) models in the second equations were estimated separately so that there are (10 +20=) 30 equations to estimate in (a) and (b). The equations in (b) show the relationship between LREER and LREX at the level while those in equations in (a) show the relationship between LREER and the one period relative growth rate of LREX¹¹.

The results for the equations in (a) and (b) are reported in Tables 4 and 5. It is clear from the tables that LREER does not have any statistically significant relationship either with LREX or its one period relative growth rate. However, there is a statistically significant cointegrating relationship with LREER without structural break (see section A of the appendix¹²).

Insert Tables 4 and 5 about here

Statistically, the difference in the result is due to the incorrect determination of the order of integration of the LREER series. As it turns out, LREER falls within a class of variables first analyzed by Perron (1989)¹³. Using the argument in that paper we can argue that with an obvious regime shift for LREER resulting in a significant shift of intercept as well as the slope of the trend function (see figure 4), the ADF test is no more consistent and the unit root hypothesis has

⁹ The rest of the Greek letters in the equations being the coefficients to be estimated.

¹⁰ The Schwarz Bayesian Criterion (SBC) was used for determining the lag lengths.

¹¹ Thus, say, $\hat{x}_{it} = \frac{dx}{x}$ in this discrete case has been written as $\Delta \ln x_t (\ln x_t - \ln x_{t-1})$.

¹² Veeramani (2008) conducts a similar exercise (as in the appendix) for the period 1960-2007 and arrive at the similar conclusions. Working with several forms of quarterly REER (including the 5-country trade weighted version and the ones where the wholesale price index for India is replaced by the consumer price index) between 1993 1nd 2001 Kohli (2002) finds that REER is mostly stationary. None of these papers consider structural breaks.

¹³ Perron (1989) showed that a large number of variables found to be I (1) by Nelson and Plosser (1982) without break become I (0) after internalizing the break. Many subsequent papers (in fact almost all papers on structural break have raised and discussed these issues).

been accepted by the test for the level variable even though it is not true. The magnitude of the shift (at the break point) is strong enough for the ADF test to give erroneous results.

Insert Figures 4 - 6 about here

On the other hand, Figures 5 and 6 clearly show that nothing so momentous happened with LREX and LY. Their trends are smooth compared to LREER. Logically the low variability of the LREX series is due to the fact that the main impact of reform in the trade sector in India was in imports rather than exports. Imports were considerably more regulated than exports so that there was much more for the government to do with imports compared to exports. Also, the relatively minor changes that were undertaken for exports were introduced over a long period of time resulting in a relatively smoother transition. Thus although there were continuous changes in export mix and also the destination, the acceleration in growth was broad-based, with a double-digit growth rate registered across all the commodity groups and service sectors. Export performance improved after reforms at a comparatively greater pace. For the period 1970 to 1990 total merchandise exports grew at 37.49 per cent while for the period 1990 to 2008 the growth rate increased to 48.33 per cent¹⁴. The case of GDP is different, with export accounting for a small part of GDP it had its own story to tell independently of exchange rates. The decade of eighties was marked by the emergence of the Indian economy out of the low growth syndrome of the previous three decades; the pick-up benefitted from the initiation of some reform measures since mid-eighties aimed at increasing domestic competitiveness. The political instability and the Gulf war coupled with rising current account deficits, and dwindling foreign exchange reserves, resulted in a dip in the average of the annual growth rate of GDP dipped during the three year period of fiscal contraction from 1990-91 to 1992-93¹⁵. Thereafter, the growth impulses gathered the necessary momentum and exhibit a near upward trend.

IV. Concluding Observations

The government of India's New Economic Policy of 1991 had two parts. The main aim was to change the structure of the economy from a government oriented one to a market oriented one. This was the long term objective which was expected to be implemented in phases over a

¹⁴ Source: WITS

¹⁵ It is not surprising therefore that Lee and Strazicich's (2004) break-point for LY has been estimated at 1989-90.

period of ten or twenty years. The other objective was to stabilise the economy while the policies are being implemented. These policies mostly consisted of monetary and fiscal policies and were clearly short term in nature implemented from time to time and adjusted or withdrawn according to the prevailing situation at any point of time.

The journey from a mixed economy with socialistc objectives towards a free market economy with competitive objectives has to be an extremely tedious one anywhere in the world. For a country as massive and as complex and chaotic as India it is natural to expect the journey to be next to impossible. However they did not have a choice as they were made to follow a liberalization package of the IMF.

