Estimating Long Run Trade Elasticities In Pakistan—Cointegration Approach

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I. INTRODUCTION

The importance of exchange rate policy regarding the foreign trade regime is obvious. An important macroeconomic policy to reduce the trade deficit is said to be devaluation. The reluctance to use devaluation has been a constant bone of contention in the negotiations between the governments of some developing countries and the International Monetary Fund [IMF]. During 1970s IMF emphasis on devaluation was not much strong. However, in 1980s IMF attitude towards currency depreciation became very stringent.

There is considerable disagreement among theoreticians concerning the desirability of devaluation in developing countries. The advocates argue that it is an invaluable instrument for strengthening the balance of payments [BOPs] because of its impact on absolute prices and real and monetary variables. Whereas, critics argue that devaluation is stagflationary, reducing real output and increasing domestic rate of inflation and fails to improve the current account of the BOPs [Bird (1983)].

It has been argued that devaluation may not be much beneficial because of very low imports and exports elasticities notably in the developing countries [Gylfason and Risager (1984), Edwards (1986), Upadhyaya and Upadhyaya (1999)]. Naqvi et al [(1983), p.151] argue that devaluation should not have much effect on exports, even though it will have a definite effect on imports. They recommend that a policy of stimulating domestic production and directly subsidising exports is a sure way of expanding exports rather than a straight devaluation. This means that an adjustment in the effective exchange rate is more important than changes in the nominal exchange rate for BOPs purposes. Hasan and Khan [(1994)] have examined the impact of devaluation on Pakistan’s trade balance for the period 1972-91. They have concluded that devaluation may improve the trade balance in Pakistan. They have reported that Marshall-Lerner condition for devaluation is satisfied for Pakistan and thus devaluation will be successful in improving the trade balance.

Some Structural Adjustment Reforms were started with the help of IMF and World Bank in 1982-83 with the objective of improving the efficiency of the economy by increasing the role of the private sector. The reforms included the delinking of the Rupee from US dollar in January 1982, price deregulation of a large number of products, denationalisation of industry, imports liberalisation and export expansion [Khan (1994)]. The successive governments have taken a number of steps to pursue
an extensive liberalisation of the trade regime in addition to taking a number of export measures. Exchange and payment reforms were also implemented [see GOP (1991-92)]

Exchange rate policy has assumed renewed importance, as devaluation is an important component of the traditional stabilisation programme. Because of the divergence of opinion on the desirability of exchange rate depreciation and the more recent advances in time series econometrics like introduction of Cointegration and error correction, it is desirable that the import and export elasticities are restimated in a developing country like Pakistan using the technique of Cointegration.

Therefore, the objective of this paper is to estimate the Marshall-Lerner condition for Pakistan employing Cointegration technique using annual data for the period 1960-2003. The rest of the paper is structured as follows. Section II contains model and data sources. Johansen cointegration test and estimation results are given in section III and the final section deals with conclusions.

### II. MODEL AND DATA SOURCES

Following literature [Khan (1974), Hasan and Khan (1994), Afzal (2001)] export and import demand equations are:

\[
\ln X_d = \alpha_0 + \alpha_1 \ln \left[ \text{UVXp/UVXw} \right] + \alpha_2 \ln ZW + \alpha_3 \ln \text{NER} \quad (1)
\]

\[
\ln M_d = \phi_0 + \phi_1 \ln \left[ \frac{\text{PM}}{\text{Pd}} \right] + \phi_2 \ln \text{GDP} + \phi_3 \ln \text{NER} \quad (2)
\]

Where

- \(X_d\) = real value of exports demand
- \(\text{UVXp}\) = Unit value of exports in USA $
- \(\text{UVXw}\) = Unit value of world exports in US $
- \(ZW\) = world real income
- \(\text{NER}\) = nominal exchange rate [domestic price of the foreign currency]
- \(M_d\) = Real value of imports
- \(PM\) = unit value of imports
- \(\text{Pd}\) = Wholesale Price index [WPI] of Pakistan
- \(\text{GDP}\) = Pakistan’s real GDP [1990=100]

The expected signs of the coefficients are: \(\alpha_1, \text{and} \phi_1 < 0;\) and \(\alpha_2, \phi_2 > 0.\) The expected sign of the coefficient of the nominal exchange rate for exports is positive and for imports it is negative.
DATA SOURCES

