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Price and Income Elasticity of Imports: The case of Pakistan

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Price and Income Elasticity of Imports: The case of Pakistan

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Abstract
The paper estimates the elasticity of Imports with respect to relative prices and income for Pakistan from 1971 to 2009. What distinguishes this paper from the earlier studies is the use of robust estimation technique of Autoregressive Distributed Lag (ARDL) model utilizing the bounds test procedure. The results point to cointegration among the variables. The estimated long run elasticity of Imports with respect to relative prices and income are -0.53 and 1.22 respectively.

JEL Classification: *C22, F10, F14*
Key Words: *Cointegration, Foreign Trade, Import Price.*

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I. Introduction

In this age of globalization, substantial structural shifts in one economy influence the structure and policy decisions of other trading partners' economies. External sector has become a vital ingredient as the engine of growth for many a nations around the world. Ricardo's comparative advantage theory has driven nations around the world for all the benefits they can muster from external trade, allowing them to grow at faster speeds than were seen before.

Balance of Payments (BoP) account of a country shows the net balance of transaction of a nation with the rest of the world at the end of each financial year. Policy makers in a developing country like Pakistan are often comfortable with running external deficits in order to grow at faster rates. However, on the flipside running an unsustainable foreign deficit could render the country bankrupt. This thus leads us to the importance of looking in depth at the components of BoP account and changes it goes through over time. The most important component of BoP is the trade balance. In Pakistan, exports of goods constitute almost 11 percent of GDP while share of imports of goods in GDP is almost 17 percent.[1] Thus the average trade deficit for last three decades hovers around the 6 percent mark. Over the stated period the share of exports[2] in GDP has not increased much but the share of imports has grown from almost 15 percent in 1980s and 90s, to 19 percent in 2000s. Thus given their contribution in GDP and relative increase in the last decade as compared to exports, aggregate value of imports has earned significant attention of policy makers for the external sector sustainability and timely exchange rate adjustments (whether discretionary or market induced).

Given the significance of imports, this paper examines the extent to which the macroeconomic variables determine the demand for imports of Pakistan. The questions that need to be answered at the aggregate level are: how relative prices affect real imports? By how much do the imports increase with the increase in the real income of the masses? The answer to these questions lies with the econometric estimation of relevant elasticities. A lot of previous and recent literature has focused on the elasticity of import demand with respect to relative prices and income. What distinguishes this paper is the use of Autoregressive Distributed Lag model (ARDL) utilizing the bounds test analysis proposed by Pesaran et al. (2001) to re-estimate the import elasticities and the emphasis on economic implications of the results. This approach is intended to give consistent

[1] Averages from Fiscal Year 1983 to 2010
[2] Averaging 9, 12 and 13 percent in 1980s, 1990s and 2000s respectively.

and unbiased estimates, given that the sample period is too short to carry out the traditional Engel Granger (1987) or Johansen-Juselius (1990) procedures.

The empirical results point to a cointegrating relationship between the variables i.e. imports demand, relative prices and income. One percent change in relative prices brings about a -0.53 percentage change in demand for import other things remaining the same. Given that our estimated price elasticity falls in the range -0.5 and -1, exchange rate and import tariff policies can be utilized by the monetary authorities to correct the Balance of Trade disequilibrium. On the other hand a one percent change in income brings about a 1.22 percentage change in demand for imports other things remaining the same. This result holds significance for fiscal managers in terms of revenue collection and long term policy horizon, to gear the government machinery towards provision of basic infrastructure and market conditions for import substitution industries.

The structure of the paper is as follows. Section II provides an elaborate discussion of the literature. Section III presents the data and the methodology used in the paper. Section IV presents the results of econometric estimation, diagnostics, interpretation and policy implications. Section V concludes.