The IMF's liberalization package touched upon every aspect of the economy. Since simultaneous implementation of all of them was not feasible a question of sequentiality in the policies came to the fore and was much discussed by economists in the early 1990s. One of the first policies to be implemented was the exchange rate policy. It should be understood that before the decade of the 1990s India's exchange rate was more or less fixed. Between 1947 and 1975 the rupee was pegged to the pound sterling after which it was pegged to a basket of currencies¹⁶. The Reserve bank of India announced the exchange rates on the basis of the daily exchange rate movements of a select number of currencies (of India's major trading partners). The fluctuations were intended mainly to keep the real exchange rate constant.

From this system of fixed (or “implicitly adjustable peg”) exchange rate the Indian government shifted to a flexible exchange rate system (in the current account) by 1992-93. The shift was achieved by devaluations as well as removal of regulations. The devaluation of the currency created a break in the exchange rate series and the removal of regulations affected its over-time movements. However exports, which did not face such drastic policy changes and was riding the crest of booming world trade due to liberalization performed relatively steadily over time. Thus the two variables became delineated after the post reform period, exports continuously rising at a time when the rupee was actually appreciating in terms of the real

¹⁶ There was a period in 1971 when the rupee was pegged to the dollar rather than the sterling at Rs 7.5 to the dollar. The sterling peg returned from January 1972 and continued till September 1975. In June 1972 the sterling started to float so that the peg implied that the value of the rupee had to be kept stable with respect to the (floating) sterling.

effective exchange rate. This weakened the impact of the real effective exchange rate on exports to insignificant levels. Exports in India are mostly caused by other factors, not by the real effective exchange rate.

Figures

Figure 1: Annual Trend in LREER & LNEER

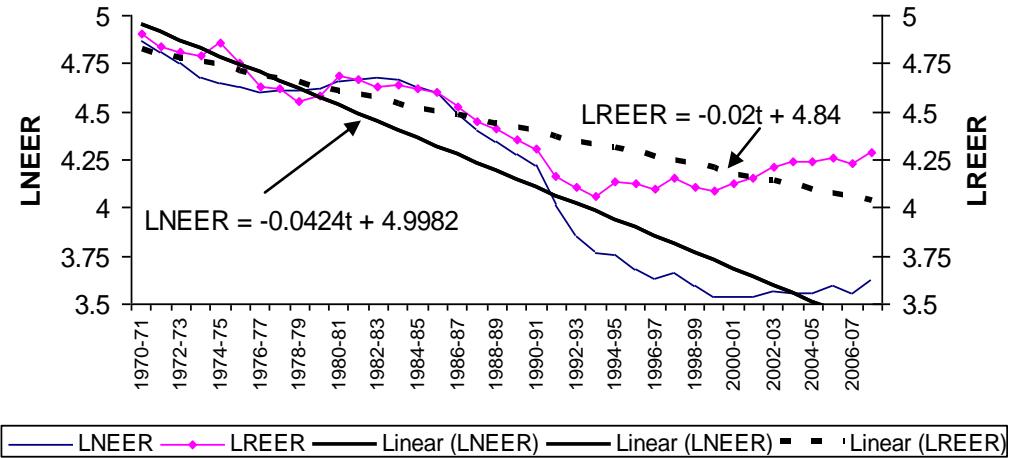


Figure: 2: Phase I; LREER (1970-71 – 1993-94)

