An Estimation of Disaggregate Import Demand Function for Pakistan

by

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Abstract

Import is an actually most important variable of an open economy. It would be meaningful to explore the determinants causes change in import demand. The researchers have mainly used the import model in two ways i.e. aggregate import demand function and disaggregate import demand function. The present study purpose is an estimation of disaggregate import demand function by using two alternative co-integration approaches, namely Engle-Granger and Bound tests. The tests were conducted to investigate the consistency of long run parameters between import demand and it's determinants for Pakistan during the period of 1981 to 2009. Prior the testing for co-integration, ADF and PP tests confirmed that all of the variables are stationary at their first differences. The results from co-integration show the presence of long run relationship in import demand and its determinants regardless of estimation methods. The estimated long run elasticities of import demand with respect to consumption expenditure, investment expenditure, export expenditure and relative prices are range over (0.40, 0.38), (0.57, 0.77), (-0.17, -0.26) and (-0.53, -0.59) using Bound and EG procedures respectively. The results are first, distributed consistently across the two different long run tests conducted. Second, the effects of expenditure components are different on aggregate import demand in Pakistan. The import demand is highly sensitive to investment expenditure component followed by consumption expenditure and less sensitive to the expenditure on export in the long run. This study is newish in Pakistan import demand analysis considering expenditure components of national income. Thus, the elasticities results for expenditure components give a hand the policy makers in managing trade balance in Pakistan.

Keywords: Aggregate Import Demand, Disaggregate Import Demand, Consumption Expenditure

1 Introduction

Import is an actually most important variable of an open economy. It would be meaningful to explore the determinants causes change in import demand. The researchers have mainly used the import model in two ways i.e. aggregate import demand function and disaggregate import demand function. The traditional aggregate import demand function treats imports as a function of relative prices and domestic income. Ajayi (1975) estimated Nigeria's aggregate import demand and found that relative prices and domestic income were important determinants of the demand for Nigeria's import. Recently, to avoid from an aggregation bias and estimate in separate for the effect of expenditure component of national income in aggregate import demand, researcher prefer the use of disaggregate import demand function over the traditional aggregate demand function of import. Fosu et al (2008) using disaggregates import demand function for Ghana, to test for the behavior of import demand during the period of 1970-2002. Their study found that the effects of relative price was not sensitive, however the investment and expenditure components of national income were of the major determinants of imports in the long run and the public versus private expenditure component were in the short run.

As for as Pakistan is concerned various studies have empirically investigated the demand function for import. For example, Rehman (2007) investigated the behavior of Pakistan aggregate import demand for the period of 1975 to 2005. Using co-integration technique, he found that the import demand is co-integrated with relative price and domestic income. More recently Rashid and Razaq (2010) by applying alternative econometric approach investigated the aggregate import demand during 1975-2008. They in study also support for the existence of long run relationship among the import volume and relative price as well as domestic income. However these studies and that of Shabbir and Mahmood (1991) all use domestic income as explanatory variable rather than expenditure components in separate.

Therefore, to examine the relationship between aggregate import demand and aggregate economic activity on disaggregate basis in Pakistan and thereby lessen the research deficit in this area. According to our recognition this study would be the first that divided domestic economic activity into expenditure components as, consumption expenditure, investment expenditure and expenditure on export, and estimate its effects in separate on import demand for Pakistan over the period of 1981 to 2009 by using two alternative method of estimation for co-integration Engle Granger test and Bound test. In section wise the remainder of this study is classified as follows. The next section Two discusses the more relevant literature studies. Section Third presents modeling a disaggregate import demand function for Pakistan. Section Four; assign the econometric techniques and data set used in the study while the empirical findings are presented in section Five. In the last, Section six consist of summery and conclusion.

2 Disaggregate Import Demand in Literature

In conventional import demand, researcher viewed that change in import demand is due to change in domestic income and relative prices of import (Faini et al, 1988). Now the researcher treats expenditure components in import demand as explanatory variables rather than domestic income. There are numerous studies that have observed disaggregate import demand but here we review some of these that are most closely relevant to our analysis.

