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THE EFFECT OF EXCHANGE RATE VOLATILITY ON PAKISTAN'S EXPORTS

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Abstract. The purpose of this study is to empirically determine the long-run relationship between exchange rate volatility and exports growth in Pakistan. To establish this relationship a multivariate cointegration and error-correction model techniques are used on quarterly data during 1982:1 to 2000:4. The other variables considered for multivariate estimation include world trade volume, domestic export price index and world export price index. The results suggest that exchange rate volatility has negative impact on exports. In addition, the exports in Pakistan are also driven by the volume of world trade and world exports price as the coefficients of these factors are positive and statistically significant during the study period. These relationships are explaining the exports significantly in both short-run and long-run.

I. INTRODUCTION

The adoption of flexible exchange rate system by many countries during 1973 produced a significant volatility and uncertainty in exchange rates. This started a debate among policy makers and researchers about the impact of exchange rate volatility on international trade. However, there is no consensus theoretical or empirical on this issue on international trade flows. Researchers who supported the hypothesis that exchange rate risk depresses trade include Cushman (1983, 1986, 1988); Akhtar and Hilton (1984); Kenen and Rodrick (1986); Thursby and Thursby (1987); De Grauwe and De Bellefroid (1987); De Grauwe (1988); Pere and Steinherr (1989); Koray and

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Lastrapes (1989); and Arize (1995). On the other hand, many studies did not find support for the depressing effects of exchange rate volatility on trade (Hooper and Kohlhagen, 1978; Gotur, 1985; Baily *et al.*, 1987; Asseery and Peel, 1991).

Like many developing countries Pakistan also shifted to a managed floating exchange rate system during 1982. In general, the rationale for the switch in exchange rate regime was that a share-weighted float would be responsive to the changing trade flows among major trading partners and bilateral currency fluctuations. As a result of this policy we also expected to generate greater geographical and commodity diversification of Pakistani exports. However, this shift is also likely to cause volatility in exchange rate and could influence the exports. For instance, on an overall basis, the real export growth in Pakistan was about 5.09 percent during the study period (1982:1 to 2000:4) with a standard deviation of 26.77. The growth rate in real exchange rate was only a quarter percent, with a standard deviation of 8.26 during the same period. During the decade of 1980s (1982:1 to 1990:4), the growth rate in real exchange rate was minimum, *i.e.* 0.02 percent and the variability had been lower with a standard deviation of 7.16. The growth rate in real exports was higher during this period (6.27 percent with a standard deviation of 28.64) compared to growth rate observed during overall study period. It indicated a negative relationship between variability in exchange rate and growth in real exports. This suggested that when the variability in exchange rate was lower the growth in real exports is higher. A similar negative relationship between exchange rate variability and growth in real exports had been observed even during the recent period (1991:1 to 2000:4) of financial and economic reforms to boost investment and exports in Pakistan. For example, during this period the growth in real exchange rate is almost half a percent with an increased standard deviation of 9.20, whereas the growth in real exports declined to 4.05 percent with a standard deviation of 25.34. It again validates a negative relationship between exchange rate variability and export growth in Pakistan as observed in other developing countries (Grobar, 1993; Hassan and Tufte, 1998).

In case of Pakistan only detailed study has been conducted by Kumar and Dhawan (1991) based on data during 1974 to 1985 using simple OLS. This study ignored the nature of non-stationarities apparent in various time series data and rather examined the possibility of lagged relationships between the volume of exports and its various determinants, which may infer misleading long-run responsiveness of exchange rate volatility on exports (Granger and Newbold, 1974; Phillips, 1986).

This study takes into account the possibility of such lagged relationship and empirically investigates the long-run relationship between exports and its determinants. This study also considers the short-run dynamics by which exports converge on their long-run equilibrium. This study is important since it has implications for the choice of exchange rate system and conduct of exchange rate policy.

The rest of the paper is organized as follows. The econometric methodology is presented in section II. Section III introduces the data while section IV discusses the empirical results. The concluding remarks are provided in section V.