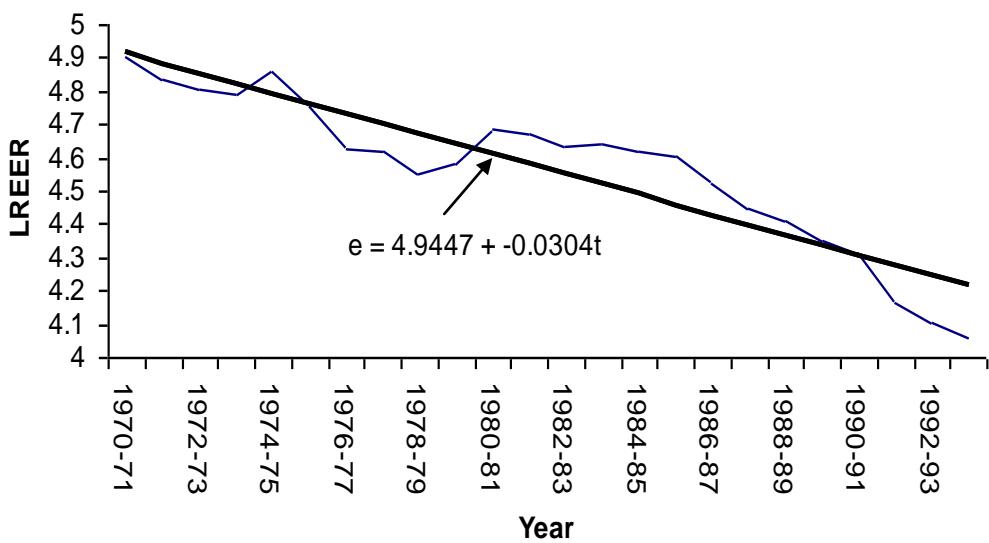


Figure 3: Phase II: (1994-95 – 2006-07)

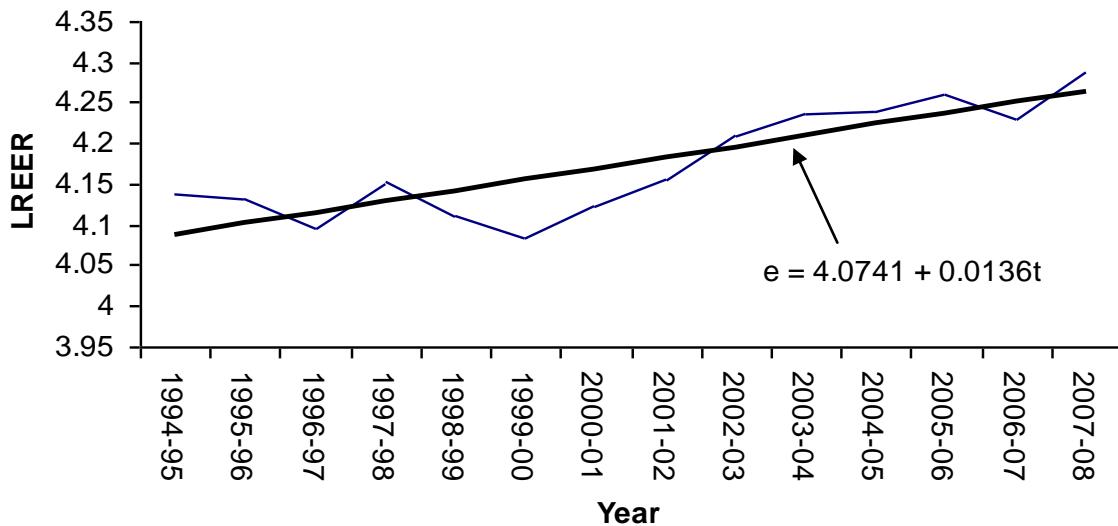
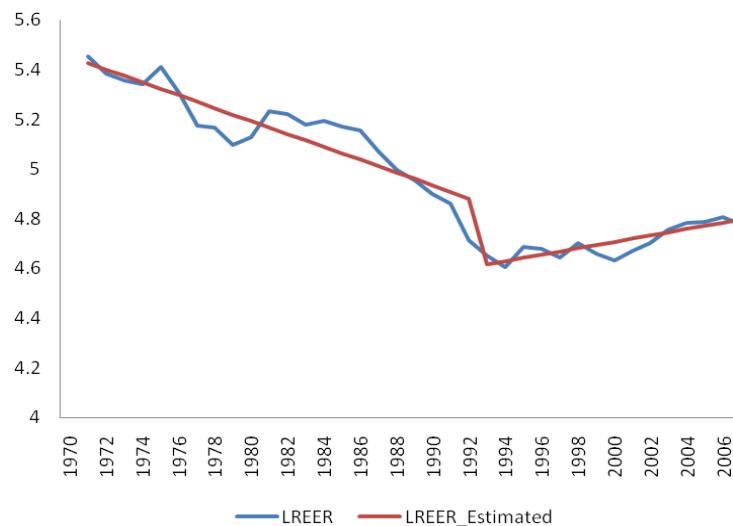
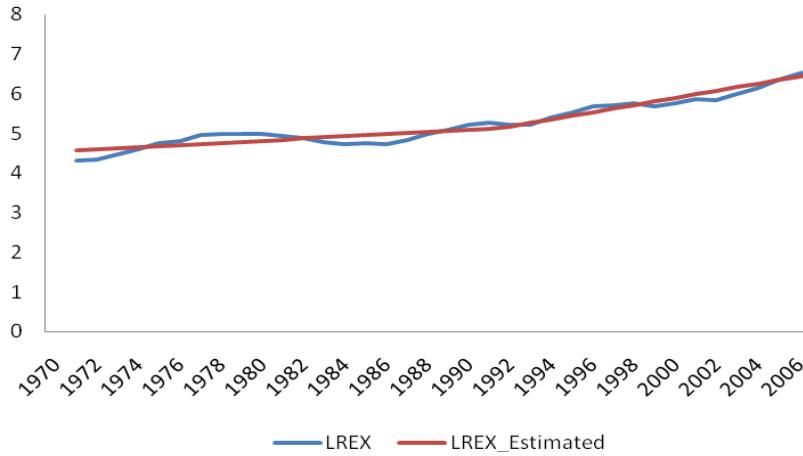