Data on GDP, Consumer Price Index [CPI], Wholesale Price Index [WPI], value of imports and exports have been taken from government of Pakistan [GOP] Economic Survey [1987-88 statistical supplement, 1997-98 Statistical appendix, and 2002-03 Statistical appendix]. Real world Income data were obtained from the World Tables [various issues]. The data regarding export unit value index for Pakistan and the world in US$, unit value of imports in domestic currency were collected from International Financial Statistics [IFS] yearbooks [various years]. Data on nominal exchange rate were taken from IFS for the early years 1960s and 1970s and for 1980-2003 from State Bank of Pakistan Annual Reports [various reports]. All the variables are in natural logarithm and are in constant 1989-90 = 100 prices. Using annual data the period of the study is 1960-2003.

III. JOHANSEN COINTEGRATION TEST

Before we apply the cointegration technique, we must determine the order of integration of each variable. We used both ADF [Augmented Dickey-Fuller] and PP [Phillips-Perron] unit root tests. The results not reported but available upon request indicated that all the variables under consideration are non-stationary. They are integrated of order 1. Now we apply Johansen [1988] and Johansen and Juselius [1990] technique of cointegration. The Johansen’s technique is a multivariate generalisation of the Dickey-Fuller test. The Maximum Likelihood procedure tests how many of the cointegration vectors are significant that is what rank the cointegration matrix has. This method has the following Vector Autoregressive [VAR] representation:

\[
X_t = \mu + \Pi X_{t-1} + \Pi X_{t-2} + \Pi X_{t-3} + \ldots + \Pi X_{t-k} + \varepsilon_t \tag{3}
\]

Where \( \varepsilon_t \sim N (0, \Sigma) \). Johansen estimates the rank of the matrix \( \Pi \) that is the rank of the coefficient matrix of the lagged variables. This rank mirrors the number of cointegrating relationships. Johansen method uses two test statistics for the number of cointegrating vectors: the Trace test and Maximum Eigenvalue (\( \lambda \)-max) test. According to Johansen [(1991), p.1566], the choice of lag length is more important, but simulations indicate that moderate departures (which could not be detected in the initial statistical analysis) the inference does not seem to change. The choice of lag length was based on AIC and the optimal lag length was 1 and Eviews 3.1 obtained the results of Johansen cointegration technique. Table 1 and Table 2 give the results of exports and imports functions.
Table 1
Export Function: LnX LnY Ln [UVXp/UVXw] LnNER

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>$\lambda$-max</th>
<th>95%CV</th>
<th>Hypothesis</th>
<th>$\lambda$-trace</th>
<th>95%CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$: $r = 0$</td>
<td>27.84*</td>
<td>27.07</td>
<td>$H_0$: $r = 0$</td>
<td>48.13*</td>
<td>47.21</td>
</tr>
<tr>
<td>$H_1$: $r = 1$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_0$: $r \leq 1$</td>
<td>14.19</td>
<td>20.97</td>
<td>$H_0$: $r \leq 1$</td>
<td>20.29</td>
<td>29.68</td>
</tr>
<tr>
<td>$H_1$: $r = 2$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_0$: $r \leq 2$</td>
<td>5.41</td>
<td>14.07</td>
<td>$H_0$: $r \leq 2$</td>
<td>6.10</td>
<td>15.41</td>
</tr>
<tr>
<td>$H_1$: $r = 3$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 3$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_0$: $r \leq 3$</td>
<td>0.69</td>
<td>3.76</td>
<td>$H_0$: $r \leq 3$</td>
<td>0.69</td>
<td>3.76</td>
</tr>
<tr>
<td>$H_1$: $r = 4$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 4$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Critical values of the Table 1 and Table 2 are from Osterwald – Lenum ([1992])

