AGGREGATE IMPORT DEMAND FUNCTION: EMPIRICAL EVIDENCE FROM BONDS TESTING APPROACH IN CASE OF PAKISTAN; 1972-2006

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Abstract

The paper re-estimates the traditional aggregate demand function for Pakistan by employing Bounds test (ARDL) on the annual data for the period of 1972 to 2006. The study examines the long-run relationship among the import demand, real income, and relative price. The estimated results of the Bounds test (Pesaran at al. 2001) corroborate the existence of co-integration relationship among the relevant variables over the sample period. Stability tests demonstrate that import demand function is stable. Overall results exhibit that import demand function is even and suitable for the policy implications.

Key words: Import demand function, Bounds test, Pakistan

I- Introduction

Historically, Pakistan's over all economic out look (GDP) has grown every year since a 1951 recession. Despite this record of sustained growth, Pakistan's economy had been characterized as unstable and highly vulnerable to external and internal shocks and circumstances.

The fiscal year 2007-08 corroborate this fact. In the back drop of disturbed political conditions; an unstable law and order situation; supply shocks; soaring oil, food and other commodities prices; softening of external demand, Pakistan economy has registered a bleak performance in 2007-08 .

According to Economic Survey 2007-08, the GDP growth has been registered at 5.8 percent as against 6.8 percent in last year. Performance of other sectors of the economy also remained

dull. Agriculture, manufacturing, large scale manufacturing sector, total investment and national saving declined noticeably.

Though the exports have registered a recovery and recorded a growth rate of 10.2 percent during the first ten months (July-April 2008)but it still remained far short of the average growth of 16 percentage achieved during 2002-03 to 2005-06.

Imports during the first ten months (July -April) of the current fiscal year 2007-08 grew by 28.3 percent compared with the same periods of last year, reaching to US $ 32.8 billion. Owing to sharp increase in imports and dismal performance of the economy, Pakistan's current account deficit widened to US $ 11.6 billion during Jul-April FY 08 against US$ 6.6 billion in the comparable period last year, showing an increase of 75.7 percent.

In the current fiscal year 2007-08, the State Bank of Pakistan (the central bank) reckons the highest ever the country's current-account deficit which is estimated as 7.8 percent of GDP.In addition to current account deficit, country's trade deficit is also in a muddled shape. Pakistan's trade deficit stood at recorded high level of US$ 16.8 billion during July- April 2008, which is 37.8 percent higher then the annual trade deficit target.

Pakistan's current account deficit and balance of trade are in tatter profile and desperately need a prudent trade policy. In this endeavour, empirical work can help greatly in formulating trade policy.

The structure of this paper is organized as follows: the next section discusses the literature review. Section III provides model specification Section IV deals with empirical results. Last section presents conclusion and policy implications.

II- Literature review

There is a vast body of literature devoted to the import demand function. Here we review some of major research work done by different scholars.

Afzal (2001) estimated the import demand function for Pakistan by using OLS and TSLS techniques on the annual data for the period of 1960-99. His results show that the signs of the price

coefficient and income coefficient were as expected but price coefficient was insignificant.

The work of Bahmani-Oskooee (1998) examines the import demand functions of 30 countries through the aggregate model by using the Johansen-Juselius (JJ) co-integration tests (Johansen 1988; and Johansen 1990). Annual data is used and the sample period of each individual country is mostly 1960-1992. Fourteen countries are found to contain one co-integrating vector and 12 of them are found to contain two co-integrating vectors. In most cases, the price elasticities and income elasticities are high.

Dutta and Ahmed (1999) used Engle-Granger's (1987) and Johansen's multivariate approaches to estimate the aggregate import demand function for Bangladesh using quarterly data from 1974 to 1994. Their study found that Bangladesh's aggregate import demand and its determinants were co-integrated. Similarly Dutta (2001) use the aggregate import demand function to investigate the behavior of India during the period 1971-1995. Johansen (1988 and 1991) and JJ (Johansen 1990, 1992 and 1994) co-integration tests are employed to obtain the relevant co-integrating vectors. In addition, the respective ECM is estimated by the general-to-specific procedure (Hendry 1995). One co-integrating vector is detected and then incorporated in the ECM. The aggregate import volume is rather price inelastic with coefficient estimate being -0.47. The value of income elasticity of demand for imports of two-year lag is greater than unity at 1.48, implying that the import demand changes more than proportionately to the changes in real GDP.

