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The Long-run and Short-run Impact of Exchange Rate Devaluation on Pakistan's Trade Performance

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In estimating trade elasticities for Pakistan, most previous researchers have employed non-stationary data and OLS or 2SLS techniques. In this paper we use Johansen's cointegration methodology to re-investigate the long-run trade elasticities and existence of the Marshall-Lerner condition. Using quarterly data, the trade performance with Pakistan's ten major trading partners is empirically tested. Moreover, we also investigate the short-run exchange rate dynamics by constructing an error-corrrection model to trace the j-curve.

INTRODUCTION

Since 1982 the Pak rupee has been characterised by a managed float; the rupee was pegged to a basket of currencies with the US dollar being the main anchor currency. In July 2000 this system was replaced by a free float. However, we can argue that in practice regular State Bank of Pakistan (SBP) intervention continues, and therefore the issues of real depreciation to correct the trade balance still remain relevant.

In this paper we investigate if the Marshall-Lerner (ML) condition holds true for Pakistan in the long run. The ML condition implies that the sum of total export and import elasticities must be greater than one if depreciation is to have a favourable impact on the trade balance; moreover, it is found that for most countries, even when the conditions are satisfied in the long run, in the short run the price elasticities of export and import demand are inelastic, and this may be one of the factors explaining the j-curve. We confirm the satisfaction of the ML condition in the long run and the existence of the j-curve in the short run for Pakistan.

Existing empirical evidence with respect to the satisfaction of the Marshall Lerner condition for Pakistan is mixed. Hasan and Khan (1994), using 3SLS technique for annual data (1972–1991), conclude that the Marshall-Lerner condition

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for Pakistan is satisfied and a devaluation ought to be successful in improving the trade balance. Khan and Aftab (1995), using the Instrumental Variable (IV) technique for quarterly data (1983-93), find that the sum of import and export demand elasticities is slightly greater than one and therefore the "ML condition is barely satisfied for Pakistan". Bahmani-Oskooee (1998), on the other hand, using quarterly data (1973–90) and applying cointegration, reported that the ML condition was strongly satisfied in the case of Pakistan. Further, Akhtar and Malik (2000), using quarterly data and applying the 3SLS technique, investigate the ML conditions with Pakistan's 4 trading partners, UK, USA, Germany, and Japan. They conclude that "real devaluation is unlikely to improve our trade balance with USA and Germany, while [it] can arrest the trade balance deterioration with UK and Japan". As mentioned above, we confirm the satisfaction of the ML condition for Pakistan using Johansen's, *et al.* (1990) cointegration technique, which is now commonly used in time series analysis. The above studies, with the exception of Bahmani-Oskooee (1998), simply rely on 3SLS and IV technique, and therefore there is a possibility that the respective models may suffer from spurious correlation and the demand elasticity estimates may be biased. In the case of Bahmani-Oskooee (1998), although the cointegration technique is applied, the author has used aggregate world income and aggregate export prices while we have constructed trade-weighted indices for these variables based on Pakistan's 10 major trading partners. Moreover, with respect to short-run dynamics, the authors came across only one study by Bahmani-Oskooee (1992) which investigated the j-curve for Pakistan. This study uses quarterly data to trace the j-curve for selected developing countries including Pakistan. The model used lags of the real effective exchange rate to trace the j-curve through OLS estimation. Considering that this is a dated paper, recent time-series econometric techniques such as Vector Autoregression (VAR) and Error-Correction Model (ECM) functions are not employed in this study.

Our paper is an empirical extension of the above studies. Using quarterly data (1980:1 to 2000:4) and statistically more rigorous methodologies, we confirm that ML conditions are satisfied in the long run. Moreover, by using error-correction modelling technique, the j-curve for Pakistan is traced.

