Import’s Price and Income Elasticity Estimates: Reconsidering the Evidence for Pakistan

Saleem Khan, Rafaqet Ali and Mahmood Shah

Abstract: This paper largely explains for the price and income elasticity estimates in Pakistan’s import demand. The aim is to obtain and construe the new estimates of the responsiveness of real imports demand to real effective exchange rate and domestic income in Pakistan using the annual data set and ARDL application. The empirical result indicates evidence of co-integration among the variables. Majorly and differently, the study found in evidence that in the long run real imports are significantly price inelastic, when the effective exchange rate were used as a measure of price competitiveness. Furthermore, along with price inelastic imports found highly income elastic i.e. a one percent increase in domestic income level will have to increase imports demand by more than one percent. Thus, the results make obvious for case study the relative responsiveness of imports demand to changes in exchange rate and domestic income level.

Keywords: Import Demand, REER, Time Series, ARDL, Pakistan

INTRODUCTION

Since the work of [1], so many researchers strived to look at the determinants of import demand. To this end mostly believed that domestic aggregate economic activity and relative import prices are majorly influencing import demand, [2] has surveyed hundreds of articles. Among the others, [3], [4], [5], and [6] have tested that the use of two illustrated factor is valuable in Pakistan import demand. Further, researcher in huge literature have equal approach to aggregate economic activity and take the real or nominal gross domestic product of the country to estimate for income elasticity in import demand function. Recently, the expenditure components of national income are too widely viewed in separate, for instance [7], [8], [9] and [10]. However, despite the crucial importance of relative prices and of great concern to the researcher and trade policy makers, the proper and unanimous uses of relative prices are yet not developed. In empirical work, for measurement of price elasticity different price indices are proxies which aimed at investigating exact estimate. It is of worthy to note that the successful devaluation can be viewed from price elasticity of export-import demand [11].

The relative price term, in import function equivalent to the ratio of import unit vale (MUV) and domestic price proxy by wholesale price index (WPI), based on the seminal work of [1], has perhaps attained the nearly all attention. Later on to quantify the price effects of imported good and domestically substitute in separate, the use of additive price term rather than ratio is suggested in econometric specification of import demand [16]. Also in many studies the relative price term has adjusted for exchange rate to represent foreign price of imported goods in domestic currency. As, [17] used bilateral real exchange rate a measure of relative prices in import demand. The study quote that in formulating import demand function, Dornbush (1980: 58) has employed the real exchange rate

1. Economics Department, Gomal University, KPK, Pakistan

2. This paper is from the first author PhD thesis

1. See [12], [13], [14], and [15] etc.
3. Measured as the domestic price of foreign currency (exchange rate), multiplied by the ratio of US prices to Mexico’s Prices.
term. [18], in Mexico import demand function has placed the variable of real exchange rate to measure for price competitiveness.3 Besides, it is argued that the effective exchange rate adequately approximates rather than bilateral exchange rate in aggregate analysis of a country trade with multi country case. Reference [19] states, a movement in the real effective exchange rate reflect changes in the competitiveness of goods that are internationally traded. Example of studies that estimated import demand function using real effective exchange rate for price elasticity estimate are [20] and [21].

Having focus on Pakistan’s import demand, this paper objective is to regress the real imports on real effective exchange rate and income level in the context of co-integration analysis. The study in evidence provides support that Pakistan’s import demand, domestic income and real effective exchange rate are co-integrated. This study extends Pakistan related previous studies in two ways. First, our study construct import weighted real effective exchange rate and includes 20 trading partners that share more than 80 percent in Pakistan’s total imports mostly in time period of the study. Second, this paper employ the econometric methodology relatively recently developed by [22] that entitle autoregressive distributed lag model or bound test approach in literature.

The subsequent of this study is organized as follows. Section two introduces the model for Pakistan’s import demand and Section three explain for data sources. In section four discusses the econometric issues and in Section five the empirical findings. In last section six concludes the analysis.