II. Literature Review

The empirical literature on estimation of aggregate import demand function is vast. An earlier comprehensive literature review is available in Goldstein and Khan (1985). As times have changed, the estimation methodologies have changed too. Earlier studies were based on the single equation Ordinary Least Squares (OLS) models. Granger and Newbold (1974) state that the standard OLS approach may lead to spurious regressions if the stationarity condition is not satisfied. Hence the resulting inferences would be unreliable. Thereafter came, the Engel-Granger (1987) approach and then a refinement in Johansen-Juselius (1990). In the presence of cointegration the Error Correction Method (ECM) has been widely used in the literature to estimate short run and long run elasticities.

Some notable studies based on such techniques are Salas (1982) for Mexico, Gafar (1988) for Trinidad and Tobago, Gafar (1994) for three Caribbean nations, Arize and Walker (1992) for Japanese import demand function, Doroodian et al. (1994) for Kingdom of Saudi Arabia, Mah (1994) for Japan, Mah (1993, 2000) for Korea, Bahmani-Oskooee and Rhee (1997) for Korea, Carone (1996) for United States, Bahmani-Oskooee (1998) for six LDCs, Sinha (1997) for five

Asian countries, Sinha (2001) for Thailand, Sinha (1996) for India, Abbott and Seddighi (1996) for United Kingdom, Arize et al.(2000) for Thailand, Milas (1998) for Greece, Dutta and Ahmed (1999) for Bangladesh, Raijal et al.(2000) for Nepal, Mohammad and Tang (2000) for Malaysia, Aydin et al (2004) for Turkey, Mwega (1993) for Kenya, Gumede (2000) for South Africa .

A relatively recent approach of ARDL put forth by Pesaran et al. (2001) using the bounds test for cointegration has been utilized in many empirical studies for import demand: Tang and Nair (2002) for Malaysia, Bahamani and Kara (2003) for nine industrial countries, Constant and Yue (2010) for Cote D'Ivoire, Ho (2004) for Macau and Narayan and Narayan (2005) for Fiji.

Ample amount of intellectual endeavor has also been put in for the same purpose in the case of Pakistan. Table 1 presents these efforts in tabular form. The estimates from Afzal (2004) seem pretty erratic compared to the rest of the studies. Also Sinha (1997) study shows negative relationship between import demand and income which is contrary to the theoretical literature. Excluding these two studies, the average import demand elasticity with respect to income and relative prices is 0.91 and -0.36 respectively.

A recent study by Fida et al (2011) conducted the same exercise as in this paper. The long run elasticity of imports with respect to income was 0.613 while with respect to relative price it was -0.042. The results point to no role of relative prices as the long run coefficient is too low to have a significant impact on imports and is contrary to other reviewed literature. Fida et al paper was focused on econometric issues, whereas the economic significance of the results had not been highlighted. This paper however focuses more on the policy implications of the econometric results. Also the purpose of this paper is to converge to a unifying estimate of long run elasticities in case of imports for policy making purposes.

Table 1:Elasticities of Imports for Pakistan as in various studies

Study (Year)	Methodolgy	Long Run Elasticity			
		Pm[3]	Pd[4]	Pm/Pd	Income
Pakistan specific					
Sinha (1997)	Engel-Granger	-1.03	2.45		-0.96
Afzal (2001)	Simultaneous			-0.35	0.52
Afzal (2004)	Johansen-Juselius			-5.26	3.19
Rehman (2007)	Pesaran-Shin ARDL	-0.50	-0.36		0.69
Hye (2008)	Engel-Granger , Johansen-Juselius, Pesaran-Shin			-0.54	1.36
Alam and Ahmed (2010)	Pesaran-Shin ARDL			0.70	0.62
Rashid and Razzak (2010)	Pesaran-Shin ARDL			-0.66	1.00
Multi-country studies					
Khan (1974)	2SLS			-0.82	1.37
Senhadji (1997)	FMOLS			-0.47	0.83
Tokarick (2010)	Non Econometric Approach			-0.84	
Average		**-0.77**	**1.05**	**-1.03**	**0.96**

III. Data and Methodology

The formulation that has been used in most empirical studies for the estimation of the import demand function can be expressed by the following standard relationship:

$$Imports_{demand} = F\left\{\frac{Price\ of tradables}{price\ of\ non\ tradables}, Income\right\}$$