Modelling Long-run Import and Export-demand Functions

By assuming that the world supply of imports to Pakistan is perfectly elastic we consider a single-equation model for aggregate import demand. In this model relative prices and income variables are crucial because the effectiveness of import policy is highly dependent upon the size of their elasticities. The long-run aggregate import demand function for Pakistan therefore is specified as follows.

$$\log M_t = \alpha_1 + \alpha_2 \log RPM_t + \alpha_3 \log Y_t + \varepsilon_{1t} \qquad \dots \qquad \dots \qquad \dots \qquad (1)$$

Where *M* is the real quantity of total imports; *RPM* is the relative prices defined as the ratio of import prices to domestic price level (*PIIMP/PI)*; *Y* is the gross domestic product at 1995 prices, and ε_{1t} is the random disturbance term with its usual classical properties. It is expected that $\alpha_2 < 0$ and $\alpha_3 > 0$.

Similarly, for the export demand function, by considering the literature, the model relationship is derived from the simple relationship between exports (X), international competitiveness, and world income (*YW*):

$$\log X_t = \beta_1 + \beta_2 \log RPX_t + \beta_3 \log YW_t + \varepsilon_{2t} \quad \dots \quad \dots \quad \dots \quad (2)$$

Where *X* is the real quantity of total exports; *RPX* is the relative price of exports (*PIX/PXW*) defined as the ratio of domestic export prices to the trade-weighted price of exports of the major trading partners, *YW* is the trade-weighted average of the Gross Domestic Product of major trading partners, and ε_{2t} is the random disturbance term. An increase in export prices relative to that of the trading partners' export prices is expected to hurt Pakistan's exports. Thus, $\beta_2 < 0$. An increase in the trading partners' income leads to an increase in our exports. Hence it is expected that $\beta_3 > 0$. For detailed data description, see Annex I.

Modelling Short-run Trade Balance Equation

To trace the j-curve for Pakistan we set the following trade balance equation:

$$\Delta \log\left(X_t / Y_t \right) = \beta_0 + \sum \beta_{1i} \Delta \log REER_{t-i} + \sum \beta_{2i} \Delta \log RY_{t-i} + \sum \beta_{3i} \Delta \log RC_{t-i}$$

$$+ \sum \beta_{4i} \Delta \log\left(X_{t-i} / Y_{t-i} \right) + \beta_5 ECM_{t-1} + \upsilon_t \quad \dots \quad \dots \quad (3)$$

Where *REER* is the real effective exchange rate with the trading partners; *RY* is the relative income defined as the ratio of the real domestic income to the weighted average of the income of trading partners; *RC* is the relative price of inputs, defined as the ratio of domestic wholesale price index to the weighted average wholesale price index of the trading partners; and *ECM* is the Error Correction term. Following Haynes and Stone (1982), we define the trade balance as the ratio of exports over imports.

Methodology and Empirical Findings

We begin our empirical investigation by examining the basic time series properties of the data. Using quarterly data for the period 1980–2000 we first employed the ADF and PP test (with and without trend) to determine the degree of integration of each variable. The lags of each individual series were selected in such a manner as to render the ADF test residuals free of autocorrelation (as the ADF test statistics are highly sensitive to the assumption of i.i.d.). The results of the ADF and PP tests, applied to level and first-difference data, are reported in Annex II, Table 1.

It is observed from Table 1 that most of the series are non-stationary at level (with and without trend), but all series are stationary at first difference (at 1 percent level of significance).

Secondly, we use the Johansen technique [Johansen (1988, 1991); and Johansen and Juselius (1990)] to test the existence of cointegration in the underlying series. The result of λ-max, to determine the number of co-integrating vectors among the variables of the import and export demand functions, and the trade balance equation are given in Annex II, Tables 2 a, b, and c respectively. The tests confirm that the null hypothesis of "no cointegration" is rejected at the 1 percent level of significance in all three equations. Therefore, we can conclude that at least one co-integrating vector exists among these equations.

Both the cointegrating equations estimated by OLS and JJ methodology are reported below. The *t*-statistics are given in paranthesis.