Table 2
Import Function: LnM LnY Ln [PM/Pd] LnNER

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>$\lambda$-max</th>
<th>95%CV</th>
<th>Hypothesis</th>
<th>$\lambda$-trace</th>
<th>95%CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$: $r = 0$</td>
<td>51.89*</td>
<td>27.07</td>
<td>$H_0$: $r = 0$</td>
<td>94.46*</td>
<td>47.21</td>
</tr>
<tr>
<td>$H_1$: $r = 1$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 1$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_0$: $r \leq 1$</td>
<td>28.63*</td>
<td>20.97</td>
<td>$H_0$: $r \leq 1$</td>
<td>42.57*</td>
<td>29.68</td>
</tr>
<tr>
<td>$H_1$: $r = 2$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 2$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$H_0$: $r \leq 2$</td>
<td>13.88</td>
<td>14.07</td>
<td>$H_0$: $r \leq 2$</td>
<td>13.94</td>
<td>15.41</td>
</tr>
<tr>
<td>$H_1$: $r = 3$</td>
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<td>$H_1$: $r \geq 3$</td>
<td></td>
<td></td>
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<tr>
<td>$H_0$: $r \leq 3$</td>
<td>0.064</td>
<td>3.76</td>
<td>$H_0$: $r \leq 3$</td>
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<td>3.76</td>
</tr>
<tr>
<td>$H_1$: $r = 4$</td>
<td></td>
<td></td>
<td>$H_1$: $r \geq 4$</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The $\chi^2$ statistic in the import function has two degrees of freedom. The critical value of $\chi^2 (2) = 5.99$ at the 5% level of significance.

Table 3
Cointegrating Vectors Normalized on LnX

<table>
<thead>
<tr>
<th>LnX - Ln</th>
<th>+LnZW</th>
<th>+LnNER</th>
</tr>
</thead>
<tbody>
<tr>
<td>[UVXp/UVXw]</td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td>1.0[12.08]*</td>
<td>2.92[5.45]*</td>
<td>-3.78[5.36]*</td>
</tr>
</tbody>
</table>

Note: The $\chi^2$ statistic in the export function has one degree of freedom. The critical value of $\chi^2 (1) = 3.84$, at the 5% level of significance.

Table 4
Cointegrating Vectors Normalized on LnM

<table>
<thead>
<tr>
<th>LnM +LnGDP</th>
<th>- Ln [PM/Pd]</th>
<th>- LnNER</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
<td><img src="image.png" alt="Image" /></td>
</tr>
<tr>
<td>1.00[11.02]*</td>
<td>3.19[12.56]*</td>
<td>-5.26[9.26]*</td>
</tr>
</tbody>
</table>

Note: The $\chi^2$ statistic in the import function has two degrees of freedom. The critical value of $\chi^2 (2) = 5.99$ at the 5% level of significance.
The null hypothesis of no cointegration is rejected on the basis of both $\lambda$-max and $\lambda$-trace tests. The cointegration results [Table 1 and Table 2] show that there is one cointegrating vector in the exports function and two cointegrating vectors for import function. Since we aim at estimating long run export and import elasticities, we normalise the cointegrating vectors following the common practice on the $\ln X$ in the export function and on the $\ln M$ in the import function. Although many Normalisations are possible, economists usually find that the interpretation of the cointegrating vectors suggests that one of the coefficients in each vector should be set equal to 1 [Patterson (2000)].

Now it is necessary to ascertain which of the variables are cointegrated. For this purpose we can use likelihood ratio test. Making the coefficient of each variable equal to zero in turn can perform this test. Johansen [(1988), p.237] and Johansen and Juselius [(1990), p.194] have shown that likelihood ratio test of excluding a variable is given as:

$$-2\ln(Q) = - T \sum_{i=1}^{r} \ln \left( \frac{1 - \lambda_i^*}{1-\lambda_i} \right)$$  \hspace{1cm} [4]

Where $r$ is the number of cointegrating vector, $\lambda_i$ is the Eigenvalue of the of the $i$th vector of the original cointegrating space and $\lambda_i^*$ is the Eigenvalue of the of $i$th vector of the new cointegrating space obtained by excluding a variable. Johansen and Juselius have shown that the expression [4] is distributed as $\chi^2$ with degrees of freedom equal to $r (p-s)$ where $r$ is the number of cointegrating vectors, $p$ is the dimension of the original cointegrating space and $s$ is the dimension of the new cointegrating space. Since the latter space is obtained by restricting the coefficient of a variable equal to zero, $s = p-1$ and the degrees of freedom of each $\chi^2$ is equal to $r (p-p+1) = r$ [see Bahmani-Oskooee (1996)].

The likelihood ratio test for the exclusion of each variable has been reported in the bracket next to each coefficient in Table 3 and Table 4. These coefficients are significant as the $\chi^2$ value exceeds $\chi^2(1) = 3.84$ for export function and $\chi^2(2) = 5.99$ for import function. These expression show that export and import elasticities are sufficiently high and in absolute terms they add up to more than unity as Marshall-Lerner condition postulates.

