ИКОНОМИЧЕСКИ ИЗСЛЕДВАНИЯ
ECONOMIC STUDIES

ГОДИНА XXII, 2013, 2

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AN ESTIMATION OF STRUCTURAL IMPORT DEMAND FUNCTION FOR PAKISTAN

This paper estimates the structural import demand function for Pakistan using a theoretical framework developed by Emran and Shilpi (2010). ARDL and DOLS techniques are used to estimate the log-run price and income elasticities. The results of cointegration analysis provide strong evidence of the existence of a long-run stable relationship among the variables included in the model. The estimates for price and income elasticity have correct sign and are statistically significant. The coefficient of scarcity premium variable is negative and statistically significant, indicating a binding foreign exchange constraint on imports in Pakistan for pre-trade liberalization period.
JEL: F14; O16

1. Introduction

The estimation of import demand elasticities for both developed and developing countries has been a one of the most active research areas in international economics literature. Although a plethora of studies have been done, however, the main issue which is ignored almost in most of the studies is about the theoretical foundation or microeconomic foundation of the theoretical models.[3] Recently, Emran and Shilpi (2010) developed a structural import demand function. This model not only incorporates a binding foreign exchange constraint at the administrated import prices but also is relatively more suitable for developing economies such as Pakistan. In addition, Emran and Shilpi (2010) argued that the model significantly takes into account the problem of near identity. Thus, this model yields unbiased estimates for income and price elasticity of impart demand, particularly for developing countries. Given the context of Pakistan's economy, we prefer this model over the traditional import demand functions and empirically estimate for Pakistan in the Autoregressive

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[3] See, for example, Goldstein and Khan (1985), Clarida (1994), Reinhart (1995), Carporale and Chui (1999), Bahmani-Oskooee and Kara (2005), Frimpong and Fosu (2007), and Tang (2008). See, for a detailed literature survey, Rashid and Razzaq (2010).

Distributed Lag (ARDL) and the Dynamic Ordinary Least Squares (DOLS) frameworks using time series data covering the period 1975-2008.

A few studies have thus far been empirically estimated import demand function for Pakistan. For instance, Sarmad (1989) investigates the determinants of import demand for the period 1960-1986. He shows that the income elasticity of import demand is greater than one, while the price elasticity of import demand is less than one for several industries. He concludes that the devaluation of domestic currency is not an effective tool to improve deficits in trade balance.[4] However, Sinha (1997) estimating an aggregate import demand function for Pakistan during the period 1970-1993 shows that the absolute value of income elasticity of import demand is less than one, while the price elasticity is greater than one. Shabbir and Mahmood (1991) estimate the import demand model for Pakistan with an aim to determine the year of structural change in aggregate import demand function. They utilize the data over the period 1960-1988. They find the different values of elasticities of import demand for the period before and after 1971-1972.

Rehman (2007) estimates a traditional import demand function using cointegration technique and finds a long-run equilibrium relationship among the variables used in the analysis. He also shows that the both short-run and long-run income and price elasticities of import demand are less than one. Another study by Hye (2008) reports that real quantity of imports; relative prices and real GDP are co-integrated in the long run. The long-run income elasticity of import demand is greater than one, while the income elasticity in the short-run in less than one.

The results of study by Alam and Ahmed (2010) indicate the existence of a long-run relationship among imports, economic growth, relative prices, real effective exchange rate and the volatility of real effective exchange rate. In addition, the estimates indicate that there is a positive relation of economic growth with aggregate imports. Arize, Malindretos and Grivoyannis (2004) include foreign exchange reserve in cointegration vector while estimating the import demand function for Pakistan and report a one unique relationship among real imports, real income, relative prices and real foreign exchange reserves. They also argue that imports quickly respond to changes in their determinants. These observations lead one to consider that foreign exchange reserves have a significant role to play in Pakistan's import demand function.