II. ECONOMETRIC METHODOLOGY

We employ a multivariate cointegration technique suggested by Johansen (1988, 1991) and Johansen and Juselius (1990, 1992 and 1994) in order to draw meaningful conclusions on the speed of adjustment and perform the direct hypothesis test on the coefficients entering the cointegration vectors. The short-run dynamics by which real exports converge on their equilibrium and long-run values are examined using error correction model. This study uses quarterly data and focuses on flexible exchange rate regime between 1982:1 and 2000:4.

We specify a standard long-run relationship between exchange rate volatility and exports and incorporate other variables suggested in various research works, such as world trade volume, foreign and domestic prices which explain the variability in exports. It has the form:

$$X_t = \beta_0 + \beta_1 W_t + \beta_2 PP_t + \beta_3 PW_t + \beta_4 V_t + u_t \quad (1)$$

where,

X = natural logarithm of export volume index

W = natural logarithm of world trade volume

PP = natural logarithm of Pakistan export price index

PW = natural logarithm of world export price index

V = natural logarithm of a moving sample standard deviation (a measure of exchange rate volatility explained later in section III)

u = an error term

The coefficients of Pakistan export price (PP) is expected to be negative for export demand function. Also the world export price is expected to be positive to reflect substitution of Pakistani goods for the exports of other countries. Moreover, we expect a positive coefficient of world trade volume due to possible increase in Pakistani exports as world trade increases. However, we cannot predict the sign for the coefficient of exchange rate volatility because of the mixed evidence given in the literature.

To test the presence of long-run equilibria among the variables, Johansen (1988, 1991) multivariate cointegration test is employed to estimate equation (1). Testing for cointegration involves two steps. First, the stationarity properties of the individual variable(s) in equation (1) are investigated by conducting unit root test suggested by Phillips and Perron (1988). Second, two likelihood ratio tests, namely, the trace and the maximum eigenvalue statistics are employed to identify the number of significant cointegrating vectors. The basic idea of cointegration is that two or more variables may be regarded as defining a long-run equilibrium relationship if they move close together in the long-run, even though they may drift apart in the short-run. This long-run relationship is referred to as a cointegrating vector.

If such a cointegrating relationship is present, then the Granger representation theorem states that a dynamic error-correction representation of the data also exists. According to Engle and Granger (1987), the following error correction model (ECM) is estimated:

$$\begin{aligned} \Delta X_t \;=\; & \alpha_0 + \sum_{i=0}^{n} \alpha_1 \Delta X_{t-i-1} + \sum_{i=0}^{n} \alpha_2 \Delta W_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta PP_{t-i-1} \\ & + \sum_{i=0}^{n} \alpha_4 \Delta PW_{t-i} + \sum_{i=0}^{n} \alpha_5 \Delta V_{t-i-1} + \lambda Z_{t-1} + \mu_t \end{aligned} \tag{2}$$

where all the variables are as defined above. Δ is first difference operator, u_t is the error term and Z_{t-1} is the error correction term generated by taking one lagged error term from Johansen multivariate procedure applied to equation (1). While the error correction term Z_{t-1} appearing as a regressor reflects long-run dynamics. The coefficients on the lagged values of other regressors are short-run parameters measuring the short-run immediate impact of independent variables on the dependent variable in equation (2).

III. DATA AND VARIABLE DEFINITIONS

The sample consists of quarterly data for the period 1982:1 to 2000:4 on the real value of Pakistani exports (X), the volume of world trade (W) –

calculated as the sum of world import and export volume deflated by world import and export price indices respectively, a price index for world exports (*PW*), domestic export price index (*PP*) and a measure of Pakistan exchange rate volatility (*V*). All the data for this study has been extracted from *International Financial Statistics* available in electronic and published form. The data on exchange rate is used from various bulletins of State Bank of Pakistan.