Marshall-Lerner condition is concerned with long run trade elasticities and the estimation of these elasticities using cointegration analysis dealing with long run relationship among economic variables supports the Marshall-Lerner condition. And this implies that the devaluation should improve the trade balance in Pakistan in the long run.

Khan [(1974)] found that for most of the 15 developing countries including Pakistan in his sample showed price elasticities of both import and export demand were close to or greater than one. This implies that the ML condition for successful devaluation would be easily satisfied in a number of developing countries including Pakistan for the period 1951-1969. Arize [(1986)] reported that the Marshall –Lerner condition for
devaluation was satisfied for a majority of countries in his sample that included nine African countries for the period 1960-1982. The absolute sum of exports [-1.32] and import demand elasticities [-0.35] adds up more than one [Afzal (2001a), (2001b)].

Given that ML condition is satisfied, it is pertinent to ask why the Balance of Payments [BOPs] continues to deteriorate after devaluation? A possible explanation is that expansionary monetary policy following the devaluation may be partly responsible for the worsening of the BOPs. Monetary approach to the Balance of Payments posits that the devaluation must be accompanied by a reduction in the money supply through reduction in public spending. This can generate contractionary effects leading to unemployment, social unrest and a fall in the standard of living. The innate conflict between the Balance of Payments equilibrium and the internal balance explains why some governments make resort to trade and foreign exchange restrictions, multiple exchange rates and even operating an artificially overvalued exchange rate.1

Generally speaking, it is difficult to isolate the impact of devaluation on imports because what happens to import demand depends crucially on what other policies are simultaneously pursued. It is quite possible that import liberalisation and expansionary demand management policies will result in an increase in import volume even though the initial effects of the devaluation through increased import prices and reduced real expenditures would tend to cause a contraction.

Also the substitution effect away from imports may be neutralised if additional export earnings cause income and therefore, imports to rise. And increased export supply may of course; lead directly to an increase in imported inputs. It is because of such

The open economy national income identity is

\[ Y = C + G + I + (X - M) \]  

This can be written as

\[ Y = C + Sp + T \]

Where

\[ Sp = \text{private savings} = I + (X-M) \]

and assuming \( G = T \), \( G = \text{government spending} \), \( T = \text{taxes} \), \( I = \text{investment} \), \( C = \text{consumption} \), \( X = \text{exports} \), \( M = \text{imports} \). Using (1) and (2), we can also write

\[ I + (X-M) = Sp + (T - G) \]

(3),

\[ X - M = Sp + (T - G) - I \]

(4),

\[ D (X - M) = dS, - dI \]

(5),

Where \( St = Sp + (T - G) \)

Equation (5) makes a simple but very important point that a country’s trade balance can improve if savings rises relative to investment. The policy implications of this statement are not pleasant. Total savings must grow rapidly or severe restraints are put on the investment if devaluation is to succeed. Discouraging savings notably in the export sector is an unpalatable idea. The sector of savings over government can exercise control is \([T - G]\). This implies that restrictive fiscal policy \([G↓ \text{ or } T↑\) or both] becomes inescapable in order to make devaluation a success. When the economy is closed to full employment and the domestic output could not be increased to improve trade balance, it is essential that significant resource mobilization is undertaken by the government implying that maximum revenue is generated though taxation so that trade balance improves to make devaluation a success. All this shows that why LDCs governments are reluctant to follow orthodox BOPs adjustment programs and why they often do not succeed to adopt policies that make devaluation successful [see Ingram and Dun (1996), Alexander (1959), Clark (1959)].
reasons that that an increase in real imports has been observed following devaluation in some cases [Bird (1983), p.467].

IV. CONCLUSIONS

The effects of devaluation or depreciation on the trade balance of a country are usually examined by the Marshall-Lerner condition which states that if the sum of the absolute values of imports and export demand price elasticities is greater than one, devaluation is expected to improve the trade balance of a country.

Cointegration being concerned with long run relationship among economic variables was used to estimate the long run Marshall-Lerner condition. Cointegration approach has supported the Marshall-Lerner condition. This suggests that devaluation should improve the trade balance in Pakistan. But despite this, the trade balance does not improve. It may be that devaluation sets in motion other forces that tend to neutralise the positive effects of devaluation.

Studies differ in their results. Some studies have reported that devaluation would improve trade balance in LDCs and is expansionary; other studies have concluded that devaluation is contractionary and will not improve trade balance. However, devaluation is an important macroeconomic policy that could be used accompanied by appropriate fiscal and monetary policies to stabilise the economy.

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