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India's Real Exchange Rate and Trade Balance: Fresh Empirical Evidence

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Abstract

This paper studies the relationship between India’s real exchange rate and its trade balance with her major trading partners using quarterly trade data for 15 countries over the period 1975 Q1-2011Q1. Apart from oft used bilateral trade model we use Pooled Mean Group estimator of Pesaran and Smith (1995) to get direct estimates of long term income and real exchange rate elasticities. We find that real exchange rate depreciation is positively associated with the trade balance in the long run. At the same time real exchange rate volatility is negatively correlated with India’s trade balance in the long run.

Keywords: Trade, Exchange Rate, J-Curve

I. Introduction

Relationship between exchange rate and trade balance has been a subject of intense theoretical and empirical debate in economics literature. On the theoretical side the much touted J-curve phenomenon postulates an initial deterioration of the trade balance followed by a subsequent improvement in response to real exchange rate depreciation. Presence of lags in the transmissionof exchange rate changes to prices, together with subsequent lags in the quantity response to these price changes could significantly impede overall balance of payments adjustment to exchange rate changes leading to a J-curve shaped response of the trade balance.

Most empirical papers investigating the J-curve phenomenon fall in to one of the two broad categories – (a) papers employing aggregate trade data (see Bahmani-Oskooee (1985), Rosensweig and Koch (1988), Bahmani-Oskooee and Malixi (1992) and Bahmani-Oskooee and Alse (1994)) and (b) those empoying bilateral trade data (see Rose and Yellen (1989); Marwah and Klein (1996); Bahmani-Oskooee,Arora and Goswami (2003)).

This paper uses quarterly bilateral trade data for India between 1975 Q1 and 2011 Q1 in order to study the short and long run relationship between real exchange rate and trade balance. Aggregate dataon trade balance and real exchange rate could suppress the actualmovementstaking place at the bilateral levels thus giving misleading results. Use of bilateral trade data is also helpful as it does not require construction of a proxy for the rest of theworld (ROW) income variable.

Apart from using a new dataset covering a longer time span andmore trading partners, we use recently developed panel co-integration techniques to study the long-term relationship between trade balance and exchange rate.To the best of our knowledge these techniques have not been used to study this relationship in the literature.

Rest of the paper is organized as follows: section II describes the dataset, section III explains the methodology, and section IV presents the empirical results and section V concludes

II. Data

Our dataset includes quarterly trade data on fifteen major trading partners of India over the period 1975 QI -2011-QI. Main source for bilateral trade data is IMF's *Direction of Trade Statistics*. Along with it we use quarterly Index of Industrial Production (IIP) from *International Financial Statistics (IFS)*. In cases where reliable data for IIP was not available from *IFS* we used indexed quarterly GDP instead.For China the *IFS*series on quarterly GDP started only in 1996; we therefore usedthe estimates of quarterly Real GDP growth presented byAbeysinghe and Rajaguru (2004) to extrapolate the *IFS* series backwards.Data on consumer price indices and bilateral nominal exchange rates is once again from the *IFS*.For real effective exchange rates data was obtained from RBI's *Handbook of Statistics*. To calculate the bilateral real exchange rates we adjust nominal exchange rates for the differences in relative price levels using Consumer Price Index.

III. Methodology

Bilateral Trade Model

It is important to clarify at the outset that purpose of our empirical analysis is not to establish causality. We only try to establish empirical regularities observed in the data in what follows. To begin with we use the reduced form bilateral trade model used in Arora, Bahmani-Oskooee and Goswami (2003)

$$\Delta LnTB_{j,t} = \alpha + \sum_{i=1}^{p} \alpha_i \Delta LnTB_{j,t-i} + \sum_{i=1}^{p} \beta_i \Delta LnY_{IN,t-i} + \sum_{i=1}^{p} \gamma_i \Delta LnY_{j,t-i} + \sum_{i=1}^{p} \theta_i \Delta LnER_{j,t-i} \quad (1)$$
$$+ \phi_{j,1} LnTB_{t-1} + \phi_2 LnY_{IN,t-1} + \phi_3 LnY_{j,t-1} + \phi_4 LnREX_{j,t-1} + \mu_t$$

Here, $TB_{j,t}$ is the trade balance measure defined as the ratio of India's exports to country j over her imports from country j. $Y_{IN,t}$ is a measure of India's real income set in index form to make it unit free, $Y_{j,t}$ is similar unit free measure of trading partner's real income and ER_t is the real exchange rate measurefor India defined as domestic currency per unit of foreign currency.All the variables are expressed in log form. As shown by Pesaran and Shin (1995, 1996), in this set up one does not need to test for unit root in each variable in order to look for co-integration.

Testing for the null hypothesis of 'no co-integration' is equivalent to testing $H_0: \emptyset_1 = \emptyset_2 = \emptyset_3 = \emptyset_4 = 0$ against the alternative $H_1: \emptyset_1 \neq 0, \emptyset_2 \neq 0, \emptyset_3 = 0, \emptyset_4 \neq 0$ using an F-test. Critical values of the F-test in this case are non-standard and have been tabulated by Pesaran *et. al.* (1996).