There are various measures of exchange rate volatility proposed in the literature. Some of these are averages of absolute changes, standard deviation and deviation from trend. The measure we utilize is the squared residual from the ARIMA process fitted to the logarithm of the real exchange rate of Pakistan. The moving-sample standard deviation is then constructed as:

$$\mu_t = \left\{ \frac{1}{m} \sum_{i=1}^{m} \left(R_{t+i-1} - R_{t+i-2}\right)^2 \right\}^{\frac{1}{2}}$$

$$R = \ln\left\{ \frac{et}{p_t} \right\}$$

where,

R = natural logarithm of real exchange rate

e = nominal exchange rate

p = wholesale price index

m = order of moving average which is four

This measure of volatility has been used to take account for periods of high and low exchange rate uncertainty and captures the temporal variation in the absolute magnitude of changes in real exchange rates. It has been widely used in international trade literature by Cushman (1983), Kenen and Rodrick (1986), Koray and Lastrapes (1989) and Hassan and Tufte (1998).

IV. EMPIRICAL RESULTS

To determine the empirical relationship between exchange rate volatility and exports equation (1) is estimated using the quarterly data during 1982:1 to 2000:4. It is important to mention that statistical inference from time series is usually based upon the assumption of stationarity. Therefore, prior to estimating equation (1), the time series properties of the individual series were tested. For this Philips and Perron unit root test is employed. This test allows for the presence of unknown forms of autocorrelation and conditional heteroscedasticity in the error term. Table 1 provides the relevant test statistics. The results suggest that the null hypothesis of non-stationarity is rejected for all the variables in the levels form except for Pakistan export prices and world export prices. Both of these variables are I(1).

TABLE 1

Phillips and Perron Unit Root Test

Variables	Level	First Difference
X	–4.00**	
W	–6.94*	
PP	–3.06	–8.52*
PW	–1.90	–6.53*
V	–8.96*	

* Significant at 1%

** Significant at 5%

X = natural logarithm of export volume index

W = natural logarithm of world trade volume

PP = natural logarithm of Pakistan export price index

PW = natural logarithm of world export price index

V = natural logarithm of a moving sample standard deviation (A measure of exchange rate volatility)

In determining the number of significant cointegration vectors Johansen multivariate procedure is employed, which can also make use of I(0) variables. The null hypothesis is that there can be r cointegrating vectors among the five variables in equation (1). Tables 2 and 3 report the trace and λ max tests statistics using lag lengths till four quarters. These statistics indicate strong evidence of cointegration among all the variables. There is at least one cointegrating vector demonstrated by both tests in all the cases. Accordingly, we estimated three error correction models of the form shown in equation (2) using lag lengths till four quarters in all the variables. These estimated models are presented in Table 4. According to the adjusted R^2 and Akaike Information Criteria (AIC), model 1 with one to two quarters lags gives the most robust results. The results of this model highlight a highly

TABLE 2

The Johansen Cointegration Test Statistics

Linear Deterministic Trend in Data and a Constant	Trace Tests				
H_0: r =	0	1	2	3	4
One period lag	95.76**	49.13	24.52	9.76	3.87
One to two lags	101.67*	61.59	36.89	14.96	4.56
One to three lags	94.80**	58.13	32.03	9.29	3.35
One to four lags	91.64**	56.83	26.89	12.26	3.54

* Significant at 1%

** Significant at 5%

TABLE 3

The Johansen Cointegration Test Statistics

Linear Deterministic Trend in Data and a Constant	λmax Rank Tests				
H_0: $r \geq$	0	1	2	3	4
One period lag	46.63*	24.61	14.76	5.89	3.87
One to two lags	40.08*	24.70	21.93	10.40	4.56
One to three lags	36.67*	26.10	22.74	5.94	3.35
One to four lags	34.81*	29.94**	14.63	8.72	3.54