THE MODEL FOR PAKISTAN’S IMPORT DEMAND

We consider the real imports demand of Pakistan’s economy from rest of the world. Until now, it is quietly known to us that relative import prices and domestic income majorly determine import demand. However, based on studies of [5], [13], [18], [20], and [21], we keep domestic income and real effective exchange rate two major determinants of aggregate import demand. Thus, to express the relationship between Pakistan’s imports demand, domestic income and real effective exchange rate specify the model of aggregate import demand as given:

$$\ln R_{t}^{PAK} = \beta_{0} + \beta_{01}\ln REER_{t} + \beta_{11}\ln RY_{t}^{PAK} + \varepsilon_{t} (1)$$

Where variables are explained as, \(\ln R_{t}^{PAK}\) = log of Pakistan’s real import at time \(t\); \(\ln RY_{t}^{PAK}\) = log of Pakistan’s real income or GDP at time \(t\); \(\ln REER_{t}\) = log of import weighted real effective exchange rate at time \(t\). and is defined as the product of nominal effective exchange rate (domestic currency price per unit of a basket of foreign currencies) and MUV divided by WPI; and \(\varepsilon_{t}\) is the disturbance term.

DATA SOURCES

Annual data for the time period of 1981 to 2010 is collected from various national as well as international sources that including:
- (a) Pakistan Economic Survey (various issues) [23]
- (b) State Bank of Pakistan, A Handbook of Statistics 2010, [24]
- (c) World Bank, World development Indicators and Global Development Finance, [25]

The variable real import is measured by nominal imports from source (a) deflated by import unit value from source (b). The index of MUV and WPI are from source (b), and are in constant 2000=100 prices. The nominal effective exchange rate (NEER) between Pakistan and trading partners’ currencies are calculated, data is from source (a) and (c). Using three indices, i.e. MUV, WPI and NEER, the REER were constructed. Real domestic income is taken as the gross domestic product at 2000 constant factor cost, source (b).

ECONOMETRIC ISSUES

Since the included variables in import models of equation (1) are time series and country specific, the elasticity estimate of relative prices for long run and short run are desired to obtain by using an appropriate co-integration technique. In application of co-integration approach, we in this study of...
small sample rely upon on relatively more powerful test of co-integration offered by [22] and are known in literature as bound test or ARDL approach. The ARDL approach is verbalized at length in many research papers including [8], [13] and [17], thus needs not to repeat here. Below simply express the basic steps of the approach that how the long run relationship and short run effects can be determined.

Reference [21] suggests three steps to test for long run relationship between dependent and independent variables. To begin with import demand and examine the co-integration relationship between Pakistan’s import demand and its determinants, first employ the error correction representation of ARDL as following:

\[
\Delta \ln RM_t = C + \sum_{i=1}^{m} \alpha_i \Delta \ln RM_{t-i} + \sum_{i=0}^{n} \beta_i \Delta \ln X_{t-i} + \delta_1 \ln RM_{t-1} + \delta_2 \ln X_{t-1} + \mu_t
\]  

(2)

Where \(X_t\) is a vector of regressors (includes RM and REER) and \(m, n\), represents number of lags. Accordingly, after the OLS results for unrestricted error correction model (UECM) as given in equation (2), the Wald test is tested against the coefficient of level lagged variables. The test assume null and alternative hypothesis as given:

\[
H_0 = \delta_1 = \delta_2 = 0 \quad \text{(No co-integration)}
\]

\[
H_A = \delta_1 = \delta_2 \neq 0 \quad \text{(Co-integration)}
\]

Also [21] study provides a set of critical values that is an upper and lower bound critical values. If the value of F-statistics exceed the upper bound value and support the joint significance of an alternative hypothesis, then the results would confirm co-integration. In this like case the inferences about long run relationship can be taken without pre unit test of the explanatory variables in the model.

