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REVISITING THE RELATIONSHIP BETWEEN REAL EXCHANGE RATE AND TRADE BALANCES

This paper examines a study, which investigates the impact of real exchange rates on trade balances of three countries in South with the US. The relationship between real exchange rates and trade balances was found to be ambiguous as revealed by previous empirical studies. This study applies Augmented Dickey-Fuller and Phillips-Perron tests for stationarity followed by the cointegration tests. All variables in the model have been found to be non-stationary but cointegrated for all the countries studied. The results show that the impact of real exchange rates on trade balances is significant in most cases and that the generalized Marshall-Lerner condition seems to hold. We also specify and estimate a model by Stock and Watson (1989) to investigation whether and to what extent bilateral trade balances respond to real exchange rates.

JEL: F1, O1

I. Introduction

Studying the relationship between trade balance and exchange rates is especially important for developing economies where trade flows continue to drive balance of payments accounts due to low development of capital markets. In addition, exchange rate behavior, whether determined by exogenous or endogenous shocks, or by policy, has been a common yet controversial policy issue in most of those countries. Economic authorities in developing countries have repeatedly resorted to nominal devaluations as a means to correct external imbalances and/or misalignments of real exchange rates, to increase competitiveness, to increase revenues, to be a key element of adjustment programs, and/or to respond to pressures from diverse interest groups (exporters, bureaucracy, etc.). The decision to devalue has been made many times even if the devaluation might cause inflationary spirals, domestic market distortions, and disruptive effects on growth and undesirable re-distributive effects.

There are several theories regarding the effect of devaluation on the trade balance. The elasticity approach to exchange rate suggested that transactions completed at the time of devaluation or depreciation may dominate a short-term change in the trade balance. That is, there is an initial deterioration in the trade balance during the 'contract period' before quantities of exports and imports adjust. According to the monetary approach to exchange rate, devaluation (or depreciation) decreases the real supply of money, resulting in an excess domestic demand for money. This leads to hoarding and an increase in the trade balance.

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Currency devaluation may affect trade balance through two channels: devaluation of the real exchange rate and a direct effect on domestic absorption. The first channel stresses on the fact that a nominal devaluation is assumed to affect real exchange rate (a relative price) and hence improve competitiveness. This in turn improves the trade balance, ceteris paribus. The second channel is related to the absorption effect on devaluation. In a world where all goods and assets are perfect substitutes, prices are exogenously given for the small-country case, and wages and prices are flexible both in nominal and real terms, devaluation increases the price level by the same percentage. The increase in price level reduces real balances and thus domestic absorption.

This paper is an attempt to explore the impact of real exchange rates on the trade balances between major countries in South Asia – India, Pakistan and Sri Lanka – and their major trading partner – USA. Once we have examined whether there is a long-run equilibrium relationship between the trade balance and exchange rate, we investigate whether the trade balance first deteriorates following currency depreciation before it improves, that whether a country's trade balance exhibits the J-curve effects.

The biggest countries in South Asia – India, Pakistan and Sri Lanka – together account for about 1/3 of the world population and share around 2% of the world GDP. All these countries got independence in the late 1940s and sought to develop their economies by import substitution of industrial production. The importance of the government in the production and distribution had always been prominent. As the economy got more centralized and plagued by government controls and characterized by permits and licenses. Around the same time, their East Asian cousins were making rapid strides in economic development by adopting more open and outward oriented strategies.

The realization of the advantages of pursuing a more outward oriented developmental strategy, combined with the international debt crisis of the early 1980s, made economic liberalization a precondition for multilateral borrowing (Nowzad, 1990).

During 1980s and early 1990s the governments in these countries have been taking less part in development by deregulating and liberalizing financial markets and encouraging private participation in economic development process. Some of the adopted policies resulted in a more central role for the external sector in general and the foreign exchange market and foreign trade in particular (Dean, Desai and Reifel, 1994). The foreign exchange regimes chosen by South Asian countries were either a managed-float regime (Sri Lanka and Pakistan) or a unified floating exchange regime.

Sri Lanka got rid of quantitative restrictions by 1985, and later on focused on reducing tariffs and encouraging exports. Pakistan embraced trade reforms during 1985 – 1990 while India and Bangladesh adopted liberalized economic policies in 1991 and have moved a long way in the last decade. Overall, though the reform processes are not complete, there has been a distinct change in level of acceptance towards tradable goods sector. Since 1980s the restrictions of these countries' external sectors have been relaxed and hence, this offers a useful opportunity to undertake the study.