As, Abbott and Siddighi (1996) examined import function for UK using time series analysis, and disaggregate expenditure component, and shows that consumption expenditure had the larger impact on import demand than investment and export expenditures.

Mohammad and Tang (2000) used a co-integration approach to estimate the long run relationship between Malaysian import demand and its major determinants for the period of 1970 to 1998. Their results indicate that the partial coefficient for all variables is statistically significant. Where, investment and consumption expenditure have some more effects on import demand i.e. 0.78 and 0.72 respectively than that of export which is equivalent to 0.385. The elasticity of import price found -0.69 that is negative and inelastic.

Tang (2003) has evaluated the disaggregate import demand function for Bangladesh using bounds test approach to long run relationship during the period 1965 to 1998. He found as relative price effect as theory predict but the effects is so weak as equal to -0.25 and significant only at 10 percent level. However in expenditure components, expenditure on export found a key determinant of Bangladesh import demand in the long run with coefficient of value 1.19. Moreover in their study each component has proved statistically significant and different in their effects on import demand in Bangladesh.

Ho (2004) examined the import demand function of Macao using quarterly data for the period of 1970-1986. His study diagnosed the two popular models; (1) aggregate import demand and (2) disaggregate import demand in more illustrative way. Using Johansen Juselius co-integration tests, his study found that co-integration exists and disaggregate model is more appropriate to explain the import demand of Macao. In disaggregate import demand the partial elasticities stand as, export (1.148), investment (0.1396) and relative prices (-0.3041).

Fosu and Magnus (2008) used bound test to carry out the estimation of Ghana's disaggregate import demand function for the period of 1970-2002. The results shows that in the long run, expenditure on investment and export significantly affect imports demand of Ghana. In the short run, however investment and export lose their value and government consumption expenditure highly effect import demand. The relative price effect import demand negatively but statistically insignificant.

Guncavdi and Berc (2008) tested reduced import demand model using quarterly data for the Turkish economy during 1987-2006. Their study examined the role of macroeconomic components of aggregate expenditure in determining import demand. They found that there exist a long run relationship between aggregate imports and the main component of final expenditure and a relative price variable. Moreover consumption expenditure appear a major determinant of the Turkish import in the long run, followed by exports and investment expenditure, while relative price elasticity of demand for imports seems to possess the second largest effect on the demand for imports.

More recently, Constant et al (2010) derived a disaggregate import demand function for Cote d'Ivoire using annual data for the period 1970 to 2007. They run a method of autoregressive distributed lag model to capture the effect of various expenditure components and import prices on import demand. The results indicate that relative price effect import demands negatively while the expenditures activities positively but the effects are not more elastic or inelastic. As in the long run, elasticities of final consumption expenditure, export expenditure and investment expenditure estimated as 0.65 percent,

0.49 percent and 0.19 percent respectively. In these key determinants the coefficient of export expenditure is significant at the 1 percent level while of relative price is not statistically significant.

3 Model Specification Of Import Demand Function

Goldstein and Khan (1985) in their study have specified two trade models, one is perfect substitute model and another is imperfect substitute model. In modeling import demand for Pakistan, here follows imperfect substitute model, in which the major assumption is that neither imports nor exports are perfect substitutes for the domestic goods of a country under consideration i.e. at the same time country is functioning as exporter and importer. Conversely in perfect substitute model assume that country is either exporter or importer. In addition to farmer case, Pakistan's demand for import is relatively a small fraction of the rest of the world imports, here to make the assumption that the supply of world imports to Pakistan is perfectly elastic may not be unrealistic. Further, an increase in prices could not hinder the supply of export to a small country like Pakistan.

On the basis of these assumptions, the standard demand function of import postulates that the import demand is determined by relative prices and domestic income level. To study the relationship between import demand and its conventional determinants, the model of import demand is clearly expressed in term of relative prices and domestic income by [Sinha and Sinha (2000), Chang et al (2005), Dutta and Ahmad (2006) and Shareef and Tran (2007)]. In formal term the model could be write as,

$$M_t = f\,(MP_t/DP_t)^{\eta},\ Y_t^{\varepsilon} \qquad (1)$$

By taking log, this equation first can be articulated in log-linear form as;

$$\ln M_t = a + \eta \ln RP + \varepsilon \ln Y_t + \mu_t \qquad (2)$$

This log-linear equation provides a best framework to represent the analysis of import responsiveness to changes in domestic income and relative prices of import.