Once the presence of co-integration is being confirmed then in second stage one can move to investigate the long run coefficients and in stage three the associated error correction model of ARDL. The general ARDL of import demand and the interrelated error correction representation of ARDL can be developed as given in (3) and (4):

\[
\ln RM_t = C + \sum_{i=1}^{m} \alpha_i \ln RM_{t-i} + \sum_{i=0}^{n} \beta_i \ln X_{t-i} + \mu_t
\]  

(3)

\[
\Delta \ln RM_t = C + \sum_{i=1}^{m} \alpha_i \Delta \ln RM_{t-i} + \sum_{i=0}^{n} \beta_i \Delta \ln X_{t-i} + EC_{t-1} + \mu_t
\]  

(4)

In equation (4) the term \(EC_{t-1}\) is the lagged of residuals from long run ARDL in equation (3) and allocate that how disequilibrium adjust back to long run equilibrium. The one thing that is common, looking the order of lags in all three equations. Thus, to select the appropriate lags length, here is allocated by using the Schwarz Bayesian Criteria (SBC) in all cases.

THE STUDY EMPIRICAL FINDINGS

Equation (1) is estimated for Pakistan’s economy imports demand using annual data for the period of 1981 to 2010. The estimation is based on autoregressive distributed lag model (ARDL) approach of co-integration. Therefore, firstly a test of co-integration using the bound test to the error correction mode outlined in equation (2) is executed to identify a vector of co-integration. The computed F-statistics is found 13.22 when the real import variable is used as a regressand. The [19] study reported 5.4333 (at 5 %) and 7.8433 (at 1 %) upper bound critical values for sample size of 30 in case of unrestricted intercept and no trend with two regressors. Therefore, it can be seen that the F-test
outcome is greater than the [26] upper bound critical value at 5 as well as at 1% and confirm that Pakistan’s import demand and its determinants are co-integrated at 1 percent level of significance.

Having found long run relationship in import demand, now estimate equation (3) to extract the long run coefficient. For the purpose, based on Schwarz Criteria the final ARDL (1, 1, 2) model of import demand is of the following form:

\[
\ln R_{t}^{Pak} = C + \alpha_0 \ln R_{t-1}^{Pak} + \beta_{00} \ln \text{REER} + \beta_{10} \ln R_{t-2}^{Pak} + \beta_{11} \ln R_{t-1}^{Pak} + \beta_{12} \ln R_{t-2}^{Pak}
\]

(5)

Table 1: The Estimated Results of Equation (5)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>T-ratio (Prob.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>constant</td>
<td>-8.019</td>
<td>-1.75 (0.093)</td>
</tr>
<tr>
<td>lnRM_{t-1}^{Pak}</td>
<td>0.385</td>
<td>2.92 (0.008)</td>
</tr>
<tr>
<td>lnREER</td>
<td>-0.699</td>
<td>-4.19 (0.000)</td>
</tr>
<tr>
<td>lnREER_{t-1}</td>
<td>0.440</td>
<td>2.61 (0.016)</td>
</tr>
<tr>
<td>lnRY_{t-1}^{Pak}</td>
<td>1.789</td>
<td>3.30 (0.003)</td>
</tr>
<tr>
<td>lnRY_{t-2}^{Pak}</td>
<td>2.403</td>
<td>2.34 (0.029)</td>
</tr>
<tr>
<td>lnRY_{t-3}^{Pak}</td>
<td>-3.237</td>
<td>-4.92 (0.000)</td>
</tr>
</tbody>
</table>

R-square = 0.97  

F-statistic = 113.22

Note: There is F-statistic value of diagnostic Test and probability in parenthesis.

The respective import model long run results discussion is based on the data reported in Table 1. The estimates are statistically significant and diagnostic tests are in the range that not detect for the problem of serial correlation, heteroscedasticity and functional form. The regression results in Table 1 are of dynamic nature and not represent the long run estimates. Therefore, the normalized long run estimates of import demand are derived from the above regression results and are reported in equation 6 below.

\[
\ln R_{t}^{Pak} = -8.019 - 0.42\ln \text{REER}_{t} + 1.55\ln RY_{t}^{Pak}
\]

(6)