This study investigates the relationship between the exchange rate fluctuations and bilateral trade balance of India, Pakistan and Sri Lanka with the

US. This paper has been structured into four sections. Section II reviews some related literature. The theoretical framework and the empirical evidence are presented in Sections III and IV, respectively. The last section provides conclusions.

II. Review of Literature

The literature that modeled the relationship between the trade balance and exchange rates appeared first in the seminal paper of Bickerdike (1920), a five page document with no math, which was written at the end of a period of instability of England's foreign exchange market (Metzler, 1948).

Under a fixed exchange rate regime, trade flows differ in their reaction to a change in relative prices resulting from a change in the exchange rate rather than to that resulting from a change in national currency prices of exporting items. This may not be the case under a flexible exchange rate regime. Wilson and Takacs (1979) estimated the response of trade balances to fluctuations in prices and exchange rates for six major industrial countries, namely Canada, Japan, France, United Kingdom, Germany and United States. Their study covered the period 1957-1971 when fixed exchange rate system was in vogue all over the world. They found that trade flows adjusted differently to changes in prices and the exchange rate.

Miles (1979) tested the effects of devaluation by entering the exchange rate directly into the trade balance equation. The statistical significance and sign of the exchange rate coefficient were inconclusive. For example, the exchange rate coefficient with respect to the trade balance was significant at the 95% level (one-tailed test) among only 3 out of 14 countries.

Warner and Kreinin (1983) used conventional equations to specify the determinants of trade flows of 19 developed countries. They found that allowing the exchange rate to float affected the volume of imports in several major countries, but the direction of change was indeterminate. On the export side, the effects of real exchange rate changes on the volume of exports were found to be significant.

Bahmani-Oskooee (1986) employed a distributed lag structure to assess import and export demand functions for a sample of 5 developing countries. It was found that trade flows adjusted differently to trade stimuli. This finding supported the result of Wilson and Takacs (1979).

Grauwe (1988) showed that introducing the floating exchange rate system caused a substantial decline in the growth rate of trade among industrial countries. This finding supported the notion that the increase in exchange rate variability due to a floating exchange rate regime has a negative effect on trade.

Lastrapes and Koray (1990) concluded that there was a statistically significant relationship between contemporaneous shocks to exchange rate volatility and trade variables. Contemporaneous shocks or changes in the state of the economy such as a change in money supply that imposes pressure on interest rates or a change in the level of production could introduce downward or upward pressure on the real exchange rate. Furthermore, lagged volatility has explanatory power for imports but not for exports. The relationship between trade and volatility is relatively small compared to other variables.

This is contrary to Cushman's (1983) finding, which indicated that there was a significant negative effect on trade quantity from the real exchange rate risk or volatility in many cases. Rose (1991) utilized the imperfect substitutes model to analyze the relationship between the effective real exchange rate and the real aggregate trade balance of 5 major OECD countries – United Kingdom, Canada, Germany, Japan and United States. He found no relationship between these two variables, and thus the generalized Marshall-Lerner condition did not hold.

Reinhart (1995) examined the relationship between relative price changes resulting from devaluation and trade flows in 12 developing countries. He found that the relative prices significantly affected trade flows (both imports and exports) in most cases. His finding thus supported the theoretical prediction.

Some researchers use a powerful test that allows detection and estimation of number of cointegrating vectors in the context of a vector auto-regression model (VAR). These include the works of Clarida (1994) and Chua and Sharma (1998). Chua and Sharma observed the effects of prices and exchange rates on trade flows in Korea, Philippines, Singapore and India. They found that in the import and export models domestic and foreign prices had greater impact on trade flows than did real effective exchange rates in most cases.

Historical data for developed countries have shown that devaluation may cause a negative effect on the trade balance in the short run but an improvement in the long run; that is, the trade balance followed a time path which looked like the letter 'J'. In the literature, it is called the J-curve (Junz and Rhomberg 1973, Magee 1973, Meade 1988).

The main explanation for this behavior has been that, while exchange rates adjust instantaneously, there is lag in time the consumers and producers take to adjust to the changes in relative prices. In terms of elasticity, there is a large export-supply elasticity and a low short-run, import-demand elasticity (Rincon, 1998).

Recent studies found that trade balance is negatively correlated with current and future movements in terms of trade (which are measured by the real exchange rate) but positively correlated with past movements (Backus et al., 1994).[2]

Bahmani-Oskooee and Malixi (1992) explored the relationship between trade balances and real exchange rates of 13 developing countries using a vector error correction model (VECM). They find the existence of J-curve effect in 7 countries.