Long-run Import Demand Function

OLS Estimates

$$\log M_t = 9.65 - 0.69 \log RPM_t + 0.79 \log Y_t$$

(14.7) (–4.7) (20.59)

ML Estimates

$$\log M_t = 9.79 - 0.87 \log RPM_t + 0.91 \log Y_t$$

Long-run Export Demand Function

OLS Estimates

$$\log X_t = -2.18 - 0.41 \log RPX_t + 1.91 \log YW_t$$

(–2.1) (–2.1) (8.1)

ML Estimates

$$\log X_t = -2.65 - 0.623 \log RPX_t + 2.11 \log YW_t$$

As reflected in the equations above, the sum of the absolute price elasticities of the respective export and import demand functions is greater than unity: in the OLS case it is 1.10, while the ML technique gives an estimate of 1.5 (approx). This confirms the satisfaction of the Marshall-Lerner condition for Pakistan in the long-run, and the result corresponds closely with Hasan and Khan (1994) (see the Table below for a comparison with previous studies). We would encourage a more disaggregated commodity-wise analysis for future research, incorporating current time-series techniques. However, at an aggregate level, a real devaluation in the long run should impact the trade balance positively.

	Marshall-Lerner Condition	Methodology	Estimation Period	Data Frequency
Akhtar and Malik (2000)	Satisfied for US and Germany but not for UK and Japan	3SLS	1982-96	Quarterly
Bahmani-Oskooee (1998)	Strongly satisfied (3.11)	Cointegration	1973-90	Quarterly
Khan and Aftab (1995)	"Barely satisfied"	IV	1983-93	Quarterly
Hasan and Khan (1994)	Strongly satisfied (1.64)	3SLS	1972-91	Annual

Finally, we focus on the short-run impact of real depreciation. An Error Correction Model (ECM) is employed to test the j-curve. The results are reflected in the equation below. The lag order for each variable is selected on the basis of the Final Prediction Error (FPE) criterion.[1] Refer to Annex 3, Table 1 for details of the respective estimated lag structures and their corresponding *t*- and *F*-statistics. The results confirm the existence of the j-curve phenomenon for Pakistan. This is reflected by the initial negative sign, followed by the positive signs, of the lagged coefficients of the real effective exchange rate.

$$\begin{aligned}\Delta\log\left(X_t/Y_t\right) = &-0.04 + 0.10\Delta\log\left(X_{t-1}/Y_{t-1}\right) - 0.01\Delta\log\left(X_{t-2}/Y_{t-2}\right)\\ &- 0.07\Delta\log\left(X_{t-3}/Y_{t-3}\right) - 0.02\Delta\log REER_{t-1} - 0.12\Delta\log REER_{t-2}\\ &+ 0.64\Delta\log REER_{t-3} + 0.30\Delta\log REER_{t-4} + 1.21\Delta\log REER_{t-5}\\ &- 0.27\Delta\log RY_{t-1} + 0.20\Delta\log RC_{t-1} + 1.75\Delta\log RC_{t-2}\\ &+ 0.18 DUM98 - 0.99 ECM_{t-1}\end{aligned}$$

The j-curve is traced by plotting the cumulative coefficients for the respective lags of the Real Effective Exchange Rate, with the major trading partners as shown in Figure 1 below. The analysis confirms that a real depreciation will lead to a deterioration of the trade balance in the initial 2 quarters, before showing any favourable impact.