Hafeez (2007) estimated the aggregate import demand function for Pakistan by employing Johansen and Juselius co-integration technique on the annual data for the period of 1975-2005. The results show that there is long –run relationship among variables and the stability test indicate that import demand function remains stable over the sample period.

Islam and Hassan (2004) estimated the aggregate import demand function for Bangladesh using quarterly time series data. They applied the Johansen and Juselius multivariate co-integration technique. Their results indicate that import demand function is

mainly determined by income and relative prices. The income elasticity was positive and greater than unity showing that imports are 'luxury' goods. The coefficient of relative prices is negative but less than unity; means Bangladesh imports are not much sensitive to prices.

Kotan (1999) applies two econometric methodologies to perform the estimations during the period of 1987Q1-1999Q1. The first estimation uses the Engle-Granger two-step co-integration procedure, which shows that in the long run, income level, nominal currency depreciation rate, inflation rate and international reserves significantly affect imports. In the short run, however, inflation and international reserves lose their significant impacts on imports. The second methodology estimates the import demand by using the Bernake-Sims structural Vector Auto regression (VAR) method. It indicates that anticipated and unanticipated changes in the real currency depreciation rate, and unanticipated changes in the income growth, have significant effects on import demand growth.

Mohammad (2000) examine the long-run relationship between Malaysian real imports and the underlying components of final demand expenditure - namely real final consumption expenditure, investment expenditure and exports - and relative prices during 1970-1998 via Johansen multivariate co-integration analysis (Johansen 1988; and Johansen 1990). An ECM is estimated to evaluate the short-run responses of imports to its determinants. Only one co-integrating vector is found and it implies that the partial elasticities of import demand with respect to consumption expenditure, investment expenditure and exports are 0.72, 0.78 and 0.385 respectively. The import price is fairly inelastic (at -0.69). In estimating the ECM, the speed of adjustment implied by the one-period lagged ECT is -0.637, which is quite fast. The specification of the ECM dropped out the effect of final consumption expenditure as its effect is statistically insignificant to imports.

Rijal, Koshal and Jung (2000) estimated an aggregate import demand function for Nepal based on an annual series from 1968 to 1997. They applied the unit root test and Johansen-Juselius (1990) multivariate co-integration analysis. The results showed

that real imports, real income, import price index and domestic price index were non stationary but co-integrated. A partial adjustment mechanism showed that Nepalese import was inelastic with respect to its own price and cross-price, both in the short-run and the long-run. The Nepalese long-run import demand was found to be income elastic.

Shabbir and Mahmood (1991) analyzed the stability of the import demand function for Pakistan. They applied the maximum likelihood-based switching regression technique to examine the timing and nature of the structural change. Their conclusion was that both income and price elasticities were altered during end 1971-beginning 1972. The study of Sinha's (1997) finds one co-integrating vector in Thailand's aggregate import demand function using Johansen's multivariate procedure for the period 1953 to 1990. The study found that Thailand's aggregate import demand was price inelastic (-0.77) and cross-price inelastic (0.3) but highly income elastic.

Tuck Cheng Tang (2002) estimated the long-run relationship between Indonesia aggregate import demand and its determinants by using bounds test. The results revealed that import volume, real income and relative import prices are co-integrated.

III- Model Specification, Data and Empirical Results

The traditional aggregate import demand function relates the quantity of imports demanded to domestic real income and the relative price (i.e. the ratio of import prices to domestic prices).The standard mathematical form of import demand function can be stated as:

$$M_t = f(Y_t, RP_t) \qquad (1)$$

Where M_t is the quantity demand of import at period t, Y_t is real domestic out put (GDP), and RP_t is a relative price (that is the ratio of import price index to domestic price level).

In this paper, we follow the formulation for import demand function suggested by Doroodian at al. (1994), Gafar (1988), and

Tang (2002)[§§§].The log-linear specification for import demand function is as follows:

$$LnM_t = \beta_0 + \beta_1 LnY_t + \beta_2 LnRP_t + \mu_t \quad (2)$$

Where $\mu_t \sim N(0,\sigma^2)$, and the expected signs for coefficients are: $\beta 1>0$; $\beta 2<0$

The sample period used in the study covers the annual data from 1972 to 2006. The raw data are obtained from World Development Indicators, International Monetary Fund's International Financial Statistics 2007, and the various Statistical Bulletin of the State Bank of Pakistan. The quantity demand of import is nominal imports of goods and services deflated by import price index, nominal GDP is deflated by GDP deflator to use as a real income variable, and the relative import price variable is the ratio of import price to domestic price (i.e. GDP deflator).All implicit price indexes are based on 2000 prices.