Wilson (2001) uses a two-country imperfect substitutes model put forth by Rose and Yellen (1989) to examine the J-curve effect in bilateral trade in merchandise goods between Korea and Malaysia and USA and Japan. Their findings suggest that the real exchange rate does not have a significant impact on the real trade balance, and they find no persuasive evidence for J-curves in each case.

Studies in Singapore also suggest that despite periods of rapid nominal and real appreciation of the Singapore dollar, export growth in aggregate has remained buoyant (Wilson and Takacs, 2001). Further, it has been found that the positive relationship between real exports and lagged values of real exchange rate might suggest 'small country' pricing in U.S. dollars. It is not clear that this is

[2] This has been called the S curve effect because of the symmetric shape of the cross-correlation function for the trade balance and the real exchange rate.

masking J-curve effects from initial rise in import values as the home currency depreciates.

Boyd, Caporale and Smith (2001) study generalized impulse response functions to calculate trade balance response to shocks in real exchange rates in 8 OECD countries. The study suggests evidence of J-curve in each of the countries studied. Similar study has been done in North European countries - Belgium, Denmark, The Netherlands, Norway and Sweden (Hacker and Hatemi, 2003) using generalized impulse response functions. The results provide empirical support for the J-curve. Each country has an impulse response function generated from a vector error-correction model which suggests that after a depreciation there will be a dip in the export-import ratio within the first half-year after the depreciation.

Data and Methodology

Analytical Framework

The hypothesis underlying the estimation is that the real exchange rate, besides other determinants, affects the trade balances in a suitable manner. Theory suggests that trade balance is affected by macroeconomic variables (real output, exchange rates and money supply *inter alia*). Recent studies show the existence of direct and indirect feedback effects between trade balance and macroeconomic variables.

In the paper we use a model that has been widely used by Krugman and Baldwin (1987), Rose and Yellen (1989) and Bahmani-Oskooee (1991). This model is represented by the following relationship:[3]

$$\mathbf{B = B\,(Q, Y, Y^{W})}$$

$$\mathbf{Q = E^{*}(P_f / P)}$$

The equation expresses the trade balance as a function of real exchange rate (Q), real domestic income (Y) and real foreign income (Y^W).

E^* = Nominal Exchange Rate P^* = foreign Consumer Price Index;

P = India Consumer Price Index

Data

The data has been sourced from various databases viz., Global Financial Data and US Census website for *trade balance data* and University of British Columbia database for *real exchange rates*. The real GDP and foreign GDP have been taken from the International Financial Statistics (IFS) provided by the IMF.

The data is quarterly and logarithmic and spans the period 1984:1–2002:4. Here, we briefly note that **TB**, **Y** and $\mathbf{Y^W}$ denote the real balance of trade on merchandise exports and imports, real domestic income (real GDP), and real foreign income respectively, all valued at 1987 prices.

Methodology

The empirical exercise comprises two parts: (1) testing for a unit root in each series, and (2) testing for the number of cointegrating vectors in the system, provided that we cannot reject the null hypothesis of unit root in each of the time series being studied;

[3] See Appendix for derivation of the relationship

1. **Unit Root Test**: To test for a unit root in each series, we employ the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1981) methodology. The tests are conducted with and without a deterministic trend (t). The general form of ADF test is estimated by the following regression

$$\Delta Y_t = \alpha_0 + zt + a_1 Y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-1} + \varepsilon_t$$

where α_0 is constant, t is a deterministic trend, and enough lagged differences (p) are included to ensure that the error term becomes white noise. If the autoregressive representation of Y_t contains a unit root, the t-ratio for a_1 should be consistent with the hypothesis, $a_1=0$. However, the ADF test loses power for sufficiently large values of p. Consequently, an additional, alternative test posited by Phillips and Peron (PP) (Phillips and Peron, 1987), which allows weak dependence and heterogeneity in residuals, is conducted by the following regression:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + u_t$$

where u_t is serially correlated.

2. **Cointegration Test**: To investigate the existence of a long-term relationship between trade balance and other variables, we explore existence of any significant long-run relationships among the variables in our model. If B is cointegrated with Q, Y and Y^W, then this will provide statistical evidence for the existence of a long-run relationship. Though, a set of economic series are not stationary, there may exist some linear combination of the variables which exhibit a dynamic equilibrium in the long run (Engle and Granger 1987). We employ the maximum-likelihood test procedure established by Johansen and Juselius (1990) and Johansen (1991).[4]

Specifically, if Y_t is a vector of n stochastic variables, then there exists a p-lag vector auto regression with Gaussian errors of the following form:

$$\Delta Y_t = k + \Gamma_1 \Delta Y_{t-1} + \ldots + \Gamma_{p-1} \Delta Y_{t-p+1} + \Pi Y_{t-1} + z_t$$

where Γ_1, ... Γ_{p-1} and Π are coefficient matrices, z_t is a vector of white noise process and k contains all deterministic elements.