Unlike the above cited studies, this study aims to modeling aggregate import demand function for Pakistan taking into consideration both theoretical and empirical issues associated with the estimation of import demand function, particularly for developing countries. Specifically, we use the structural model recently developed by Emran and Shilpi (2010) that incorporates a binding foreign exchange constraint at the administrated import prices. In addition, we use both the ARDL procedure developed by Pesaran, Shin and Smith (2001) and the DOLS method developed by Stock and Watson (1993) to estimate the elasticities of import demand. In this way, we investigate the sensitivity of elasticity estimates to estimation methods and determine relatively appropriate method for elasticities of

[4] Naqvi and Ahmed (1986) and Sarmad and Mahmood (1987) are among the earlier studies that estimated aggregate import demand function for Pakistan.

imports in Pakistan. Finally and more importantly our empirical model enables us to determine the effects of trade liberalization on Pakistan's imports, which have generally been ignored in the existing studies on the import demand function for Pakistan.

Our findings are mainly in line with the results of Emran and Shilpi (2010), who estimate the import demand function for Indian and Sri Lanka. We find significant evidence of the existence of a long-run stable relationship among real imports, real domestic consumption, relative prices, and our proxy for scarcity premium ((real domestic expenditures/real foreign exchange reserves) × trade liberalization dummy). The long-run estimates for income and price elasticities are highly significant and follow the sign restrictions imposed in the model. We also find that the estimate of income elasticity is close to unity, suggesting the need to the implementation of certain measures for a reduction in income elasticity of import in order to improve the trade balance. The estimate for price elasticity is negative and closer to one. Finally, we find that the ARDL estimate of coefficient of scarcity premium appears with correct negative sign and is statistically significant, confirming the presence of a binding foreign exchange constraint on imports for pre-trade liberalization period. We, on the whole, produce conclusive evidence that strongly supports the validity of the structured import demand model for Pakistan.

The program for rest of the paper is as follows. In the next section, we review recent trends of Pakistan's exports and imports and discuss the measures taken by the government in order to improve trade balance. In Section 3, we give an overlook of our empirical framework. In Section 4, we display and discuss our results. In Section 5, we conclude the paper.

2. Trends in Pakistan's Exports and Imports

Despite the slowing down of the economic activities across the globe, the decrease in the volume of the world trade, the decline in international commodity prices, the unfavorable global environment, the continual energy crisis domestically, Pakistan's exports increased by 14 million USD during July-April 2011-2012 as compared to the same period last year and reached at 20 474 million USD. On the other hand, during the period July-April 2011-2012, the imports increased by 4198 USD, approximately 14.5% higher than the period July-April 2010-2011. The much higher growth of imports as compared to the growth of exports over the same period clearly points out increasing deficits in trade balance: one of the persistent and mounting problems of Pakistan's economy. Specifically, the trade deficit has increased by about 49.2% during the period from July-April 2010-2011 to July-April 2011-2012. The one of the major reasons behind the tremendous increase in the imports bill is higher international prices of crude oil during the period. Inelastic demand of imports by consumers can be considered another factor which widening the trade deficit over the time in Pakistan.

In addition to the wide trade deficit, another problem faced by Pakistan regarding international trade is that Pakistan's exports are highly concentrated in a few items. Only three items viz. cotton manufacturing, leather, and rice made up 61% of total exports during July-March 2011-2012. The share of these three exports items in

overall exports over different periods are given in Table 1. Although the share other items in total exports increased to 39 percent in July-March 2011-2012 which was 28.5% during the fiscal year 2006-2007. The export of cotton manufacturers remained dominant making up more than 50% of total exports during the period 2006-2007 to 2011-2012. During 2006-2007, the share of cotton manufacturing in overall exports was 59.7%. However, the corresponding figure declined to 50.1% during 2011-2012.