Let us denote the above equation as:

$$M_d = F\left\{\frac{P_T}{P_N}, Y\right\} \qquad f_1 < 0, f_2 > 0$$

That is, import demand is a function of relative prices (P_T/P_N) and income (Y). We expect a positive relationship between import demand and income while we expect a negative relationship between relative prices and imports. We have used the same formulation for their research. Many empirical studies have also included exchange rate as an independent variable (Afzal (2004), Alam and Qazi (2010)). We are of the view that including both the relative price variable and a

[3] Elasticity of Real Imports with respect to Unit Value of Imports
[4] Elasticity of Real Imports with respect to Domestic Prices (Consumer Price Index)

variable for exchange rate will create endogeniety problem[5] in the estimation of the behavioral equation and thus have omitted the exchange rate from the equation.

Khan and Ross (1977) and Salas (1982) have preferred the log linear model over the linear model. The log transformation is also advocated by Gujrati (1995) who states that compression of the scale minimizes the hetroskedasticity problem. Studies by Doroodian et al (1994), Sinha (1997) and Raijal et al (2000) have performed the Box and Cox (1964) procedure and have shown that the log linear transformation are more effective compared to linear transformation. For empirical estimation we log-linearize the above equation as

$$\ln M_d = \beta_0 + \beta_1 \ln Y + + \beta_2 \ln \frac{P_T}{P_N} + u \qquad (1)$$

Denoting the log transformation in small letters, (1) can be written with time-series subscript as

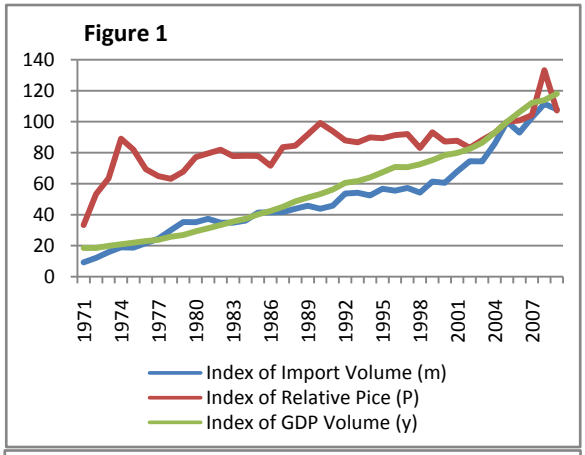
$$m_t = \beta_0 + \beta_1 y_t + \beta_2 p_t + v_t \qquad (2)$$

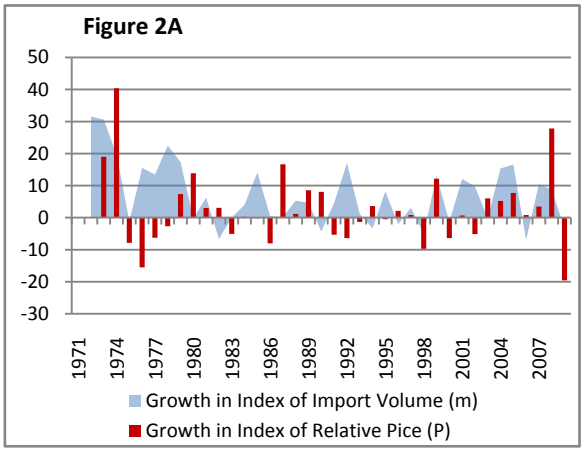
The data set is obtained from International Monetary Fund-International Financial Statistics (IMF-IFS). For the purpose of study imports *(m_t)* are defined as the volume of imports while relative prices *(p_t)* are defined as the ratio of unit value of imports and Gross Domestic Product (GDP) deflator, and *(y_t)* defined as the volume of GDP. v_t is the white noise error term.[6] The data spans from 1971 to 2009. The rationale for using the annual series for the study period was the non availability of comprehensive quarterly or monthly data series on GDP deflator and GDP volume. The GDP figures are only available in annual frequency.