FIGURE 4: Regime Shift in the (log) value of "REX"



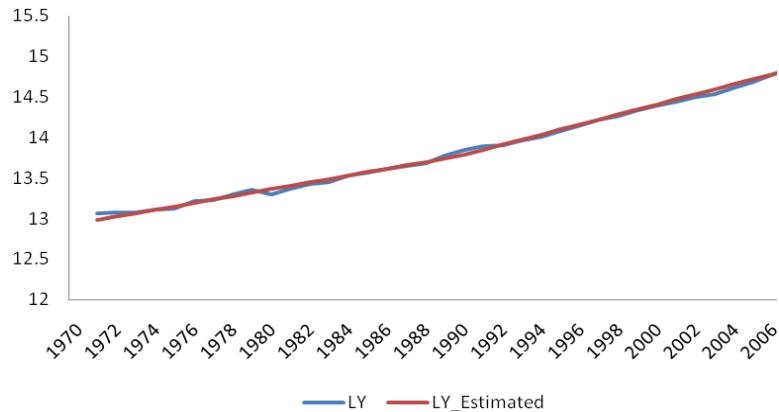
Note: The broken trend line is a fitted trend by (OLS) of the form $\hat{y}_t = \hat{\mu} + \hat{\gamma}_1 DU_t + \hat{\beta} t + \hat{\gamma}_2 DT_t$, where $DU_t = DT_t = 0$ if $t \leq 1991$ and $DU_t = 1$, $DT_t = t$ if $t > 1991$

FIGURE 5: Regime Shift in the (log) value of "REX"



Note: The broken trend line is a fitted trend by (OLS) of the form $\hat{y}_t = \hat{\mu} + \hat{\gamma}_1 DU_t + \hat{\beta} t + \hat{\gamma}_2 DT_t$, where $DU_t = DT_t = 0$ if $t \leq 1990$ and $DU_t = 1$, $DT_t = t$ if $t > 1990$

FIGURE 6: Regime Shift in the (log) value of "Y"



Note: The broken trend line is a fitted trend by (OLS) of the form $\hat{y}_t = \hat{\mu} + \hat{\gamma}_1 DU_t + \hat{\beta} t + \hat{\gamma}_2 DT_t$, where $DU_t = DT_t = 0$ if $t \leq 1989$ and $DU_t = 1$, $DT_t = t$ if $t > 1989$

Tables

Table 1: Correlation Coefficients between Export and Exchange Rate

Year	Export & REER		Export & NEER	
	Level	(1st Diff)	Level	(1st Diff)
70-71 to 07-08	-0.86 (-0.36)		-0.95 (-0.21)	
70-71 to 93-94	-0.97 (-0.62)		-0.92 (-0.40)	
94-95 to 07-08	+0.89 (+0.07)		-0.42 (+0.15)	

Source: DGCI&S and Reserve Bank of India.