Table 1

Major Exports of Pakistan (%)

Commodity	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
Cotton Manufacturing	59.7	51.9	52.6	50.6	52.9	50.1
Leather	5.2	5.8	5.4	4.5	4.4	2.2
Rice	6.6	9.8	11.2	11.3	8.7	8.7
Sub-total of three items	71.5	67.5	69.2	66.4	66.0	61.0
Other items	28.5	32.5	30.8	33.6	34.0	39.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

Source: Pakistan Bureau of Statistics.

Despite the high concentration of exports items, Pakistan has witnessed diversification in exports market. In 2005-2006, about 47% of Pakistan's exports were concentrated in only five markets, namely USA, UK, Germany, Hong Kong, and U.A.E, of the world, whereas, the share of all other countries was about 53%. Table 2 present the percentage of the country's exports in major exports markets. However, this concentration is on continuous decline since the fiscal year 2005-2006 and reached at 35% during July-March 2011-2012. The Strategic Trade Policy Framework (STPF-2009-12) introduced by Pakistani government and increases in exports to China, Afghanistan, and Bangladesh were the major factors behind this improvement in geographical diversification.

Table 2

Pakistan's Major Exports Markets (%)

Country	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
USA	25.5	24.6	19.5	18.9	17.4	16.0	14.7
UK	5.4	5.6	5.4	4.9	5.3	4.9	5.1
Germany	4.2	4.1	4.3	4.2	4.1	5.1	4.8
Honk Kong	4.1	3.9	2.7	2.1	2.2	2.0	1.6
U.A.E	8.0	8.2	10.9	8.2	8.9	7.3	9.0
Sub-total	47.2	46.4	42.8	38.3	37.9	35.3	35.2
Other Countries	52.8	53.6	57.2	61.7	62.1	64.7	64.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Pakistan Bureau of Statistics.

In comparison to exports, Pakistan's imports are fairly geographically diversified in these days. Table 3 presents the percentage share of six major imports markets in overall imports of Pakistan. The combined share of these six countries was 36.7% during the period 2007-2008, which has been declined to 30.2% in 2011-2012, showing a 6.5 percentage point fall. It should be noted that the percentage share of imports from USA significantly declined from the 6.1% in 2007-2008 to only 3.3% during the period July-March 2011-2012. This improvement in geographical

diversification of imports can mainly be attributed to the measures taken by the government regarding imports during the period under review.

Table 3

Pakistan's Major Imports Markets (%)

Country	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012
USA	6.1	5.4	4.6	4.5	3.3
UK	1.9	2.6	1.7	1.6	1.2
Germany	3.2	3.8	3.4	2.3	2.5
Japan	4.6	3.6	4.4	4.1	4.2
Kuwait	7.5	6.6	6.9	8.2	8.4
Saudi Arabia	13.4	12.3	9.7	11.3	10.6
Sub-total	36.7	34.3	30.7	32.0	30.2
Other Countries	63.3	65.7	69.3	68.0	69.8
Total	100.0	100.0	100.0	100.0	100.0

Source: Pakistan Bureau of Statistics.

Below the key steps taken by the government of Pakistan in order to improve overall exports and imports are discussed.

Key Measures taken by the Government regarding Exports and Imports

- The Federal Cabinet approved complete zero-rating of exports in July, 2009.
- The government of Pakistan gave several incentives to increase exports. Examples of these incentives are concessionary financing, duty drawback scheme, development of export clusters, duty free imports of raw material under temporary importation scheme, and concession in duty/taxes on import of machinery and raw material of priority export sector.
- In order to get better market access for the local businesses in international markets the government of Pakistan is carrying out active trade diplomacy and forming Free Trade Agreements (FTAs) and Preferential Trade Agreements (PTAs) with different countries across the world.
- Trade Development Authority of Pakistan (TDAP) has undertaken various export promotional activities through trade exhibitions and delegations in the new markets, such as Hong Kong, Russia, Malaysia, Africa regions, and Eastern Europe.

In order to improve the trade deficit, the government of Pakistan has been taken the following measures, given in Table 4, during 2011-2012 through Amendments in the Import-Export Policy Orders.

