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Exchange Rate Volatility and Export Growth: Evidence from Selected South Asian Countries

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Abstract: The exchange rate regime and the related issues are one of the important yardsticks of the macroeconomic management in striving for economic development through improving the performance of foreign sector. The purpose of this study is to investigate the impact of exchange rate volatility on exports of three South Asian countries, India, Pakistan and Sri Lanka. Using cointegration and vector error correction model (VECM) techniques for the period 1960 to 2007, our empirical findings indicate the presence of a unique cointegrating vector linking real exports, relative export prices, foreign economic activity and real exchange rate volatility in the long run. Real exchange rate volatility exerts significant negative effects on exports both in the short run and the long run. Our results also reveal that improvements in the terms of trade (represented by declines in the real exchange rate) and real foreign income exert positive effects on export activity. Overall, our findings suggest that exporting activities of these South Asian countries can be further boosted up by policies aimed at achieving and maintaining a stable competitive real exchange rate.

Keywords: exchange rate volatility, exports, GARCH, cointegration, vector error correction

JEL Classification: C32, F14, F31

Introduction

The exchange rate regime and related issues are important macroeconomic management concepts for economic development via consistent improvements in the foreign sector of an economy. Exchange rates across the world have fluctuated widely particularly after the collapse of the Bretton Woods system of fixed exchange rates. Since then, there has been extensive debate about the impact of exchange rate

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volatility on international trade. The choice of regime can affect economic growth directly through its effects on the adjustment of the economy to economic shocks, and indirectly through its impact on other important determinants of growth, such as international trade, investment, capital flows, financial sector and developments in the financial institutions. But the most important determinant that is highly affected by the fluctuation of exchange rate is the exports. The ability to export goods helps an economy to grow by increasing its sale thereof.

Exchange rate volatility refers to the amount of uncertainty or risk associated with the magnitude of fluctuations in the value of a currency. A higher volatility implies that the foreign exchange rate can change dramatically over a short time period in either direction. The most commonly held belief is that higher exchange rate volatility generates uncertainty thereby increasing the level of riskiness of trading activity and this will eventually depress trade. It is important to point out here that in less developed countries (LDCs) where the forward markets are less developed and the cost of adjusting to changes in the economic environment is higher, exchange rate volatility coupled with protectionism, could have a major impact on trade and income. It is well documented in the literature that one of the major shortcomings of developing countries is underdeveloped financial markets or their absence altogether. Because of this, developing economies incur higher transactions costs. Hence it is concluded that the need to understand the policy implications of volatile exchange rates is of paramount importance in case of developing countries (Onafowora and Owoye, 2007).

Rest of the study is organized as follows: the empirical model, nature and sources of data and the estimation technique are presented in section 2; section 3 provides empirical results and their interpretation. Finally, section 4 concludes the study with some policy implications.

There exists abundant theoretical and empirical literature on this topic. Two most popular and related approaches have been used in the analysis of trade and exchange rate volatility; one approach is to estimate a simple export demand equation generally with real exports as dependent variable and exchange rate volatility together with relative prices and a measure of economic activity variable as regressors; the other approach is to use the so-called gravity equation models, which explain bilateral trade flows between countries as depending positively on their total output and negatively on their geographical distance from each other.

Although empirical research does not provide a definitive result that increased uncertainty reduces exports, the majority of the studies report a negative relationship between exchange rate volatility and export performance (Thursby and Thursby, 1985; Kenen and Rodrik, 1986; Koray and Lastrapes, 1989; Kumar and Dhawan, 1991; Pritchett, 1991; Pozo, 1992; Savvides, 1992; Chowdhury, 1993; Arize, 1995; Dell' Ariccia, 1998; Virgil, 2000; Doganlar, 2002; Esquivel and Felipe, 2002;

Onafowora and Owoye, 2007).On the other hand, Asseery and Peel (1991) and Todani and Munyama (2005) have found a positive relationship between exchange rate volatility and exports. However, Gotur (1985), Solakoglu (1998), De Vita and Abbott (2004), Hondroyiannis et al. (2006), Rey (2006), and Boug and Andreas (2007) could not get any significant relationship between these two time series. Thus empirical evidence on the relationship between export and exchange rate volatility is largely mixed. The objective of this paper is to provide a contribution to the empirical debate on the relationship between exchange rate volatility and exports for three South Asian countries - India, Pakistan and Sri Lanka.