Unit Root Analysis

The pre-requisite of the co-integration analysis is to determine the level of integration, I (d) for all the concerned variables, as Bound test procedure cannot be applied for the variables integrated of order greater than one[****]. However, the basic requirement for the bounds test is the stationarity of the dependent variable at first difference. In this study, as stated above, the underlying variables are import volume, real income, and relative price. The Augmented Dickey Fuller (ADF) test and Philip-Perron (1988), tests applied to check the integrating order of each variable. The results are reported in table (1)

[§§§] These studies regarded the log-linear function as more appropriate for the traditional import demand function as this form outwit some estimation problems such as multicollinearity.

[****] For further details see Abbott et al.(2001)

Table - 1 Unit Root Tests

Variables	ADF test		PP test		Results
$Ln(M_t)$	-1.2416	(0)	-2.146	(3)	Non-stationary
$\Delta ln(M_t)$	-4.1936*	(1)	-5.134*	(3)	Stationary
$ln(Y_t)$	-1.6391	(1)	-1.452	(3)	Non-stationary
$\Delta ln(Y_t)$	-3.547*	(1)	-5.0548*	(3)	Stationary
$ln(RP_t)$	-2.223	(1)	-2.3064	(3)	Non-stationary
$\Delta ln(RP_t)$	-6.973*	(1)	-6.8354*	(3)	Stationary

Note: The results of above table achieved by the performing ADF and PP tests by using E-Views 5.1.

The above results are reported of the unit root equation that does not include constant and trend. ( ) is lag value for the both tests.

[b] MacKinnon critical values for rejection of hypothesis of a unit root at 1 %, 5 % and 10 % levels respectively are -3.49, -2.89 and -2.58.

* indicates that the variable is significant at 5 % level.

The perusal of the results of the ADF and PP unit root tests reveal that all the relevant variables are stationary at first difference, hence integrated of order one.

In order to perform co-integration analysis for the equation (2), we employed the Bounds test approach (i.e. ARDL) developed by Pesaran et al.(2001).This approach is modern induction in the field of time series econometrics as compare to the conventional co-integration analysis approaches such as Engle-Granger(1987) and Johansen's multivariate (Johansen, 1988; and Johansen and Juselius, 1990). The bounds test approach is superior than the, above stated, conventionally approaches for two main advantages. Firstly, the bounds test is appropriate for small sample size studies [as pointed out by Tang and Nair (2002), Fosu and Joseph (2007)].As our study sample size is limited with a total of 34 observations only, this approach seems to be more appropriate. Secondly, this approach performs well regardless of the integration orders of the explanatory variables as far as the co-integration order is not greater than one and the dependent variable is integrated of order one ,I(1). Though according to Enders (1995) the forms of Johansen test can detect different orders of

integration, but it is prudent not to mix up the variables having different co-integration orders especially in the presence of more robust approach i.e. the bounds test (ARDL).

In order to explore the long-run equilibrium relationship among the variables in aggregate import demand equation (2), an unrestricted error correction model (UECM) can be specified to apply the bounds test procedure as follows:

$$\Delta \ln M_t = \beta_0 + \beta_1 \ln M_{t-1} + \beta_2 \ln Y_{t-1} + \beta_3 \ln RP_{t-1} + \sum_{i=0}^{p} \phi \Delta \ln M_{t-i}$$

$$+ \sum_{j=0}^{q} \gamma_j \Delta \ln Y_{t-j} + \sum_{m=0}^{r} \varphi_m \Delta \ln RP_{t-m} + \mu_t$$

(3)

Where, all variables are same as defined earlier. The bounds test approach can be performed in the followings steps. Firstly, we estimate equation (3) by ordinary least square (OLS) method. As proposed by Pesaran at al. (2001), the bounds test is based on the Wald-test or F-statistics for co-integration analysis. The existence of co-integration can be detected by carrying out F-statistic for the joint significance of the coefficients of the lagged levels of the related variables. In other words, the null hypothesis in our case i.e. Ho: $\beta_i=0$ for all i where i=1, 2, 3 .The alternative hypothesis is H_1: $\beta_i \neq 0$ for all i where i=1, 2, 3. The asymptotic distribution of the F-statistic is non-standard for the null hypothesis of no co-integration relationship among the concerned variables, and depends upon: the co-integrated orders of the variables under consideration; the number of explanatory variables in the system; and whether ARDL model includes an intercept/trend.