Where: M_t = Real Import, RP = Relative Price
Y_t = domestic real income, μ_t = Error term

The relative price is import price (MP_t) deflated by the domestic price (DP_t), η and ε are relative prices and income elasticities of import demand respectively. In elasticities, η is expected to be negative because other things remaining same, the higher import price than the price of a similar good produced domestically, the lower is the demand for import. Therefore relative prices are expected to be negatively related to import demand. On the other hand, ε is assumed to be positive because other things remaining the same, the increased domestic income will increase the demand for goods that Pakistan imported. Thus, domestic income sees to be positively related with import demand.

However, the studies of Tang (2003), Fosu and Magnus (2008), Constant and Yue (2010) substitutes the components of total expenditure for the scale variable of domestic economic activity in aggregate import demand to analyze for the effects of isolated expenditure components by disaggregating. Therefore, the present study also makes the same major modification to the basic import demand function, divide the domestic income into its expenditure components i.e. consumption, export and investment expenditure, and specify an estimable disaggregate import demand for Pakistan as follows;

$$\ln RM_t = a + \eta \ln RP_t + \varepsilon_1 \ln RCon_t + \varepsilon_2 \ln RInv_t + \varepsilon_3 \ln RExp_t + \mu_t \qquad (3)$$

Where, M_t and RP_t have already familiarized, while RCon is real consumption expenditure, RInv is real investment expenditure and RExp is real export expenditure. The signs for the coefficients of expenditure components are assumed to be positive i.e. ε_1, ε_2 and $\varepsilon_3 > 0$.

4 Estimation Techniques and Data Set

In this study, we are going to use two alternative techniques to estimate the import demand function for Pakistan. In the beginning, the two steps conventional approach for co-integration, Engle-Granger (EG) approach is applied. First, the EG need to test unit root for every series of the model. Second, EG tested the residuals obtained from the basic model of import demand, for order of integration. Next we apply a more recent approach to the co-integration Autoregressive Distributed Lag Model (ARDL) developed by Pesaran et al (2001), which is also known in the literature as bounds testing approach. As commonly enlightened in previous studies (Fosu and Magnus; 2006, Constant et al; 2010), a bound test has some effectiveness than other multivariate co-integration approaches. First, bound test carried out estimation irrespective of the pre unit root test of the variables used in the model. Second, it does not exclude OLS technique to estimate the long run relationship once the lag length is identified in the model. Third, in contrast to the conventional procedure of co-integration, the use of bound test is more suited in a small set of data.

The study used annual data for estimation purpose due to the lack of availability of quarterly data for the desired variables in any accessible sources. In addition, Hakkio and Rush (1991) investigated that the increase in time span is more robust than the increase in number of observations by exercising monthly or quarterly data in co-integration analysis. The time period cover some thirty years from 1980 to 2009. The data were obtained from various issues of Pakistan Economic Survey, State Bank of Pakistan annual reports and a Hand Book of Statistics 2005 (SBP). All nominal variables were transformed into real variables. Real import was derived by dividing nominal imports of goods and services on import price index[a]. The variables for expenditure components were based on 2000-01 prices and deflated by domestic price index i.e. GDP deflator to get its real value.

5 Empirical Results And Discussions

Prior to the estimation of long run effects of expenditure components and relative prices on our's imports volume, initially conduct a test for knowing unit roots of each variable i.e. ADF (Augmented Dickey Fuller) and PP (Phillip Perron) tests. Both the tests are performed on level and at the first difference for all of the variables. Where the results are in table 1 and table 2:

Table 1 reports ADF tests (none, with intercept, and with trend and intercept) at level and first difference for the series of (LRM, LRCon, LRInv, LRExp, LRP) and affirmed that all the series are non-stationary at integrated zero order I (0) and stationary at integrated first order I (1). In similar fashion the results of PP tests are given in table 2 and reveals unit root for all the series in levels. More interestingly, however, like ADF tests PP tests also confirm stationarity for all variables after their first differences. Thus both the tests show that the variables have I (0) at first differences.