According to the results in equation 6, the real import demand income elasticity is 1.553. This high import demand income elasticity indicates that a 1 percent increase in income level in Pakistan would increase by more than 1% i.e. (1.553), the Pakistan’s import demand from rest of the world. Conversely, the relative import price elasticity measured by the coefficient of REER in this study is negative (-0.421), reveals deprecation of rupee in Pakistan decrease import demand. Hence, a unit percentage (1%) increase in REER of Pakistan will lead to reduce import demand by 0.42%, depicts that import demand is inelastic (negatively) to the REER in Pakistan. In estimated long run import model, both the coefficients expected signs are according to the theoretical standpoint. Note that in our case the significant price elasticity estimate differentiate significantly from the more recent findings of [20] and in magnitude from that of price elasticity estimate found in study of [15]Having estimated long run elasticity estimates, now examine for short run elasticity estimate and parameter stability in model. For this we follow [27] and apply the CUMSUM and CUMSUM stability test, as suggested by [28]. In visual both the test are plotted against critical bounds. If the test statistic stays within the bound means parameters stability, otherwise instability. Graphically CUMSUM test results are shown in Figure 1, and CUMSUMQ in Figure 2. Neither tests cross the upper critical line nor lower, indicates significant structural stability. The error correction analysis focuses in results for short run elasticity estimate and speed of adjustment. In first difference variables, domestic income is highly significant compare with long run.
estimates while short run exchange rate coefficient are not more different than long run coefficient. Much interpretation could be attached to the error correction term, where the negative less than 1 coefficient is an indication of co-integration. Specifically, import demand due to short run deviation return to long run equilibrium with speed of 71 per cent per year (see Tab. 2).

### Table 2: Error Correction Representation for the Selected Import Model

<table>
<thead>
<tr>
<th>Variables</th>
<th>Coefficients</th>
<th>T-ratio</th>
<th>P-values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-0.113</td>
<td>-2.366</td>
<td>0.028</td>
</tr>
<tr>
<td>( \Delta \ln \text{REER} )</td>
<td>-0.528</td>
<td>-4.650</td>
<td>0.000</td>
</tr>
<tr>
<td>( \Delta \ln \text{REER}_{t-1} )</td>
<td>0.469</td>
<td>3.039</td>
<td>0.006</td>
</tr>
<tr>
<td>( \Delta \ln \text{REER}_{t-2} )</td>
<td>2.162</td>
<td>4.294</td>
<td>0.000</td>
</tr>
<tr>
<td>( \Delta \ln \text{REER}_{t-3} )</td>
<td>3.439</td>
<td>6.125</td>
<td>0.000</td>
</tr>
<tr>
<td>( \Delta \ln \text{REER}_{t-4} )</td>
<td>-2.423</td>
<td>-4.560</td>
<td>0.000</td>
</tr>
<tr>
<td>ECT(_t)</td>
<td>-0.711</td>
<td>-3.322</td>
<td>0.003</td>
</tr>
</tbody>
</table>

R-square: 0.85  
F-stat: 18.83  
Adjusted R\(^2\): 0.80  
DW-stat: 2.03  
SBC: -2.66

### CONCLUSION

For significant critical lines and equation of CUMSUM and CUMSUMQ test, see [14]

![Figure 1: Plot of CUNSUM Test Statistic for Coefficient Stability](image1)

![Figure 2: Plot of CUMSUMQ Test Statistics for Coefficient Stability](image2)
This study properly takes the organized import weighted real effective exchange rate (REER), defined as the value of rupee in the context of multi trading partners (20) that share more than 80 per cent imports in Pakistan’s total import during the sample period i.e. from 1981 to 2010. Particularly, it has been attempted to investigate the long and short run impact of real effective exchange on real imports in Pakistan, where for estimation has employed the more update econometric technique of co-integration i.e. called in literature an autoregressive distributed lag model (ARDL).

An aggregate import demand function is estimated between Pakistan and rest of the World. The demand function takes the domestic income level and import weighted real effective exchange rate explanatory variables. In evidence has found that the variables included in real import demand function are co-integrated. With regards to exchange rate, results have shown that in long run imports are price inelastic and significant, whereas in short run inelastic and not significant. Furthermore, along with price inelastic imports found highly income elastic i.e. a one percent increase in domestic income level will lead to increase imports demand by more than one and half percent. Both the long run income and price elasticity are statistically significant and have the theoretically expected sign. Moreover, the stability test suggests parameters stability in import demand function. Therefore, it can be argued that the use of REER will have a significant effect on the proper allocation of trade elasticities in conventional import demand function.

REFERENCES