Given the number of explanatory variables, if all variables are integrated in order, I (0) then the critical values approach to minimum/lower bound and if they are integrated in order one, I(1), then the critical values move to a maximum/upper bound. If the computed F-statistic is lower than minimum/lower bound, then we cannot reject the null hypothesis of no 'integration. On the other hand, if the computed F-statistic is greater than upper/maximum

bound, then the null hypothesis of no co-integration can be rejected However, the results become inconclusive about the co-integration relationship when the computed F-statistic lies between the lower and upper bounds.

The second step begins assuming that there is long-run co-integration relationship among the relevant variables, which is also confirmed by bounds test in our case; we can obtain the long-run elasticities. The long-run elasticities are the coefficients of the one lagged independent variables divided by the coefficient of the one lagged dependent variable (multiply by negative).Thus, in our case, the long-run income and price elasticities are $-(\beta 2/\beta 1)$ and $-(\beta 3/\beta 1)$, respectively. The short-run elasticities are obtained from the coefficients of the first difference variables from UECM model in. equation (3).

IV - The Empirical Results

In order to choose an appropriate lag length for the UECM, a set of UECMs was estimated using different lags. The lags length is selected on the basis of Schwarz Bayesian Criteria (SBC) and Akaike Information Criterion (AIC).We adopted maximum two lags in our case as proposed by Pesaran and Shin (1999).[††††] The residuals are white noise and normally distributed (based on the Q-statistics and Jarqque-Bera test).A parsimonious specification of the UECM is presented in the estimated equation (4).[‡‡‡‡]

Furthermore, we check the stability of the import demand function and applied a battery of diagnostic tests in this regard. The Breusch-Godfrey LM test demonstrates no indication of serial correlation. No evidence of autoregressive conditional heteroskedasticity (ARCH) was confirmed by ARCH Lm test. Ramsey's RESET test validates the functional form used in the study. The plots of CUSUM of squares and CUSUM (in figure 1) renders that the estimated parameters of equation (4) are robust

[††††] Some other authors such as Charemza and Deadman (1992) suggested maximum three lags for annual data case.

[‡‡‡‡] Here we follow the general to specific approach in quoting the results presented in the box 1 for the estimated equation (4).

over the sample period. The results of the estimated (4) are presented in the box 1.

Box – 1 The Results of the estimated equation (4) and stability tests

ΔLnM_t=1.76 -	0.970ΔLn M_{t-1}+0.59ΔLn Y_{t-1}-0.041ΔLn RP_{t-1}+0.62ΔLnY_t		
(3.63)	(-4.58*)	(4.52*)	(-2.38*)
(1.26)			
+1.756ΔLnY_{t-2}-		0.039ΔLn	RP_t
(4)			
(3.67)	(-2.75*)		
*indicates significant at 5%.			

R-squared: 0.89	Adjusted R-Squared: 0.79
Sum square Residual 0.02	Q-statistics(20) white Noise
Jarque-Bera 0.89(0.63)	F-statistic 9.046(0.000)
Breuch-Godfrey Serial correlation LM test(1) 2.89 0.12 (2) 1.67(0.248)	
ARCH Test [1]: 0.021(0.884) [2] 0.23 (0.79)	
Ramsey RSET Test [1] 0.47(0.50) [2] 0.41 (0.67)	

Note: The above all results obtained by estimation of equation (4) and applying different econometrics tests on the estimated results as explained in the text. All the estimation procedure is done by E-Views 5.1.

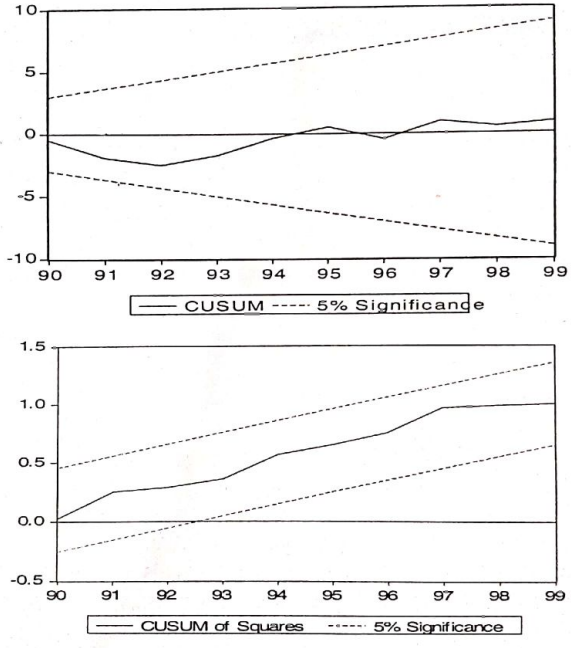
The stability of any function is very crucial over the sample period for the efficacy of any policy .The stable import demand function is a symptom of efficient trade policy in any economy. To examine the stability of import demand function we carried out CUSUM and CUSUM of squares (Brown, et.al, 1975) tests.[§§§§]