Table 2: Unit Root Tests with One Structural Break (at Level)¹

Series	Model	Break Point	Optimal Lags	T-Statistic	Critical Values at 1%	Critical Values at 5%	Result
LREX	Break (Intercept & Trend)	1990	7	-0.80	(-5.05 to -5.11)	(-4.45 to -4.51)	Unit Root
LREER	Break (Intercept & Trend)	1991	5	-5.06	(-5.05 to -5.11)	(-4.45 to -4.51)	I(0)
LY	Break (Intercept & Trend)	1989	3	-3.14	(-5.05 to -5.11)	(-4.45 to -4.51)	Unit Root

Note: 1. Method applied is Lee and Strazicich's (2004)

Table 3: Unit Root Tests with One Structural Break (at First Difference)¹

Series	Model	Break Point	Optimal Lags	T-statistic	Critical Values at 1%	Critical Values at 5%	Result
LREX	Break (Intercept & Trend)	2001	2	-5.06	(-5.05 to -5.11)	(-4.45 to -4.51)	I(1)
LY	Break (Intercept & Trend)	1990	0	-8.31	(-5.05 to -5.11)	(-4.45 to -4.51)	I(1)

Note: 1. Method applied is Lee and Strazicich's (2004)

Table 4: OLS Regression with I(0) variables

	t ₁₉₈₅ ³	t ₁₉₈₆	t ₁₉₈₇	t ₁₉₈₈	t ₁₉₈₉	t ₁₉₉₀	t ₁₉₉₁	t ₁₉₉₂	t ₁₉₉₃	t ₁₉₉₄	t ₁₉₉₅
Constant	-1.05	-1.84*	-1.71***	-0.76	-0.18	0.63	0.84	0.18	0.04	0.61	0.88
LREER	1.30	2.06*	1.87***	0.86	0.25	-0.58	-0.79	-0.12	0.01	-0.56	-0.84
DLY	0.35	0.13	-0.03	-0.02	0.26	0.18	0.17	0.20	0.17	0.25	0.26
Trend	-2.27*	-1.90***	-0.97	-0.42	-0.41	-0.70	-0.89	-0.46	-0.37	-0.64	-0.74
D	-1.39	-0.30	0.19	-0.30	-0.68	-1.39	-1.45	-0.66	-0.40	-1.16	-1.66***
DT	3.21*	2.79*	1.75***	1.22	1.18	1.59	1.63	0.94	0.71	1.31	1.72***

Notes: 1. Dependent variable DLREX. 2. The figures in the table indicate the estimated t-statistic. 3. t-statistic. (*) and (***)) indicate statistical significance at 1% and 10% levels respectively. 4. Residuals are stationary at 5% level.

Table 5: ARDL Cointegration with Level Variables

Year	Type of Break	F-Statistic	W-Statistic	Year	Type of Break	F-Statistic	W-Statistic
1985	Intercept	2.4	9.62	1991	Intercept	2	8
	Trend	3.57	14.29		Trend	1.55	6.2
1986	Intercept	2.7	10.81	1992	Intercept	2.34	9.36
	Trend	3.12	12.47		Trend	1.76	7.06
1987	Intercept	1.8	7.2	1993	Intercept	1.57	6.28
	Trend	1.72	6.86		Trend	1.37	5.5
1988	Intercept	1.54	6.15	1994	Intercept	1.4	5.62
	Trend	1.37	5.49		Trend	1.44	5.78
1989	Intercept	1.41	5.65	1995	Intercept	1.64	6.59
	Trend	1.43	5.74		Trend	2.06	6.01
1990	Intercept	1.45	5.81				
	Trend	1.37	5.49				

Notes: 1. Dependant variable LREX. 2. Critical value bounds for the F-Statistic at 5% are (3.54, 4.82) for intercept and (4.51, 5.78) for trend and for the W-statistics at 5% are (14.16, 19.28) for the intercept and (18.06, 23.12) for trend (see Pesaran and Shin (1999)).

Appendix

Analysis without Structural Breaks

(Note since all the variables are I (1) without structural break we have used the two step Granger procedure for cointegration)

Table A1: Unit Root Tests

Variables	ADF¹		PP²		Conclusion
	Level	First Difference	Level	First Difference	
LREX	-1.09	-3.23***	-0.70	-3.20***	I(1)
LREER	-0.49	-4.75*	-0.75	-4.76*	I(1)
LY	-1.27	-7.55*	-1.27	-8.77*	I(1)

Note: 1. Augmented Dickey-Fuller test. 2. Philips-Perron test. 3. Asterisks (*), (**) and (***) denote statistically significant at 1%, 5% and 10% levels respectively. 4. Results reported are those with drift and trend.

Table A2: Cointegration

	(2)
LREER	.40** (1.95)
LY	1.25* (13.05)
Constant	-14.09* (-6.22)

Note: 1. Asterisks (*) and (**) denote statistically significant at 1% and 5% levels respectively. 2. t-statistic in parentheses. 3. Dependent variable log of India's real exports. 4. Error is white noise (ADF statistic: -3.01).