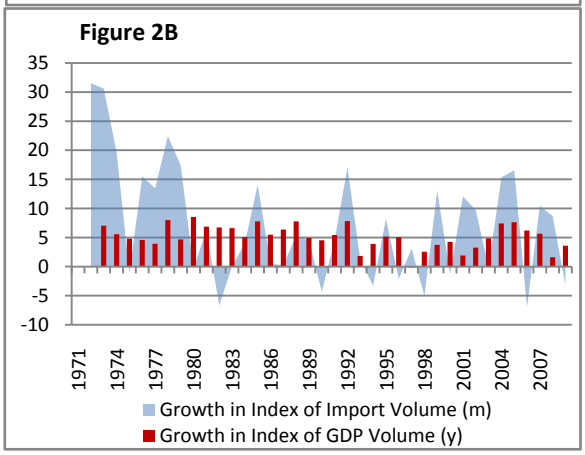
[5] Including exchange rate variable, whose effect is captured directly through import prices and domestic price level would create endogeniety in the model. Senhadji (1997) and Tang and Nair (2002) in their studies used GDP deflator as measure of price of non-tradables. Given the changing basket of WPI over the years and the fact that WPI consisted of only 92 items at the time of the study, we prefer GDP deflator over WPI.

[6] We have also included a dummy D82 in our estimation. The rationale is the change of regime from fixed to flexible for the exchange rates. The dummy takes the value of 1 since 1982

The graphical representation of indices in levels are given in figure 1, while graphical representation of growth in index of volume of imports with respective growth rates of index of relative prices and index of economic activity are given in figure 2A and 2B respectively.







In the presence of cointegration the Error Correction Method (ECM) has been widely used in the literature to estimate short run and long run elasticity. Inder (1992) presents a comparison of different approaches to estimate long run economic relationships and concludes that Unrestricted Error Correction Models (UECM) give precise estimates and valid t- tests even in the presence of endogenous variables. Mah(2000) argues that the two step Engle and Granger (1987), Johansen (1988) and the Johansen and Juselius (1990) methods of ECM are not reliable for small sample studies. Kramers et al. (1992) show that for small sample sizes no cointegration relationship can be established among variables that are integrated of order one.

A relatively recent alternative approach to cointegration analysis has been put forth in a series of studies by Pesaran and Pesaran (1997), Pesaran and Smith (1998) Pesaran and Shin (1999), and Pesaran et al. (2001). This approach employs ARDL procedure using the bounds test for cointegration analysis. This approach has been advocated to correct for the small sample bias (see Pesaran and Shin, 1999). The bounds test procedure has the advantage that it can be applied irrespective of whether the variables are I(0) or I(1) (Pesaran and Pesaran, 1997). Another advantage is that the model captures the data generating process within the model (Laurenceson

and Chai, 2003). This approach presents the ease of estimating the reduced form equation through the OLS method. An restricted ECM can also be derived from within the model (Banerjee et al, 1993) thereby incorporating the short run as well long run dynamics. The ARDL approach also overcomes problems arising out of non stationary data (Laurenceson and Chai, 2003). This paper uses UECM ARDL of Pesaran (2001) to calculate the long term income and price elasticities of imports for Pakistan. The paper also provides short term dynamics from the restricted ECM.

For a total of 39 observations, we can quantify this as a small sample. We will first test for the unit root in respective series using the Augmented Dickey-Fuller (ADF) (1979, 1981) tests. Given the variables are I(0) or I(1), we test for cointegration utilizing the Pesaran et al. (2001) bounds test methodology. If cointegration is present we estimate the long run coefficients from the UECM of ARDL. For short run dynamics we transform the equation into ECM.