Table 4

Major 2011-2012 Amendments in Exports-Imports Policy Orders

No.	Gist of Amendment	Rationale
i.	Allowing export of brown sugar.	To encourage local production of organic brown sugar.
ii.	Letting units registered under DTRE scheme also to import inputs given in restricted list of the Import Policy Order (IPO), subject to fulfillment of the conditions mentioned therein.	To bring DTRE users at par with normal importers.
iii.	Restricting import of exhausted batteries to industrial consumers only subject to a full proof mechanism.	To safeguard environment.
iv.	Confining disposal of ambulances before ten years imported as a donation in secondhand used condition by imposing duty taxes applicable at the time of import.	To avoid the misuse of ambulances as commercial vehicle after import.
v.	Importer should have to be duly registered with Oil and Gas Regulatory Authority in order to import automotive engine/gear oil etc.	To protect consumers' interest.
vi.	Another 17 categories of goods and services were included in the positive list of items importable from India.	To reduce costs of doing business.
vii.	Permitting export oriented textile and leather sector to import accessories on import cum export basis from India.	To facilitate export sector.
viii.	Banning import of import of CNG cylinders ad conversions kits. The ban shall however not apply in the following cases: a) For which letters of credit established prior to 15.12.2011. b) Public transport vehicle i.e. buses and vans.	To make a check on fast depletion of existing gas resources.

3. Empirical Framework

Unlike the residual based test such as Engle-Granger (1987) and the maximum likelihood based test such as Johansen (1991 and 1995) for testing the long-run association, the ARDL approach does not require that the underlying series included in system should have same order of integration. Another advantage of this approach is that the model takes sufficient number of lags to reduce the intensity of serial correlation of residuals in a general to specific modeling framework. Furthermore, a dynamic error correction model (ECM) can be derived from the ARDL procedure through a simple linear transformation. The ECM emerges the short-run dynamics with the long-run stable equilibrium without losing long-run information.

The ARDL regression yields a test statistic which can be compared to two asymptotic critical values (upper and lower critical values). If the test statistic is above an upper critical value at the given level of significance, the null hypothesis of no long-run relationship is rejected regardless whether the order of integration of the variables is one or zero. Alternatively, if the calculated test statistic is below the lower critical value at given level of significant, the null hypothesis of no long-run relationship is accepted.

However, if the test statistic falls between upper and lower bounds, the result is inconclusive. Another advantage of this approach is that an appropriate specification of the ARDL equation helps to fix the problems of endogenous variables and

residual serial correlation. Finally, it performs better than Engle-Granger (1987) and Johansen (1991 and 1995) cointegration tests in even case of small sample.[5] Specifically, we begin with an unrestricted VAR in level with an intercept term:

$$X_t = a + \sum_{i=1}^{p} \beta_i X_{t-i} + e_t \qquad (1)$$

where X_t is a $k \times 1$ vector of variables, which can be either $I(0)$ or $I(1)$. a is a vector of constants and β_i is a matrix of VAR parameters for lag i. The vector of error terms e_i has zero mean and positive definite variance. Next, following Banergee et al. (1993), a simple linear manipulation of equation (1) allows this VAR model to be written as a vector correction model (VECM). Specifically, it is defined as:

$$\Delta X_t = a + \Psi X_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta X_{t-i} + e_t \qquad (2)$$

where Δ is the difference operator. Here Ψ is the long-run multiplier matrix and is given by $\Psi = -(I - \sum_{i=1}^{p} \beta_i)$. The sum of the short-run coefficient is defined by:

$$\gamma = I - \sum_{i=1}^{p-1} \gamma_i = -\Psi \mid \sum_{k=i+1}^{p} \beta_k$$

where I is a $k \times k$ identity matrix, here k denotes the number of variables included in the system. The diagonal elements of this matrix are left unrestricted. This implies that each of the variables can be integrated of order one or zero. This procedure allows for the testing of at most one long-run relationship and so requires a zero restriction on one of the off diagonals of the γ matrix.