The focal point of conducting Johansen's cointegration tests is to determine the rank (r) of matrix Γ_k. In the present application there are three possible outcomes. First, it can be of full rank (r = n), which would imply that the variables are stationary processes, which would contradict the earlier finding of non-stationarity. Second, the rank of k can be zero (r = 0), indicating that there is no long-run relationship among the variables. In instances when Γ_k is of either full rank or zero rank, it will be appropriate to estimate the model in either levels or first differences, respectively. Finally, in the intermediate case when there are at most r cointegrating vectors $0 \le r \le n$ (i.e., reduced rank), it suggests that there are (n -r)

[4] By treating all the variables as endogenous, this approach avoids the arbitrary choice of the dependent variable in the cointegrating equations, as in the Engle-Granger (1987) methodology. They have also been shown to have good large- and finite-sample properties [see Phillips (1991), Cheung and Lai (1993), and Gonzalo (1994)].

common stochastic trends. The number of lags used in the vector auto-regression is chosen based on the evidence provided by Akaike's Information Criterion (AIC) (see Akaike 1974). The cointegration procedure yields two likelihood ratio test statistics, referred to as the maximum eigenvalue (λ-max) test and the trace test, which will help determine which of the three possibilities is supported by the data.[5]

IV. Empirical Results

From the results for ADF and PP tests for non-stationarity of data, each of the series is found to be stationary in the first difference. We proceed to apply cointegration tests between the variables to detect any possible long-run equilibrium between the series.

(H_0: r = 0) can be rejected for all countries in the study. In effect, this shows that there is a long-run cointegrating relationship between trade balance with US and exchange rates for all the 3 countries.

Since cointegration is attained, further investigation is made to assess whether and to what extent bilateral trade balances respond to real exchange rates. For this purpose, we use the Stock and Watson (1989) non-linear specification.

$$B_t = a_0+b_1Q_t+b_2Y_t +b_3 Y^W{}_t +\Sigma\beta_{1i}\,\Delta Q_{t-i}+\Sigma\beta_{2i}\,\Delta Y_{t-I}+\Sigma\beta_3\,\Delta Y^W{}_{t-i} + \eta_t$$

where *i* is the number of lags and η is an error term.

The model in the above equation is believed to have the power to obtain reliable estimates of the long-run relationship. This procedure was first employed by Reinhart (1995).

The results using the above equation from Table 3 show that the coefficients on real exchange rate variable have the anticipated positive sign in all cases. The coefficients are statistically significant at 5% level. The interpretation for the impact of real exchange rate on trade balance is that a depreciation of domestic currency (or a rise in real exchange rate, domestic/foreign currency) causes the trade balance to improve and vice versa. Thus, this evidence seems to support the generalized Marshall-Lerner condition.

Regarding the domestic GDP variable, the estimated coefficients have an anticipated negative sign in all three cases. In case of India, the coefficient of GDP is significant at 1% level and for both Sri Lanka and Pakistan; GDP is significant at 5% level. Considering the trade balances with these 3 countries, an increase in domestic real GDP will cause the imports to rise, and thus worsen the bilateral trade balances, and vice versa.

As for the relationship of trade balances with foreign real income, the coefficient of foreign real income in all three cases has been found to be insignificant at 5% level of significance.

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[5] The trace test statistic is given by Trace = $T\ \Sigma^n{}_{i=r+1} \ln(1- \lambda_i)$ where λ_{r+1}, ..., n are the (n- r) smallest squared canonical correlations between Y_{t-k} and ΔY_t series, corrected for the effect of the lagged differences of the Y_t, and T is the sample size actually used for estimation. The -max statistic is given by - max = $T\ln(1 - \lambda_{r+1})$ Since the asymptotic distributions of the Trace and -max test statistics follow $\chi 2$ distributions, a simulation procedure is needed to identify proper critical values for each test (see Osterwald-Lenum, 1993).

V. Conclusion

This study assesses the impact of real exchange rate on the trade balances between India, Pakistan and Sri Lanka and their major trading partner - US. As we have discussed earlier, different studies gave different results about the nature of the relationship for different countries. As opposed to Rose (1991) who finds that there is little evidence of significant impacts of the real exchange rate on the trade balance, the results from this study show that real exchange rates significantly impact the balance of trade of the three countries with USA. We can therefore conclude that the generalized Marshall-Lerner condition seems to hold in all the cases. Furthermore, the evidence from this study indicates that foreign real income does not seem to be a significant determinant of trade balance of any of the countries in the study.