Model, Data and Estimation Technique

At the theoretical level, the effects of a greater volatility of exchange rates on export flows are much debated. The literature gives results, which contrast strongly. Using a traditional export demand model with an addition of a measure of exchange rate volatility, the long run export demand function can be written as :

$$RX_t = \rho_0 + \rho_1 RP_t + \rho_2 VOL_t + \rho_3 Y_t + v_t \tag{1}$$

where, RX_t is real exports (nominal export/export price index), RP*t* is relative prices (home export price index/industrial countries' export price index). Theoretically, the bilateral relative price variable should be the ratio of an index of export prices, for the exporting country, and an index of prices of similar goods in the importing country, expressed in the same currency. Since such a measure is not available, in this article the relative price variable (RP) is is proxied by the real exchange rate. VOL_t is the real exchange rate volatility which measures uncertainty associated with fluctuations in the exchange rate. Y_t is the foreign economic activity (industrial production in industrialized countries) which is an indicator of exports of selected South Asian countries and the subscript t symbolizes the time. Theoretical priors dictate that we should expect $\rho_1 > 0$ and $\rho_3 > 0$ and as discussed in the section 2, the sign of ρ_2 is theoretically ambiguous.

The study has used RX, RP and Y in natural logarithm for carrying out the empirical exercise. . In order to ensure consistency in data, the exports of each country have been measured in US Dollar. All the data have been collected from International Financial Statistics, IMF. The set of data consists of yearly data and spans the period from 1970 to 2007.

Since Engle (1982), the exchange rate volatility has essentially been defined by ARCH (Autoregressive Conditional Heteroskedasticity) models, and subsequent generalizations (GARCH, IGARCH, etc.). As Baillie and McMahon (1989) and others show, ARCH type effects remain very strong in high-frequency data, but diminish with monthly or quarterly series. We have constructed a GARCH measure of volatility as follows:

$$RER_t = \gamma_0 + \gamma_1 RER_{t-1} + u_t \tag{2}$$

$$\sigma_t = \alpha_0 + \alpha_1 u_{t-1}^2 + \alpha_2 \sigma_{t-1} \tag{3}$$

where RER_t is real exchange rate expressed in natural logarithm and u_t is a random error. The conditional variance equation in (3) is a function of three terms: (i) the mean, α_0; (ii) news about volatility from the previous period, measured as the lag of the squared residual from the mean equation, u_{t-1}^2 (the ARCH term); and (iii) the last period's forecast error variance, σ_{t-1} (the GARCH term).

Unit Root Test

Since macroeconomic time-series data are usually non-stationary (Nelson and Plosser, 1982) and thus conducive to spurious regression, we test for stationarity of a time series at the outset of cointegration analysis. For this purpose, we conduct an augmented Dickey-Fuller (ADF) test, which is based on the t-ratio of the parameter in the following regression.

$$\Delta X_t = \kappa + \phi t + \Theta_i X_{t-i} + \sum_{i=1}^{n} \varphi_i \Delta X_{t-i} + \varepsilon_t \tag{4}$$

where X is the variable under consideration, D is the first difference operator, t captures any time trend, ε_t is a random error, and n is the maximum lag length. The optimal lag length is identified so as to ensure that the error term is white noise. While κ, ϕ, Θ and φ are the parameters to be estimated. If we cannot reject the null hypothesis $\Theta = 0$, then we conclude that the series under consideration has a unit root and is therefore non-stationary.

Cointegration Test

The econometric framework used for analysis in the study is the Johansen (1998) and Johansen and Juselius (1990) Maximum-Likelihood cointegration technique, which tests both the existence and the number of cointegration vectors. This multivariate cointegration test can be expressed as:

$$Z_t = K_1 Z_{t-1} + K_2 Z_{t-2} + ...+ K_{k-1} Z_{t-k} + \mu + v_t \quad (5)$$

Where,

Z_t =(RX_t, P_t , Y_t ,VOL_t) i.e., a 4 x 1 vector of variables that are integrated of order one [i.e. I (1)]

μ = a vector of constant and

v_t = a vector of normally and independently distributed error term.