The above specification in (2) is transformed into ARDL specification as in Pesaran et al. (2001):

$$\Delta m_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i} \Delta\ y_{t-i} + \sum_{i=0}^{n} \alpha_{2i} \Delta\ p_{t-i} + \sum_{i=0}^{n} \alpha_{3i} \Delta\ m_{t-i} + \alpha_4\ y_{t-1} + \alpha_5\ p_{t-1} + \alpha_6\ m_{t-1} + \varepsilon_t \qquad (3)$$

Where; Δ shows the first differences of the variables. We then test for cointegration using the bounds test procedure. The bounds test is based on the Wald or F-Statistic and follows a non standard distribution (Pesaran, 2001). The null hypothesis is: no cointegrating relationship among the variables. The null hypothesis of no cointegration is tested by using ARDL UECM in (3) without the difference lagged variables. The null hypotheses is

$$H_0: \alpha_4 = \alpha_5 = \alpha_6 = 0$$

And the alternative is

$$H_A: \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq 0$$

Given the level of significance, if the computed F-statistic falls above (below) the upper (lower) critical bound, then the null hypothesis of no cointegration is rejected (accepted). In case of the computed F-statistic falling in between the upper and lower bound no conclusive inference can be drawn about the cointegrating relationship among the variables.

From this ARDL UECM, the long run income and price elasticity of imports can be calculated by $-(\alpha_4/\alpha_6)$ and $-(\alpha_5/\alpha_6)$ respectively (Bardsen, 1989). For the short run dynamics of the model we will have to turn to the restricted ECM. The error correction term *ecm* is defined as:

$$ecm_t = m_t - \beta_1 y_t - \beta_1 p_t$$

Where $\beta_1 = -(\alpha_4/\alpha_6)$ and $\beta_2 = -(\alpha_5/\alpha_6)$ are the OLS estimators obtained from (3). The ARDL restricted ECM model is defined as:

$$\Delta\, m_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\, \Delta\, y_{t-i} + \sum_{i=0}^{n} \alpha_{2i}\, \Delta\, p_{t-i} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta\, m_{t-i} + \gamma ecm_{t-1} + v_t \qquad (4)$$

The coefficients of the lagged difference variables provide the short run dynamics of the model converging to the equilibrium path while we expect γ to be < 0 for it implies stability of the model. The coefficient of the *ecm* term signifies the speed of adjustment to equilibrium after a shock.

IV. Results

A graphical analysis of the three variables in the model is presented in Figure 1. All the three variables seem to grow over the time period and there seems a coherent relationship among the variables. The relationship between GDP and Imports seems more robust than that between relative prices and imports.

Table 2: p-Values of ADF Unit Root Test

Variables	Level				First Difference			
	No Intercept or Trend	Intercept	Trend & Intercept	lags	No Intercept or Trend	Intercept	Trend & Intercept	lags
m	0.993	0.447	0.150	2	0.003	0.004	0.028	2
y	1.000	0.215	0.889	1	0.282	0.048	0.081	1
P	0.820	0.171	0.000	2	0.000	0.000	0.000	2

The inception point of any empirical estimation of a time series model starts with the test for stationarity of the variables in the model. We will utilize the ADF test for the presence of unit root in the data series. The results of the unit root test are presented in Table 2. Table 2 shows that all the variables are I(1). The preconditions are fulfilled for the bounds test to be applied.

Next we turn to the estimation of (3). Pesaran and Shin (1999) and Narayan (2004) suggested 2 as the maximum order of lags in the ARDL framework for the annual data series. Given the maximum lag length a parsimonious ARDL *(p,q,r)* model following General to Specific approach is selected on the basis of Akaike Information Criterion (AIC). The total number of regressions to be estimated for ARDL is $(p+1)^k$, where *p* is the maximum number of lag order to be used and *k* is the number of variables in the equation. Since p=2 and k=3, the total number of regressions to be estimated are 27. The result of the bounds test for the cointegrating relationship between the variables is given in Table 3 for the equation that resulted in the lowest value according to both the AIC and the SIC.