[1]FPE as defined by Akaike (1969) is calculated using the following equation:

$$FPE = \frac{T+m+1}{T-m-1}\frac{SSE}{T}$$

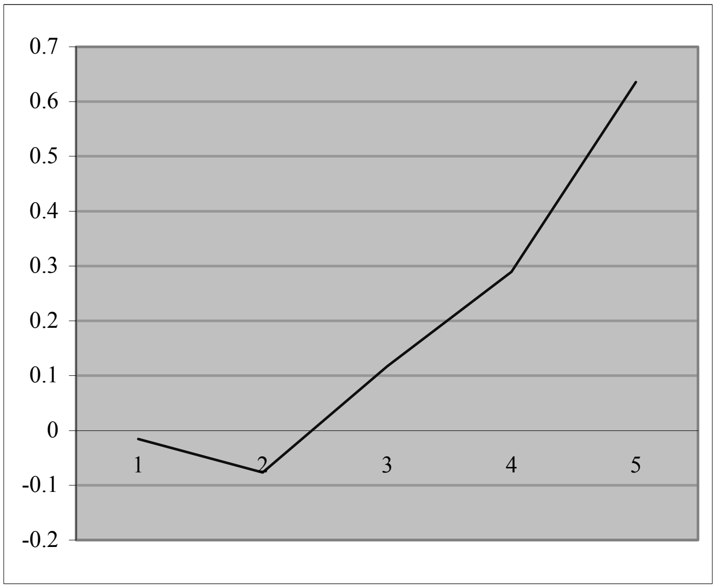

Fig. 1. Plot of the ECM Cumulative Coefficients.

CONCLUSION AND POLICY IMPLICATIONS

Through rigorous time-series analysis we have reaffirmed the satisfaction of the ML condition for Pakistan in the long run. The analysis confirms that real depreciation of the Pak rupee may be used as a policy tool to improve the trade balance. However, in the immediate future, the trade balance is expected to deteriorate, and then a steady improvement in the trade balance is expected.

Annexures

ANNEXURE I

PAKISTAN'S DIRECTION OF TRADE

Pakistan's trade is narrowly concentrated in terms of both origination of its imports and destination of exports. While constructing our indices we used weights with respect to Pakistan's 10 major trading partners, USA, Germany, Japan, UK, Italy, France, Korea, Singapore, the Netherlands, and Canada. These countries accounted for 53 percent of Pakistan's total trade in 1990. We did not consider the UAE and Saudi Arabia when constructing the indices because disaggregated quarterly data for these countries are not available.

Data Description

X = Real Exports measured in Rs million.

M = Real Imports measured in Rs million.

Y = Gross Domestic Product (Pakistan). For the time period 1980–1990 the data are taken from Bengali (1995). For the decade 1991–2000, the data are extrapolated by using ARIMA process. The quarterly nominal figures were then deflated by the Wholesale Price Index (WPI) to obtain the real quarterly GDP.

YW = Trade-weighted GDP of Pakistan's 10 major trading partners (United States, Germany, Japan, United Kingdom, Italy, France, Korea, Singapore, the Netherlands, and Canada). The nominal GDP is deflated by the trade-weighted WPI of the 10 trading partners.

WPI = Wholesale Price Index (WPI) of Pakistan.

WPI* = Trade-weighted Wholesale Price Index (WPI) of 10 trading partners.

REER = Pakistan's Real Effective Exchange Rate. This variable is computed in 2 steps:

(i) The real bilateral exchange rate (RE) is computed as

$RE_j = \left(WPI / WPI_j \right) \times e_j$ where e is defined as the number of units of domestic currency per unit of respective trading partner j's currency.

(ii) *REER* is then computed by taking the weighted average of the 10 trading partners as given by the formula $REER = \sum_j^{10} \omega_j RE_j$ where ω is the trading partner j's share in Pakistan's total trade.

PIX = Domestic Price Index of Exports.

PXW = Trade-weighted price index of exports with respect to Pakistan's 10 major trading partners.

RPX = Relative price of exports (PIX/PXW).

PIM = Domestic Price Index of Imports.

RPM = Relative price of imports (PIM/WPI).

RY = Relative Income (Y/YW).

RC = Relative Cost of Production (WPI/WPI*).