References:

- Bahmani-Oskooee, Mohsen, and Orhan Kara, 2003. "Relative responsiveness of trade flows to a change in prices and exchange rate", *International Review of Applied Economics*, 17:293-308
- Christiano, Lawrence J., 1992. "Searching for a Break in GNP", *Journal of Business and Economic Statistics*, 10: 237-250
- Dickey, D.A. and W.A. Fuller, 1979. "Distribution of the Estimators for Autoregressive Time series with a Unit Root", *Journal of American Statistical Association*, 74: 427-31
- Ghosh, 1990. "Exchange Rates and Trade Balance Some Aspects of Recent Indian Experience", *Economic and Political Weekly*, 441-445, March.
- Gopinath, G., Itsikhoki, O and Rigobon, R (2010), Currency Choice and Exchange Rate Pass-through, Harvard University, Mimeo.
- Gregory, A. and B. Hansen, 1996. "Residual-Based Tests for Cointegration in Models with Regime Shifts", *Journal of Econometrics*, 70: 99-126.
- Herzer, D. and Nowak-Lehmann D., 2006. "Is there a long-run relationship between exports and imports in Chile?", *Applied Economics Letters*, 13: 981-986.
- Joshi, V. and I.M.D. Little, 1994. *India: Macroeconomics and Political Economy, 1964-1991*, Delhi: Oxford University Press.
- Kim, D. and P Perron (2009) "Unit Root Tests Allowing For A Break in the Trend Function at an Unknown Time Under Both the Null and Alternative Hypotheses", *Journal of Econometrics*, 148: 1-13.
- Kohli, R. (2002), Real Exchange Rate Stationarity in Managed Floats, *Economic and Political Weekly*, February 2, 2002, p 475- 482.
- Kunitomo, N., 1996. "Tests of Unit Roots and Cointegration Hypotheses in Econometric Models", *Japanese Economic Review*, 47: 79-109
- Leybourne, S. J. and P. Newbold, 2003. "Spurious rejections by cointegration tests induced by structural breaks", *Applied Economics*, 35: 1117-1121
- Nelson, C. R., And C. I. Plosser (1982): 'Trends and Random Walks in Macroeconomic Time Series," *Journal of Monetary Economics*, 10, 139-162
- Nayyar, D., 1988. 'India's Export Performance: Underlying Factors and Constraints', in R.E.B. Lucas and G.F. Papanek (eds.), *The Indian Economy: Recent Development and Future Prospects*, Delhi: Oxford University Press.
- Perron, P., 1989. "The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis", *Econometrica*, 57: 1361-1401
- Pesaran MH and Shin Y. 1999. An autoregressive distributed lag modelling approach to cointegration analysis. Chapter 11 in *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Strom S (ed.). Cambridge University Press: Cambridge.
- Phillips, R. C. B. and P Perron, 1988. 'Testing for a Unit Root in Time Series Regression', *Biometrika*, 335-346.
- Reserve Bank of India (2005), *Reserve Bank of India Bulletin*, December, 2005.
- Sarkar, P., 1994. 'India's Balance of Payment and Exchange Rae Behaviour since 1971: A New Approach', *Economic and Political Weekly*, 29: 43-48.
- Sinha Roy, S., 2001. 'Post-reforms Exports Growth in India: An Exploratory Analysis', *RIS Discussion Paper # 13*, New Delhi: Research and Information System for the Non-aligned and Other Developing Countries.
- Srinivasan, T.N., 1998. 'India's Export Performance: A Comparative Analysis' in I.J. Ahluwalia and I.M.D. Little (eds.), *India's Economic Reforms and Development: Essays for Manmohan Singh*, Delhi: Oxford University Press.
- (2007). 'Sources of India's Export Growth in Pre and Post Reform Periods', *Economic and Political weekly*, June 23, 2007 p 2419-2427.
- Veeramani, C., 2008. 'Impact of Exchange Rate Appreciation on India's Exports', *Economic and Political Weekly*, 22: 10-15.
- Wilson, John F, and Wendy E. Takacs, 1979, "Differential responses to price and exchange rate influences in the foreign trade of selected industrial countries", *Review of Economics and Statistics*, 61:267-79.
- Zivot, E. and D. Andrews, 1992. "Further Evidence on the Great Crash, the Oil Price Shock and the Unit Root Hypothesis", *Journal of Business and Economic Statistics* 10: 251-270.