Table 3. Bounds Test for Cointegration Analysis

Computed F-Statistic: 10.64332 (lag structure, k=2)*
Critical bound's value at 10 %- Lower: 3.17 and Upper: 4.14
Critical bound's value at 5 %- Lower: 3.79 and Upper: 4.85
Critical bound's value at 1 %- Lower: 5.15 and Upper: 6.36
Two regressors with unrestricted constant term and no trends in the model
Pesaran, et al. (2001), p. 300, Table C1(iii), Case III

* based on maximum lag order for annual data series

The selected ARDL (2, 2, 2) model with the diagnostics is given in the Appendix A. The long run behavioral equation from the UECM ARDL model is

$$m_t = 0.49 + 1.22y_t - 0.53p_t$$

The derived coefficients from the ARDL model present the long run elasticity of imports with respect to income and relative prices. One percent increase in income leads to 1.22 percent increase in imports, while a similar increase in relative prices leads to 0.53 percent decrease in imports. This is also consistent with economic theory of the standard demand function as stated before.

For the short run dynamics we turn to the ARDL restricted ECM approach. The result of the model along with its diagnostics is given in Appendix B. The behavioral equation thus derived from the model is as follows:

$$\Delta m_t = 0.31 + 1.57\,\Delta y_t + 0.85\,y_{t-1} - 0.13\,p_{t-1} - 0.10\,\Delta m_{t-1} - 0.42\,ecm(-1)$$

The coefficient of the error correction term is -0.42 is highly significant, which implies that the speed of adjustment back towards the equilibrium from any external shock that is outside the system presented in the study is quite brisk. About 42 percent of disequilibrium emanating from an external shock at t_0 will get corrected in t_1.[7]

V. Policy Implications

Heien (1968) argues that for devaluation to be effective, the elasticity of imports with respect to relative price should be in between -0.5 and -1.0. Since the estimated long run elasticity falls in this range, exchange rate and import tariff policies can be employed to correct the balance of trade disequilibrium in Pakistan. Change in nominal exchange rate will pass through on to import prices and eventually on to general inflation level. This would impact the relative price variable. Also any increase in the domestic inflation rate will trigger an increase in the volume of imports.

Since imports are elastic with respect to the level of income, an increase in the income level will increase the volume of imports by the more than the increase in income. Government policies can be geared towards encouraging domestic industries that are not import intensive. Tax rebates and other allowances can be given to import substitution industries. Development of such industries will lessen the import bill and reduce the trade deficit as well as will raise employment and income level.

Another implication of the elasticities for the fiscal authorities would be from the revenue collection side. Given the elasticity of imports with income is greater than one and imports being relatively price inelastic, revenue could be gained through duties and taxes on imports. Curtailing imports and reining in the current account deficit, based on macroeconomic fundamentals, to a sustainable level is paramount. Tariffs and taxes as allowed under the foreign treaties could be used in this regard to pursue policies of economic growth within the realm of sustainable external sector.

VI. Conclusion

The study was undertaken for the purpose of estimation of standard import demand function yielding elasticity of imports with respect to income and prices. Previous studies regarding the

[7] The discussion on dummy variable is dropped intentionally to focus on the underlying relationships and not on one-off shocks (See footnote 6).

estimation were examined. The unit root test on the variables established the data series as integrated of order one (I(1)). Given the small data span, ARDL approach to cointegration testing was preferred over the other methods. The bounds cointegration test was utilized in this research effort and it pointed to cointegrating relationship among the variables. From the ARDL model stable long run estimates of elasticities were derived. The elasticity of imports was estimated to be 1.22 with respect to income and -0.53 with respect to relative prices. We then derived the ECM from the UECM. About 42 percent of the disequilibrium caused by an external shock to the system will be corrected over the course of a year implying speedy adjustment in the process. The outcome of the study holds policy implications for the monetary as well as the fiscal authorities.

However robust our estimates be, future research on the issue should also accompany disaggregated analysis of the same. It would also be useful if the relatively inelastic petroleum imports are excluded from the aggregate analysis to look at the fundamentals drivers of our imports. Another improvement in this regard would be to utilize the relative price data of tradables versus the non tradables (instead of the commonly used practice of using proxies). Further still, domestic absorption variable might be more suitable instead of the GDP volume for it would present the income minus the external sector and would eliminate endogeniety that is inherent in the GDP and import variable. Further research could be geared towards panel estimation of elasticities of various countries for comparative analysis and also towards employing a combination of estimation methodologies.