To analyze the long-run effects of the level of the variables on the level of demand for imports, we impose the restriction $\Psi_{ij} = 0$, where $i \neq j$. This condition implies that there is no long-run feedback from import demand, but there is feedback in the short-run. Under this condition, the empirical equation for the import demand function from the VECM of equation (2) can be obtained as:

$$\Delta D_t = a_0 + a_1 t + \Psi_{DD} D_{t-1} + \Psi_{DD} G_{t-1} + \sum_{i=1}^{p-1} \gamma_i \Delta X_{t-1} + \phi \Delta G_t + e_t \qquad (3)$$

where t is a linear trend and G_t is a $(m \times 1)$ vector of regressors. The symbol Δ is the difference operator and ϕ is a matrix of parameters for ΔG_t.

[5] For details on this, see Laurenceson and Chai (2003).

To test the existence number of the long run relation(s), we use the bounds "F" test developed by Pesaran, Shin and Smith (2001) along with the widely used Johansen approach to determine the cointegration rank. To estimate the elasticities, the following two alternative approaches are used: (i) the ARDL approach developed by Pesaran and Shin (1999), and (ii) the DOLS method developed by Stock and Watson (1993).

The alternative methods are used to test the sensitivity of the results with respect to different estimation techniques. For ARDL approach, we adopt the two-step procedure suggested by Pesaran and Shin (1999) where the specification of the ARDL model is chosen by Schwartz Bayesian Criterion (SBC) and then in second-step the ARDL equation is estimated by OLS. The Monte-Carlo evidence of Pesaran and Shin (1999) provides significant evidence that this two-step procedure effectively corrects for endogeneity of explanatory variables and the estimates exhibit good small sample properties. Finally, the stability of the estimated parameters is tested by using the Chow, CUSUM, and CUSUMSQ tests.

In order to estimate the structural import demand function for, annual time series data for the period from 1975 to 2008 are used. The data sources are International Financial Statistics (IMF) CD-ROM, World Bank Development Indicator (WDI) CD-ROM and 50 years of Statistics of Pakistan. Variables included in the analysis are log values of imports ($\tilde{m}_t$), log values of domestic consumption ($\tilde{h}_t$), log values of relative price ($\tilde{p}_t$), log values of foreign exchange reserves ($\tilde{f}_t$), and scarcity premium (x_t^*), which is defined as (((GDP + Imports – Exports)/CPI)/F multiplied by trade liberalization dummy), where CPI is consumer price index and F is foreign exchange reserves and trade liberalization dummy takes value one for the period from 1975-1986 and zero for the period from 1987-2008, the post liberalization period.

4. Empirical Findings

The first step involved in applying cointegration is to determine the order of integration of each variable/series. To do this, we performed the ADF test to test the null of unit root against the alternative of stationary at both level and first differences of real imports, domestic consumption, relative prices, foreign exchange reserves, and scarcity premium variable. The estimated ADF statistics are reported in Table 5. The Akaike Information Criterion (AIC) is used to identify the optimal lag length for the ADF equation. The optimal lag lengths are given in parentheses.

It can be observed from the table that the estimated ADF test statistics (both without and with trend) are less than critical value at the 5% for all the series at their levels. It implies that the null hypothesis of a unit root in the level series cannot be rejected. Therefore, it can be concluded that the series neither drift nor trend stationary at their levels over the examined period. However, the first differences of all the variables appear stationary.