The equation (5) can be reformulated in a vector error correction model (VECM) as follows:

$$\Delta Z_t = \Gamma_1 \Delta Z_{t-1} + \Gamma_2 \Delta Z_{t-2} + \cdots\cdots + \Gamma_{k-1} \Delta Z_{t-k-1} + \Pi Z_{t-1} + u_t \quad (6)$$

where Γ_i = (I – A_1 - A_2…..-A_k) (i= 1,2,3…..k-1) and Π = -(I-A_1-A_2-A_3…..-A_k) . The Π matrix contains information regarding the long run relationships. Π can be factored into $\alpha\beta'$ where α will include the speed of adjustment to the equilibrium coefficients while the β will be the long run matrix of coefficients. To determine the number of cointegrating vectors, Johansen developed two likelihood ratio tests: Trace test (λ_{trace}) and maximum eigenvalue test (λ_{max}). If there is any divergence of results between these two tests, it is advisable to rely on the evidence based on the λ_{max} test because it is more reliable in small samples (see Dutta and Ahmed, 1997 and Odhiambo, 2005).

Estimation and Interpretation of Results

The first step in cointegration analysis is to test the unit roots in each variable.[1] Table 1 reports the results of the ADF tests for the level as well as for the first-difference of the relevant variables. It is evident from that all variables are non-stationary in their levels but are stationary in their first differences. This implies that all the time series are integrated of order one [i.e. I(1)].

Table 1: Augmented Dickey Fuller (ADF) Unit Root Tests

	Export		Relative Price		Volatility		Foreign Economic Activity	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
India	2.11	-7.33***	1.22	-4.02***	-1.07	-5.35***	-1.57	-4.22***
Pakistan	-0.46	-4.12***	-0.67	-5.53***	-1.56	-5.21***	-	-
Sri Lanka	-0.78	-6.66***	-1.30	-6.58***	-1.72	-6.18***	-	-

***Significant at 1% level.

The second step is to determine the optimal lag length because Johansen method is known to be sensitive to the lag length. As far as this study is concerned, the Schwarz Bayesian Criteria (SBC) has suggested a lag length of 1 for all the three South Asain countries - India, Pakistan and Sri Lanka as optimal as shown in table 2 and that is not surprising for annual data .

Table 2: Optimum Lag Length through SBC

Lag Length	1	2	3	4
SBC (IND)	-1.758596*	-1.542222	-1.310119	-1.030341
SBC (PAK)	0.272462*	0.584783	0.770143	0.923150
SBC (SRI)	-0.553793*	-0.212490	0.034885	0.220627

Table3: Cointegration Test Based on Johansen's Maximum Likelihood Method

		Trace Statistic				Maximum Eigenvalue Statistic			
	H0:	r=0	r=1	r=2	r=3	r=0	r≤1	r≤2	r≤3
Country	H1:	r=1	r=2	r=3	r=4	r >0	r>1	r>2	r>3
India	Statistic	68.773***	34.368	15.589	4.174	31.404**	21.779	11.415	4.174
	p-value	0.0014	0.119	0.194	0.387	0.021	0.259	0.223	0.387
Pakistan	Statistic	70.497***	32.824	9.132	3.649	35.673***	20.692	5.483	3.649
	p-value	0.0009	0.145	0.324	0.467	0.005	0.116	0.343	0.467
Sri Lanka	Statistic	95.181***	32.088	8.979	4.147	60.093***	20.109	4.832	4.147
	p-value	0.000	0.151	0.278	0.391	0.000	0.114	0.322	0.391

** and *** denote rejection of the null hypothesis at the 5 percent and 1 percent significance level respectively.

Long run relationship among real exports, foreign economic activity, relative prices and volatility of exchange rate has been investigated by using the Johansen cointegration technique. The cointegration test is carried out assuming an intercept in the cointegrating equation. Both trace statistics (λ_{trace}) and maximal eigenvalue ($\lambda_{\max}$) statistics indicate that there is at least one cointegrating vector among real exports, foreign economic activity, relative prices and volatility of exchange rate.

Therefore, there is a long run equilibrium relationship among all these variables in these three countries. The cointegrating vectors, which are normalized with respect to the real exports, together with their respective t-values, are given in Table 4.

Table 4: Normalized Cointegrating Vector

India	$RXt = 2.983 - 1.153\,RPt - 1.036\,VOLt + 2.724\,Yt$ (3.849***) (3.167***) (3.854***) (4.466***)
Pakistan	$RXt = 4.557 - 1.226RPt - 0.944\,VOLt + 2.343\,Yt$ (2.509**) (2.358**) (11.801***) (9.816***)
Sri Lanka	$RXt = 8.839 - 1.484RPt - 1.463\,VOLt + 2.01\,Yt$ (4.623***) (4.088***) (3.051***) (7.689***)

Note: The numbers in parentheses beneath the estimated coefficients are t-statistics.** and *** indicate rejection of the null hypothesis at the 5 % and 1% significance levels respectively.