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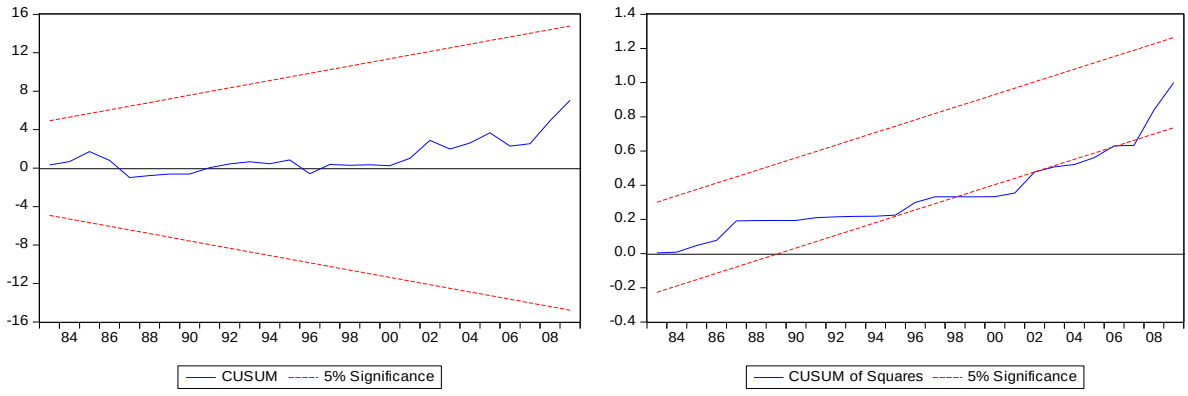
Appendix

Estimated ARDL UECM for Import Demand Function of Pakistan based on (3)

I. Estimated Model		
Sample 1971-2009		
Dependent Variable Δm_t		
Variable	Coefficient	p-Value
Δy_t	1.609	0.014
Δy_{t-1}	0.842	0.132
Δp_{t-1}	-0.129	0.217
Δm_{t-1}	-0.091	0.534
y_{t-1}	0.492	0.000
p_{t-1}	-0.216	0.066
m_{t-1}	-0.405	0.000
Constant	0.641	0.144
Dummy 82	-0.150	0.001
II. Goodness of Fit		
Adjusted R^2		0.553
F-Statistic (p-Value)		0.000
Standarad Error of Regression		0.056
Residual Sum of Squares		0.088
DW-Statistic		1.911
III. Diagnostics (p-Values)		
Normality JB test		0.840
Serial Correlation B-G LM test χ^2 (1)		0..983
Hetroskedasticity ARCH test χ2 (2)		0.390
Ramsay Reset F Stat (2)		0.097

CUSUM Parameter Stability Tests



Estimated ARDL ECM for Import Demand Function of Pakistan based on (3)

I. Estimated Model		
Sample 1971-2009		
Dependent Variable Δm_t		
Variable	Coefficient	p-Value
Δy_t	1.569	0.006
Δy_{t-1}	0.851	0.121
Δp_{t-1}	-0.129	0.145
Δm_{t-1}	-0.103	0.437
ecm_{t-1}	-0.423	0.000
Constant	0.401	0.000
Dummy 82	-0.093	0.001
II. Goodness of Fit		
Adjusted R^2		0.571
F-Statistic (p-Value)		0.000
Standarad Error of Regression		0.055
Residual Sum of Squares		0.091
DW-Statistic		1.842
III. Diagnostics (p-Values)		
Normality JB test		0.775
Serial Correlation LM test χ^2 (1)		0.618
Hetroskedasticity ARCH test $\chi 2$ (2)		0.478
Ramsay Reset F Stat (2)		0.084