* Significant at 1%

** Significant at 5%

TABLE 4
Error Correction Models for ΔX

Variables	Model 1	Model 2	Model 3
	ΔX	ΔX	ΔX
C	–0.109 (2.52)**	–0.010 (0.22)	–0.042 (0.64)
ΔXP_{-1}	0.262 (1.68)	–0.206 (1.59)	–0.410 (2.85)*
ΔXP_{-2}	0.158 (1.03)	–0.119 (0.79)	–0.201 (1.27)
ΔX_{-3}	–	–0.089 (0.59)	0.095 (0.59)
ΔX_{-4}	–	–	–0.044 (0.27)
ΔW_{-1}	4.040 (2.87)*	1.972 (1.46)	–1.551 (1.03)
ΔW_{-2}	4.119 (4.07)*	1.989 (1.40)	3.351 (2.25)**
ΔW_{-3}	–	–2.461 (2.04)**	–1.847 (1.25)
ΔW_{-4}	–	–	–1.163 (0.82)
ΔPP_{-1}	–0.303 (1.05)	0.197 (0.68)	0.649 (1.84)
ΔPP_{-2}	–0.316 (1.21)	–0.018 (0.06)	0.353 (0.10)
ΔPP_{-3}	–	–0.329 (0.83)	0.172 (0.37)
ΔPP_{-4}	–	–	–0.118 (0.27)
ΔPW_{-1}	2.067 (2.08)**	1.601 (1.43)	0.918 (0.77)
ΔPW_{-2}	0.051 (0.05)	0.405 (0.35)	0.449 (0.39)
ΔPW_{-3}	–	0.040 (0.04)	–0.057 (0.05)
ΔPW_{-4}	–	–	1.242 (1.05)
ΔV_{-1}	–1.580 (2.15)**	–1.527 (1.11)	–0.667 (0.79)
ΔV_{-2}	–0.412 (0.69)	–0.295 (0.26)	0.197 (0.21)
ΔV_{-3}	–	–0.227 (0.29)	–0.007 (007)
ΔV_{-4}	–	-	0.195 (0.268)
E_{t-1}	–0.763 (4.32)*	–0.002 (1.75)	0.028 (2.04)**
N	72	71	70
R^2	0.48	0.44	0.52
$\bar{R}^2$	0.39	0.27	0.30
AIC	–0.125406	0.096429	0.056530

t values are in parentheses
* Significant at 1%
** Significant at 5%
X = natural logarithm of export volume index
W = natural logarithm of world trade volume
PP = natural logarithm of Pakistan export price index
PW = natural logarithm of world export price index
V = natural logarithm of a moving sample standard deviation (A measure of exchange rate volatility)

significant error correction term with the appropriate negative sign, a finding that accords well with the validity of an equilibrium relationship among the variables in the cointegrating equation. Another important outcome of our results is that coefficient of exchange rate volatility (ΔV) is negative and statistically significant. It indicates a high elasticity of exports with respect to exchange rate volatility equal to –1.5. However, we could not find any significant coefficient of export price of Pakistan (ΔPP) in the short-run. Finally, according to the dynamics of the equation, changes in volume of world trade (ΔW) and world prices (ΔPW) have significant positive short-run effects on exports in addition to their long-run effects. Furthermore, elasticity of exports with respect to these variables is quite high, suggesting their strong effects. These findings lead to important policy implications regarding our resource allocation to benefit from international trade.

V. CONCLUDING REMARKS

This paper attempts to investigate the impact of exchange rate volatility on the demand for the real exports of Pakistan. In an attempt to do so, this study utilizes quarterly data for the period 1982:1 to 2000:4 and uses Johansen multivariate cointegration tests and error correction models. It has been postulated that exchange rate volatility has negative and statistically significant impact on exports. The volume of world trade, foreign and domestic prices have positive and statistically significant impact on Pakistan exports during the study period. The cointegration results suggest that there is at least one cointegrating vector among these variables. Furthermore, error correction model (ECM) results indicate that volume of world trade, world export prices and exchange rate uncertainty have significant impact on exports of Pakistan, both in the short as well as in the long-run. It implies a beneficent effect of world economic activity on exports of Pakistani goods. Our results support findings of many studies relating to developing countries (*see* Kumar and Dhawan, 1991; Grobar, 1993; Hassan and Tufte, 1998).

The findings of our study suggest that a stable exchange rate could be an effective policy instrument for promoting exports of Pakistan. However, to get further insight we need to investigate the impact of these determinants of export growth at disaggregate level.

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