Having established the presence of a long-run relationship, one can then estimate the speed of adjustment by including the error correction termin the second stage regression.

$$EC = \phi_1 LnTB_{j,t-1} + \phi_2 LnY_{IN,t-1} + \phi_3 LnY_{j,t-1} + \phi_4 LnREX_{j,t-1} \quad (3)$$

Lag length in the second stage regression is selected on the basis of AIC.

Panel Estimation

One drawback of using the above framework for estimating separate trade balance equations for each of the trading partners is that we do not get direct estimates of the long-run coefficients that are of interest to us. Further, if there are reasons to believe that the response of trade balance to currency devaluation differs across trading partners in the short run but is homogenous in the long-run then estimation of separate trade balance equations implies significant loss of efficiency in the coefficient estimates. In our case, the market structure of the trading partner, nature of imports and exports to them etc. are likely to affect the short run response of bilateral trade balance to exchange rate changes even if the long-run relationship between the two is identical across partner countries.

Pooled Mean Group estimator proposed by Pesaranand Smith (1995) allows one to estimate the dynamic relationships between variables that are identical across groups in the long-run even though they exhibit heterogeneity in the short-run. We first test for the presence of co-integration between RER and trade balance using panel co-integration tests proposed by Westerlund (2007). Next we estimate the following model using the Maximum Likelihood estimator proposed by Pesaran and Smith (1995)

$$\Delta LnTB_{j,t} = \alpha + \sum_{i=1}^{p} \alpha_i \Delta LnTB_{j,t-i} + \sum_{i=1}^{p} \beta_i \Delta LnY_{IN,t-i} + \sum_{i=1}^{p} \gamma_i \Delta LnY_{j,t-i} + \sum_{i=1}^{p} \theta_i \Delta LnER_{j,t-i}$$
$$+ \phi_1 LnTB_{j,t-1} + \phi_2 LnY_{IN,t} + \phi_3 LnY_{j,t} + \phi_4 LnREX_{j,t} + \mu_{j,t} \qquad (2)$$

In this case, while the short run coefficients are assumed to differ across the trading partners, the long-run coefficients are assumed to be homogenous.

In order to test the robustness of our findings we extend our benchmark model to include volatility of exchange rate. We model exchange rate volatility using a GARCH model and estimating the conditional volatility thus obtained. We also test the robustness of our results by using alternative measures of exchange rates which include trade weighted and export weighted Real Effective exchange rates. Next section presents our empirical results.

IV. Empirical Results

Bilateral Trade Model

Table [1] presents the results of F-tests from the first stage regression to detect the presence of co-integration. For all countries except UK, we can reject the null hypothesis of ‘no co-integration’ at either 1 or 5 percent level of significance. For UK the F-statistic lies between the upper and lower limits of the band indicating an inconclusive result. We therefore estimate the error-correction model in equation (1) for all the countries.

Table [2] presents the short run coefficients on real exchange rate and error correction term for the bilateral trade model given by equation (1). We do not find evidence for the presence of a J-curve for any of the countries in our sample but the error correction term is negative and significant for all the countries indicating the presence of a long-term relationship between trade balance and bilateral real exchange rate. This is in line with earlier findings in the literature.

Table [3] presents long-run coefficients from the bilateral trade model calculated by normalizing$\emptyset_2, \emptyset_3\ and\ \emptyset_4by\emptyset_1$. Long-run coefficient on bilateral real exchange rate is positive and significant for eight out of the fifteen countries indicating the real depreciation against their currencies improves India's trade balance vis. a vis. these countries.

For India's real income, coefficient is negative and significant for Hong Kong and Indonesia while it is positive for the US. For the rest, coefficient estimates are insignificant. For foreign income, coefficients vary in sign and significance across different trading partners.

Pooled Mean Group Estimator

Table [4] presents the results from panel co-integration test proposed by Westerlund (2007). The first two test statistics in the table test the null hypothesis of 'no co-integration' against the alternative of co-integration in at least some of the group members while the next two test the same null against the alternative of a single co-integrating vector across all groups. We find strong evidence for a single co-integrating relationship between trade balance, real exchange rate and domestic and foreign income and therefore proceed towards the PMG estimator.

PMG estimates can be sensitive to the choice of lag length. We therefore use AIC to choose appropriate lag length. For lack of space we do not present short-run coefficients from the benchmark PMG model except to say that the error correction term is negative and significant indicating the presence of co-integration. We also do not find evidence for J-curve in the data.

Table [5] presents long run coefficients from the same model. We can see that real exchange rate depreciation is associated with an improvement in India's trade balance in the long run. This is line with the results for import and export demand elasticities for India obtained by Bahmani-Oskooee (1986) who showed that in India's case these elasticities add up to more than one indicating that depreciation of the rupee will improve Indian trade balance in the long-run. India's income is negatively correlated while foreign income is positively associated with her trade balance in the long run. Former is to be expected in a developing economy like India with enormous demand for imported inputs such as oil.