DUM98 = DUM98 = 1 for 1998:Q2, 1998:Q3 1998:Q4, 1999:Q1, and zero elsewhere. This dummy is used to capture the economic/financial aftermath of Pakistan's nuclear detonation in May 1998.

Data Sources

I. International Financial Statistics of IMF.

II. Direction of Trade Statistics of IMF.

ANNEXURE II

Table 1

Tests for Unit Roots

Variables	Level			First Difference
	ADF	PP	ADF	PP
Without Time Trend				
Y	–0.36	–1.58	–8.55*	–106.64*
YW	–0.52	–0.34	–6.62*	–7.77*
X	0.79	1.03	–8.61*	–17.37*
M	–1.44	–1.93	–9.433*	–18.23*
REER	–1.04	–0.94	–7.23*	–9.55*
RPX	–1.12	–1.08	–6.44*	–8.45*
RPM	–2.27	–2.73	–7.07*	–11.26*
RC	1.65	2.02	–3.86*	–5.26*
With Time Trend				
Y	–5.31*	–22.69*	–8.09*	–106.09*
YW	–2.31	–2.11	–6.57*	–7.71*
X	–1.87	–4.11*	–8.84*	–18.43*
M	–2.06	–6.04*	–4.74*	–18.10*
REER	–1.71	–1.73	–7.18*	–9.48*
RPX	–1.96	–2.06	–6.44*	–8.43*
RPM	–2.32	–2.79	–7.04*	–11.20*
RC	–1.63	–1.66	–4.46*	–5.86*

Note: * significant at 1 percent level; ** significant at 5 percent level; *** significant at 10 percent level.

Table 2(a)

Johansen Cointegration Test Results for Export Demand Function

Maximal Eigenvalue Test				
Null H_0	Alternative H_1	λ_{max}	Critical Value (95%)	Critical Value (99%)
r=0	r=1	71.4*	34.9	41.1
r=1	r=2	31.2*	20.0	24.6
r=2	r=3	7.3	9.2	13.0

Note: * significant at 1 percent level; ** significant at 5 percent level; *** significant at 10 percent level.

Table 2(b)

Johansen Cointegration Test Results for Import Demand Function

Maximal Eigenvalue Test				
Null H_0	Alternative H_1	λ_{max}	Critical Value (95%)	Critical Value (99%)
r=0	r=1	36.4**	34.9	41.1
r=1	r=2	17.4	20.0	24.6
r=2	r=3	3.1	9.2	13.0

Note: * significant at 1 percent level; ** significant at 5 percent level; *** significant at 10 percent level.

Table 2(c)

Johansen Cointegration Test Results for Trade Balance Function

Maximal Eigenvalue Test				
Null H_0	Alternative H_1	λ_{max}	Critical Value (95%)	Critical Value (99%)
r=0	r=1	83.3*	53.1	60.2
r=1	r=2	43.7*	34.9	41.1
r=2	r=3	14.4	20.0	24.6
r=3	r=4	2.1	9.2	13.0

Note: * significant at 1 percent level; ** significant at 5 percent level; *** significant at 10 percent level.

ANNEXURE III

Table 1

Short Dynamics of Trade Balance

Dependent Variable is DL(X/IMP)	Coefficient	*t*-stats/ *F*-stats
Constant	–0.04	–1.78
DL(X(–1)/M(–1))	0.10	17.58
DL(X(–2)/M(–2))	–0.01	
DL(X(–3)/M(–3))	–0.07	
DLREER(–1)	–0.02	9.62
DLREER(–2)	–0.12	
DLREER(–3)	0.64	
DLREER(–4)	0.30	
DLREER(–5)	1.21	
DLRY(–1)	–0.27	–2.24
DLRC(–1)	0.20	10.26
DLRCI(–2)	1.75	
DUM98	0.18	2.82
ECM(–1)	–0.99	–4.97

R^2 = 0.62.
S.E. of regression = 0.11. *F*-statistic = 8.03.
DW = 1.99. *P*-value = (0.000).

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