Table 1 ADF Unit Root Tests for Stationarity

Variables	*Levels/1st Diff:*	*Test Statistics*		
		None	***Intercept***	***Intercept and Trend***
LRM	Level	2.4359	-0.4817	-3.7716
	1st Difference	-2.9904*	-3.2874**	-3.1278
LRCon	Level	6.8956	0.0768	-2.1864
	1st Difference	-2.5679**	-5.3357*	-4.2655**
LRInv	Level	2.9231	-0.5799	-2.1908
	1st Difference	-3.4244*	-4.1678*	-4.0350**
LRExp	Level	3.0487	-1.2798	-1.3239
	1st Difference	-4.2332*	-6.3141*	-7.2531*
LRP	Level	1.8895	0.0802	-2.4689
	1st Difference	-4.6056*	-5.1939*	-5.2025*

Notes: (a). EViews5 were used to test for Unit Roots (b) L stand for Log
(c) * represent 1 % level of significant and ** represent 5 % level of significant.
(d) -2.6534, -1.9538 (None), -3.6998, -2.9763 (Intercept) and -4.3393, -3.5875 (Intercept and Trend) are critical values at 1 % and 5 % level of significance respectively.

[a]. The unit value of imports is used as an import price index, the base year of whom is 1990-91 different than the base year of GDP deflator

Table 2 PP Unit Root Tests for Stationarity

Variables	*Levels/1st Diff:*	*Test Statistics*		
		None	***Intercept***	***Intercept and Trend***
LRM	Level	2.2029	-0.4817	-1.6439
	1st Difference	-2.9485*	3.2863**	-3.1265
LRCon	Level	20.9392	0.8707	-2.1334
	1st Difference	-2.5512**	-6.3119*	-9.1007*
LRInv	Level	7.2992	-0.4256	-2.1678
	1st Difference	-3.4244*	-4.1145*	-3.9772**
LRExp	Level	3.2837	-1.3227	-1.2164
	1st Difference	-4.2767*	-6.1754*	-7.5131*
LRP	Level	3.7194	0.8398	-2.4913
	1st Difference	-4.6056*	-5.2482*	-5.2628*

Notes: (a) EViews5 were used to test for Unit Roots
(b) * represent 1 % level of significant and ** represent 5 % level of significant.
(c) -2.6534 (None), -3.6998 (Intercept) and -4.3393 (Intercept and Trend) are critical values at 1 % level.
(d) -1.9538 (None), -2.9763 (Intercept) and -3.5875 (Intercept and Trend) are critical values at 5 % level.

The next stair is to operate the co-integration tests namely, the Engle Granger (EG) test and Auto Regressive Distributed Lag (ARDL) test. In the beginning conduct EG test that involves two steps. First, to test for long run relationship, estimating equation (3) in OLS and the estimated coefficients are following:

$LRM_t = -0.0772 - 0.5917\ LRP_t + 0.3841\ LRCon_t + 0.7703\ LRInv_t - 0.2631\ LRExp_t$ (4)

T-statistics =	(-2.5328)	(2.0114)	(4.3486)	(-2.9715)
P-values =	(0.0183)	(0.0556)	(0.0002)	(0.0066)

Now in step two, assess for stationarity of the residuals from estimated equation (4) by testing ADF and PP tests continually. Where, the ADF test statistics with their probability is -3.3835 and 0.0015 respectively. The alternative hypothesis of no unit root accepted with 1 % level of significance. Likewise, PP test statistics is -3.0755 with their probability of 0.0034, and rejected null hypothesis with acceptance of alternative hypothesis at 1 % level. It is concluded that both the test reject the existence of unit root in the residuals at level. Further, it ascertain the long run relationship between aggregate real import demand and its major determinants i.e. expenditure components and relative prices in above estimated equation (4).