Extensions and Robustness Tests

We include the volatility of real exchange rate in the model to check whether instability in real exchange rate has an adverse impact on India's trade balance. Table 6 presents the results from this exercise. While adding volatility to the model does not change our main results, we find a significant negative relationship between bilateral exchange rate volatility and trade balance in the long run indicating that higher real exchange rate volatility affects the trade balance adversely in the long run.

Finally, we use alternative measures of exchange rates to estimate our model. In particular we use two measures of real effective exchange rates released by the RBI – trade weighted real effective exchange rate and export weighted real effective exchange rate. The last two columns of Table 6 present the long run coefficients from this exercise. Our main results go thru with these alternative measures too.

V. Conclusion and Summary

This paper used updated bilateral trade data for India's 15 largest trading partners to take a fresh look at the relationship between India's trade balance and her real effective exchange rate. Along with the reduced form bilateral trade balance model we use panel based estimation technique to get point estimates of the long run ealsticities.

Overall, we find strong evidence for a positive long-run association between real exchange rate depreciation and India's trade balance with its key trading partners. Volatility of real effective exchange rate also exhibits a negative long-term relationship. This has important policy implications for issues such as capital account convertibility and inflation targeting in India.

Table 1: F-statistic for H0: No Cointegration

Australia	4.59**
Belgium	5.75***
China	6.41***
France	5.26**
Germany	4.97**
Hong Kong	5.99***
Indonesia	7.97***
Japan	5.44**
Malaysia	9.54***
Philippines	7.82***
Singapore	4.06*
South Korea	14.19***
Thailand	6.30****
UK	3.52
USA	5.85**

Table 2: Short-Run Coefficient Estimates

	Australia	Belgium	China	France	Germany	Hong Kong	Indonesia
REX	0.94	-0.44	2.05	-1.24	0.16	0.17	-0.31
REX_{t-1}	0.55	-0.54	-1.89	-0.47	0.09	-0.63	-0.47
REX_{t-2}	0.19	0.51	0.21		0.23	-0.70	0.33
REX_{t-3}		-0.43	-1.05		-0.03		0.73
REX_{t-4}		-0.37	-0.26		0.02		1.15
REX_{t-5}			-0.10		0.09		
REX_{t-6}			-2.16		0.45		
REX_{t-7}			-0.52		-0.19		
REX_{t-8}			0.05		-0.08		
REX_{t-9}			0.89				
REX_{t-10}			-0.003				
$EC_{(-1)}$	-0.39***	-0.76***	-1.00***	-0.36***	-0.36***	-0.49***	-0.58***

Table 2 (Contd.): Short-Run Coefficient Estimates

	Japan	South Korea	Malaysia	Phillipines	Singapore	Thailand	UK	USA
REX	0.56*	1.71*	1.21	3.34	0.27	0.17	-0.41	1.15*
REX_{t-1}	-0.70**	-0.72	0.98	-3.7**	-0.45	-0.77	-0.48	-0.29
REX_{t-2}	-0.11	0.51	-0.77	1.62		1.20		-1.06
REX_{t-3}		-2.5***	1.21	-1.16		-0.68		
REX_{t-4}		-0.56	-0.90	1.59		-1.36		
REX_{t-5}			0.78					
REX_{t-6}			2.12**					
REX_{t-7}			0.31					
REX_{t-8}			1.5					
$EC_{(-1)}$	-0.44***	-0.58***	-0.57***	-0.82***	-0.338***	-0.88***	-0.34***	-0.5***

Table 3. Long-run Coefficient

Country j	REX	YInd	Yf
Australia	-0.339	1.11	-5.80
Belgium	1.68***	-0.85*	2.87**
China	0.80	-9.33	-2.42**
France	1.18**	-1.18	2.59
Germany	0.70**	1.3	-4.5**
Hong Kong	1.38***	-1.68***	1.64**
Indonesia	0.76	-12.28***	6.11***
Japan	1.02***	-0.63***	0.15
Malaysia	1.64	-1.03	0.53
Philippines	2.21***	0.17	-1.16
Singapore	-0.02	0.61	-0.64
South Korea	1.5**	-2.6	0.09
Thailand	1.06	-0.31	-2.12
UK	-0.78	0.24	0.84
USA	1.11***	1.19**	-3.67***

Table 4: Panel Co-integration Test

Statistic	Value	Z-value	P-value
Gt	-3.404	-6.408	0.000
Ga	-33.619	-16.003	0.000
Pt	-8.508	-2.600	0.005
Pa	-7.920	-2.239	0.013

Table 5: Long Run Coefficients

ER	1.7***
Yd	-0.80***
Yf	0.89***

Table 6: Long Run Coefficients (Extensions)

	Bilateral Exchange Rate	REER (Trade Based)	REER (Export Based)
ER	1.19***	1.8***	1.9***
Yd	-0.62***	-0.99***	-0.98***
Yf	0.14	0.27**	0.25**
$Vol._{er}$	0.17	-4.4***	-4.6***

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