Appendix

The demand for imports both at home and abroad depends on real incomes and the relative price of imports:

$D_m = D_m (Y, p_{mg});$

$D^*_m = D^*_m (Y^*, p^*_{mg})$ (1)

where, D_m and D^*_m denote import demands, and Y and Y^* stand for the domestic and foreign real incomes, respectively. The price of imported goods relative to domestic, both measured in home currency, is p_{mg}, and p^*_{mg} is analogously defined for foreigners.

Exportables are supplied by perfectly competitive producers both at home and abroad, and depend on relative prices:

$S_x = S_x (p_{xg})$, and $S^*_x = S^*_x (p^*_{xg})$ (2)

where S_x and S^*_x are supplies by the domestic and foreign producers, respectively. The relative price of home country exportables in terms of domestic goods, both measured in the home currency, is $p_{xg} = (P_x / P)$, and p^*_{xg} is similarly defined for the foreigners. The relative price of imported goods for the home country is given by

$p_{mg} = E (P^*_x / P) = (E (P^* / P)(P^*_x / P^*) = RER.\ p^*_{xg}$ (3)

where E is the nominal exchange rate (defined as foreign exchange per unit of domestic currency) and RER denotes the real exchange rate (RER = E (P_x / P). Equilibria in domestic and foreign markets imply:

$D_m = S^*$ and $D^* = S_x$ (4)

The real trade balance (B) for the home country is:

$B = p_{xg} D^*_m - RER.\ p^*_{xg}\ D^*$ (5)

Equations (1) to (5) can be solved for B in terms of RER, Y and Y^* to get:

$B = B (RER, Y, Y^*)$

Table 1

Augmented Dickey Fuller (ADF) and Phillips-Peron (PP) Unit Root Tests

Countries	ADF		PP		
	Levels	Differences	Levels	Differences	Lags
India	$T\mu$ = -0.98	$T\mu$= -15.98*	$Z(\alpha^*)$ = -0.78	$Z(\alpha^*)$ = -32.67*	3
	$T\tau$ = -2.78	$T\tau$ = -16.23*	$Z(t_{\alpha^*})$ = -2.45	$Z(t_{\alpha^*})$ = -32.89*	
Pakistan	$T\mu$ = -2.70	$T\mu$ = -13.78*	$Z(\alpha^*)$ = -2.67	$Z(\alpha^*)$ = -34.99*	3
	$T\tau$ = -3.12	$T\tau$ = -14.43*	$Z(t_{\alpha^*})$ = -2.54	$Z(t_{\alpha^*})$ =-33.65*	
Sri Lanka	$T\mu$ = -1.59	$T\mu$ = -13.33*	$Z(\alpha^*)$ = -1.67	$Z(\alpha^*)$ = -34.65*	3
	$T\tau$ = -1.67	$T\tau$ = -14.67*	$Z(t_{\alpha^*})$ = -1.58	$Z(t_{\alpha^*})$ = -37.76*	

*5% significance level. $T\mu$ = without trend. $T\tau$ = with trend. The critical values at the 5% significance level are -2.86 and -3.41, respectively, for without trend and with trend. The lag lengths are determined by AIC.

Table 2

Multivariate Cointegration Tests

	λ -max Test Statistic			Trace Test Statistic		
Null Hypothesis	India	Pakistan	Sri Lanka	India	Pakistan	Sri Lanka
r = 0	153.38*	321.15*	54.20*	243.29*	345.36*	121.12*
r ≤ 1	42.37	25.46	31.02	86.54	73.50	63.86
r ≤ 2	14.09	23.43	17.56	34.98	48.14	35.43
r ≤ 3	11.05	10.34	13.43	19.93	26.51	19.87

* indicates statistical significance at the 5% level

Table 3

Estimates of Trade Balance Equation

Country	Variable	Coefficient	t-statistics	R^2
India with lag =1	Q	1.09	4.13*	0.654
	Y	-0.343	3.121*	
	Y^W	-1.307	-0.972	
Pakistan with lag =1	Q	2.21	2.133**	0.456
	Y	-2.12	2.987**	
	Y^W	5.43	2.435	
Sri Lanka with lag =1	Q	0.884	4.324*	0.809
	Y	-2.18	-2.143**	
	Y^W	0.176	0.887	

* significant at 1% level
** significant at 5% level

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