Further, to strengthen the evidence of long run relationship between import demand and its determinants in equation (3) using another approach namely bound test. Where to test for co-integration using bound test, the preliminary step is estimation of an UECM. By using annual data for small sample, different lag lengths were included in the UECM. The final lag length is specified on the basis of minimum value of Schwartz Bayesian Criteria (SBC). This led us to the following specific UECM:

$$\Delta LRM_t = \beta_0 + \sum_{i=1}^{2} \beta_1 \Delta LRM_{t-1} + \beta_3 \Delta LRP_{t-1} + \beta_4 \Delta LRCon_{t-2} + \beta_5 \Delta LRInv + \beta_6 \Delta LRInv_{t-1}$$
$$+ \beta_7 \Delta LRExp + \beta_8 LRM_{t-1} + \beta_9 LRP_{t-1} + \beta_{10} LRCon_{t-1} + \beta_{11} LRInv_{t-1} + \beta_{12} LRExp_{t-1} + \varepsilon_t \quad (5)$$

The results for this final estimated UECM is represented in table 3.

Table 3 The Estimated Specific UECM for Pakistan's Total Import Demand

Dependent Variable: ΔLRM
Method: Least Square
Sample (Adjusted): 1984 2009
Included Observation: 26 after adjustments

Variables	***C0-efficients***	***t-statistics***	*p-values*
ΔLRM_{t-1}	*0.7462* (β_1)	*3.3281*	*0.0054*
ΔLRM_{t-2}	*0.6840* (β_2)	*3.350*	*.0052*
ΔLRP_{t-1}	*0.3819* (β_3)	*1.5944*	*0.1349*
$\Delta LRCon_{t-2}$	*-0.6512* (β_4)	*-2.3047*	*0.0383*
$\Delta LRInv$	*0.3817* (β_5)	*3.0949*	*0.0085*
$\Delta LRInv_{t-1}$	*-0.3301* (β_6)	*-1.8445*	*0.0880*
$\Delta LRExp$	*-0.4982* (β_7)	*-3.0387*	*0.0095*
LRM_{t-1}	*-1.0402* (β_8)	*-4.7348*	*0.0004*
LRP_{t-1}	*-0.5467* (β_9)	*-1.7855*	*0.0975*
$LRCon_{t-1}$	*0.4186* (β_{10})	*2.5064*	*0.0263*
$LRInv_{t-1}$	*0.5882* (β_{11})	*2.4070*	*0.0317*
$LRExp_{t-1}$	*-0.1808* (β_{12})	*-1.7804*	*0.0984*
Constant	*0.7294* (β_0)	*1.0222*	*0.3253*

Note: L stand for log, and Δ denote difference.
R-square: 0.8042, Adjusted R-square: 0.6235
F-statistics: 4.4508 (Prob: 0.0060)
RESET Test [1]: 0.5221 (Prob: 0.4699), [2]: 2.4561 (Prob: 0.2928)
LM Test: 4.2232 (Prob: 0.0435)
Jarque-Bera test: 1.3226 (Prob: 0.5161)

The diagnostic tests are also reported below the table 3, where R-square shows explanatory power up to 80 % and F-statistics indicates the significance of all parameters below at 1 percent. Moreover the value of LM-test suggests for an absence of the problem of serial correlation, Jarque-Bera for non normality and RESET test for the nonexistence of misspecification error in the model. In short, these estimated tests disclose that our model is correctly specified.

The UECM did not report directly for the existence of long run relationship. Therefore, to test for the presence of a co-integration between the variables in Pakistan's import demand function, here proceed through estimated UECM using F-test. Where the F-statistics (Wald-test) test for the null hypothesis of H_0: $\beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = 0$, that the coefficients of level lagged variables are equivalent to zero (i.e. no con-integration) against the alternative hypothesis of H_1: $\beta_8 \neq \beta_9 \neq \beta_{10} \neq \beta_{11} \neq \beta_{12} \neq 0$ (i.e. co-integration). The calculated F-statistics is 5.7457 with p-values of 0.0052 that provides enough evidence to reject the null hypothesis of no co-integration and accept the alternative hypothesis of co-integration between Pakistan's total import demand and its explanatory variables [b]. This is consistent with the results of EG approach. Thus, following the results reported in table (3), the long run elasticities in equation (3) was estimated as [c]:

$$LRM_t = .7012 - 0.5256LRP_t + 0.4024LRCon_t + 0.5655LRInv_t - 0.1738LRExp_t \quad (6)$$

The results in equation (5) show that the long run coefficients of relative prices, consumption expenditure and investment expenditure have their expected sign. However, the coefficient of export expenditure is in against of their expected sign. Further, it is obvious that the effects of expenditure components are different on aggregate import demand in Pakistan. The import demand is highly sensitive to investment expenditure component followed by consumption expenditure and less sensitive to expenditure on export in the long run.