Figure 1 demonstrates that import demand function is stable over the sample period because the cumulative sum does not go away the area between two critical lines. The CUSUM of

[§§§§]We also performed the recursive coefficients test and found that import demand function is stable over the sample period. The results are not reported here.

squares Test is based on the test statistic[*****].The diagram shows that residual variance is stable over the sample period as cumulative sum of square remain inside the critical lines. So, all results provide the evidence of the stability of import demand function in case of Pakistan over 1972-2006.

Figure - 1 Description of Cumulative Sum (CUSUM) test



In order to determine the existence of a long-run relationship among the relevant variables in the equation (2), the F-statistic (Wald test) for the bounds test (Pesaran at al, 2001) was

[*****] For further details about the significance of lines, see Brown, Durbin and Evan(1975)

obtained. The computed F-statistics obtained from the Wald test for restrictions imposed on the parameters are presented in table-2. According to the computed F-statistics we can reject the null hypothesis of no cointegration at 1% level of significant for import demand model.

The computed F-statistics $F_M(M/Y, RP) = 8.133$, that is higher than the upper bound critical value of 5.52 at the 15 significance level. This demonstrates that the alternative hypothesis of the existence of a unique cointegration relationship between imports demand and its determinants can be accepted in case of Pakistan. So there is room to say that in import demand model, import demand, real income and relative price have long-run relationship or they are cointegrated for long-run period.

Bounds Test for Cointegration Analysis

F-statistic(Wald test): 8.133* (for H_0:$\beta_1=\beta_2=\beta_3=0$)			
Critical bounds value	1%	5%	10%
Lower bounds, I(0)	4.41	3.79	3.17
Upper bounds, I(1)	5.52	4.85	4.14

(Critical values Drawn from Pesaran et al (2001), p.300 Table case III: unrestricted and no trend (k=2)

* indicate rejection of the null hypothesis at 5% significance level.

We obtained the long-run and short-run elasticities for income and relative through ECM procedure, the results are presented in table 4. Both of the long-run estimated elasticities have the expected signs and are significant at 5% level. The positive sign of the real income elasticity reveals the positive relationship between real income and import demand in the long-run .In other way, we can say that if real income increases import demand over the period also increases and vice versa. The magnitude of the import demand elasticity exhibits inelastic trend, which shows that the most of the imports goods can be regarded as necessary goods for the economy. Another crucial point to be noted, that short run elasticities are insignificant and lesser than the long-run elasticities for both variables. These phenomenon exhibits

that in short run imports in Pakistan are not influenced by the real income and relative price.

Table 4 Short-run and Long-run elasticities

Variables	Short run elasticity	Long-run elasticity
Real income	0.189 (0.24)	0.613 (4.52*)
Relative price	-0.021 (-1.49)	-0.042 (-2.38*)

The above results are obtained through ECM procedure, all the estimation process have been carried out by E-Views 5.1
t-values are in parenthesis,* denotes 5% level of significance

V- Conclusion and Policy Implications

This study empirically examines the traditional import demand function in case of Pakistan using the annual data from1972-2006.We employed the newly developed time series approach, Bounds test(ARDL), to examine the long-run relationship among import demand and its determinants; real income, relative price(ratio of import price to domestic price).Short-run elasticities are estimated using Error Correction Model(ECM).In order to check the stability of import demand function we carried out different diagnostic tests.

The estimated results of Bounds test shows that import demand, real income and relative price are cointegrated over the sample period. In other words, there is a room to state that long-run relationship exists among the relevant variables in our case. Furthermore, on the basis of stability tests outcome, import demand function is stable over the sample period.

The estimated long-run elasticities have signs with the accordance of the economic theory. Long-run elasticity of real income is inelastic that gestures that imports in Pakistan can be regarded as necessary goods.

The stability of the import demand function suggests that the trade policy is appropriate for the economy of Pakistan.

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