Table 5: Summary Results from VECMs

	India ECT(-1)	Pakistan ECT(-1)	Sri Lanka ECT(-1)
Δ(RX)	-0.616 (-3.158***)	-0.317 (-2.135**)	- 0.258 (-1.897*)
Δ(RP)	0.009 (1.161)	0.0023 (0.349)	-0.014 (-0.242)
Δ(VOL)	0.009 (5.448***)	0.0001 (0.654)	0.001 (0.071)
Δ(Y)	-10.6270 (-0.048)	3.342 (1.538)	2.769 (1.524)

Note: The numbers in parentheses beneath the estimated coefficients are t-statistics. *, ** and *** denote rejection of the null hypothesis at the 10%,5 % and 1% significance levels respectively.

The results of this normalization yield estimates of the long run elasticities. The coefficients of all variables bear the expected signs. The relative price term or the price elasticity term has the expected negative sign and its coefficient ranges from 1.153 to 1.484; the foreign activity term is positively related to the real exports and the coefficient of foreign activity term ranges from 2.004 to 2.724; the sign of the exchange rate volatility term for all the three countries is also negative and ranges from 0.994 to 1.463. The negative sign for the volatility term indicates that if volatility (uncertainty) in exchange rate increases, risk-averse producers will favour domestic trade to international trade. The fact that exchange rate volatility has negative impacts on exports of India, Pakistan and Sri Lanka is indeed an interesting and important finding from the point of view of the region as a whole. This result is in line with the findings of Arize et al. (2000) and Baum et al. (2001) which demonstrate that the negative impact of exchange rate volatility is more clearly observed in less developed countries.

Since the cointegration tests in the previous section detected one long run equilibrium relationship for each of the export equations, the vector error correction models (VECMs) have been estimated to see stability of the long run equilibrium relationship. Table 5 lists the summary results from the VECMs. It may be noted that the one-lagged error-correction term, ECT(-1) appears with a statistically significant coefficient and displays the appropriate (negative) sign in the equations of RX for all the three countries.. The coefficients of the error correction term indicate that the speed of adjustment for Pakistan and Sri Lanka is relatively slow. It means that the adjustment of real exports to any change in the regressors will take a long time to return to the equilibrium. Thus market forces in the export market restore equilibrium slowly in these countries. However, the speed of adjustment in India is relatively high which shows a relatively effective role of market forces in the export market for restoring equilibrium more quickly[2]. Overall, these findings support the validity of an equilibrium relationship among the variables in the cointegrating equations for all the three countries.

Conclusion and Policy Implications

The impact of exchange rate volatility on the volume of international trade has been studied intensively since the late 1970's when the exchange rate shifted from fixed to flexible exchange rate. Theoretically higher exchange rate volatility will reduce trade by creating uncertainty about future profit from export trade. The objective of this paper was to make a contribution to the empirical debate on the relationship between exchange rate volatility and exports performance for three South Asian countries - India, Pakistan and Sri Lanka. The research exercise covers the period 1960 to 2008. The results from the cointegration analysis show that there exists a long run equilibrium relationship among real exports demand, relative export prices, exchange rate volatility and foreign economic activity. The results under the VECMs confirm the stability of this equilibrium relationship among these variables. The overall findings indicate that exchange rate volatility has a negative impact on the exports of India, Pakistan and Sri Lanka. The results of the study are consistent with the findings of other studies suggesting that exchange rate volatility in developing economies has a significant negative impact on the export flows to the world market.

Two major policy implications w.r.t. improving export earnings of the three countries are: firstly, these countries should adopt policies which aimed at maintaining a stable competitive real exchange rate. In this direction, need is to establish a transparent exchange rate system under which the stability of the real exchange rate is achieved and maintained, and 'getting the exchange rate right' should be the essential part of the overall trade and economic growth strategy; secondly, the finding that foreign economic and relative prices have significant effects on real exports implies that export growth could be driven by factors, which are beyond the control of local policy makers. This implies that external developments are important in influencing export performance.

Our empirical analysis is based on the assumption of a linear relationship among the variables of interest. Possible nonlinear nature of causal links between exports and exchange rate uncertainty may very well be the case. We leave this issue for future work.

NOTES

[1] Since the cointegration methodology involves finding a stationary linear combination of a set of variables, which are themselves non-stationary, therefore, a precondition for cointegration to hold is that all variables should be non-stationary.

[2] The most plausible explanation of this phenomenon relates to the political and economic stability in India compared to Pakistan and Sri Lanka.Indeed this requires a separate indepth study of this issue.

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