Finally, to compare the results of equation (4) and (5) that has estimated by using two different estimation techniques of co-integration. Here for simplicity the results are summarized in table 4 below:

Table 4 Long Run Elasticities under Alternative Estimation Techniques

Dependent Variable: LM

Variables	***EG-Procedure***	***UECM-Procedure***
LRP	-0.5917	-0.5256
LCon	0.3841	0.4024
LInv	0.7703	0.5655
LExp	-0.2631	-0.1738

The results in table 4 enable us to compare the long run parameters of import demand derived under alternative procedures. The similarity is that sign of coefficients are in the same magnitude. The consumption and investment expenditure components are positively related with import demand regardless of estimation methods. While the coefficients of relative prices and expenditure on export is negatively related with import demand. Moreover, the long run elasticities of two explanatory variables, the consumption component and the relative prices are found to be the main determinants of total import demand in Pakistan. Conversely, the differences are that the overall elasticities are higher in the EG-procedure than in the UECM. But the differences are no more significant in the coefficient estimates. This may be due to rounding errors because of using different techniques. More specifically the differences are marginal in equation 4 and 6 estimation, where EG procedure are used to get directly equation 4 rather than prior estimation of short run parameters while bound test need to derive the estimate of equation 6 from the results of table 3.

[b]. For critical value of Upper bound (4.68) at 1 % see in Tang (2003).
[c]. From already calculated UECM, the long run parameters are estimated by multiplying negative sign to the coefficient of first lagged independent variable divided by the value of the coefficient of dependent variable at first lagged level (see in Bardsen 1989).

Furthermore, the findings in both procedures support the positive relevance between import demand and expenditure components in aggregate i.e. the variation in import demand due to change in domestic income (sum of the coefficients of expenditure components) by using Engle-Granger and Bound tests is reported 0.89 % and 0.79 % respectively.

6. Summary and Conclusion

This study empirically explored two things, relevant to the aggregate import demand function for Pakistan over the period of 1981 to 2009. First, estimates the long run relationship between import demand and expenditure components rather than aggregate economic activity. Second, EG test developed by Engle and Granger (1987) and Bound test developed by Pesaran et al (2001) were used to estimate the long run relationship among the variables. The empirical findings support the existence of long run relationship and introduced that the expenditure components are all important determinants of the total import demand for Pakistan.

Moreover, the study observed that at disaggregate level, in expenditure components the import demand is largely explained by investment expenditure followed by consumption and then by export expenditure. The estimated long run elasticities of import demand with respect to consumption expenditure, investment expenditure, export expenditure and relative prices are range over (0.40, 0.38), (0.57, 0.77), (-0.17, -0.26) and (-0.53, -0.59) using Bound and EG tests respectively. The application of these two alternative long run econometric techniques, suggest that the expenditure components and relative prices elasticities are all statistically significant and nearly inelastic/less elastic. Besides, the results are first, distributed consistently across the two different long run tests conducted. Second, the effects of expenditure components are different on aggregate import demand.

For policy purposes, first the estimated value of relative prices elasticity (-0.55 and -0.57) is enough to improve trade balance by depreciation, although have no evidence of price elasticity of export demand in this study. Because Heien study (1968) argued that “for every country, the price elasticity of

imports in range of -0.5 to -1 is essential to assure the success of exchange rate depreciation". Therefore, the price elasticity of import demand estimated, suggests that the exchange rate policy is found to be significant in improving Pakistan's trade balance in the long run. Next, the elasticities results for expenditure components give a hand the policy makers in managing trade balance in Pakistan. The more responsiveness of import demand to investment expenditure suggests that designing fiscal expenditure on investment goods is more beneficial to reduce import pressure and trade deficit rather than expenditure on consumption and investment goods.

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