Table 5

Unit Root Test Estimates

Variables	At levels		At first-difference
	$t_{ADF\ (c)}$	$t_{ADF\ (c+t)}$	$t_{ADF\ (c)}$
Real Imports	-1.149(4)	-1.738(5)	-3.984(4)
Domestic consumption	-0.743(5)	-1.247(3)	-3.548(0)
Relative prices	-0.986(5)	-1.407(4)	-4.635(0)
Foreign exchange reserve	-1.639(1)	-1.596(1)	-5.633(1)
Scarcity premium	-0.964(1)	-1.875(1)	-3.452(0)

Note: $t_{ADF(c)}$ and $t_{ADF(c+t)}$ are the standard ADF test statistics for the null of nonstationary of the variable in the study without and with a trend, respectively, in the model for testing. The 10% and 5% asymptotic critical values are -2.57 and -2.86 for $t_{ADF(c)}$ respectively, and are -3.12 and -3.41 for $t_{ADF(c+t)}$, respectively. All variables are in log form except from scarcity premium. The optimal lag-length is reported in parentheses.

4.1. Estimates of the Long Run Import Model

The next step for estimating the import demand model is to explore a long-run relationship among the variables included in the model. As mentioned earlier, the bounds tests suggested by Pesaran and Shin (1999) and the rank tests for cointegration developed by Johansen (1995) are used. The specifications of the ARDL and VAR models (lag order and deterministic part) for the tests of cointegration are determined on the basis of the AIC. To proceed with this, the AIC statistics are calculated for lags ranging from one to four for all possible cointegration vectors from models with no intercept and no trend, with intercept and no trend, and with intercept and a linear trend. The maximum absolute value of the criterion suggests that an optimal lag length for Model I and II is 3 and for Model III is 2.

Table 6 presents the Johansen trace test results to determine the number of cointegration vectors for the optimal lag length suggested by the selection criteria. Log values of import prices, log values of domestic consumption, log values of relative prices, and scarcity premium are included in cointegrating vector. The null and alternative hypotheses are given in first and second columns of the table. The estimated F-statistics with their critical values are given in last three columns of the table. The results provide strong evidence of existing cointegrating relationship among the said variables. In general, these findings are robust to model specifications. However, the numbers of cointegration vectors vary with model specifications. For example, the results using a specification with only intercept indicate one-cointegration vector for the said variables. Whereas, when the cointegration equation includes both intercept and a linear trend the two-cointegration vectors appear statistically significant.

Table 6

Johansen Cointegration Results based on Trace of the Stochastic Matrix

Hypotheses		F-Statistics					
		No Intercept, No Trend		With Intercept, No Trend		With Intercept, With Trend	
Null	Alternative	Test Statistics	Critical Value	Test Statistics	Critical Value	Test Statistics	Critical Value
$r = 0$	$r = 1$	51.889	39.810	61.880	53.480	78.411	58.930
$r \leq 1$	$r = 2$	26.380	24.050	29.926	34.870	42.699	39.330
$r \leq 2$	$r = 3$	11.735	11.030	11.978	20.180	15.198	23.830
$r \leq 3$	$r = 4$	4.239	4.160	4.267	9.160	5.997	11.540

Note: log of real imports, log of real domestic consumptions, log of relative prices, and scarcity premium variable are included in the cointegration vector.

The presence of the cointegration in the said variables implies that these variables have co-movement in the long run. The existence of the long-run equilibrium relationship suggests that the level of domestic consumption, relative prices, and the level of foreign exchange reserve are simultaneously playing important role to determine the demand for imports in Pakistan.

The results of the bounds tests are given in Table 7. The F-statistics are calculated by estimating the Model I to Model III with specifications of no intercept and no trend, with intercept and no trend and finally by including both intercept and a linear time trend. For estimating the bounds "F" tests, the lag length, selected by the AIC is two when the model includes neither intercept nor trend and when includes only intercept. However, the criterion suggests the optimum lag length one when the model includes both intercept and a linear time trend. The main objective behind estimating the bounds "F" tests using different specifications is to test the robustness of the results with respect to different specifications.

The results of the bounds "F" tests provide evidence of the rejection of the null hypothesis of no cointegration for all different specifications used in the analysis. The overall results from the Johansen's cointegration tests and bounds tests provide strong evidence in favor of a significant long-run relationship among the variables included in the import demand model.

Table 7

Bound Tests for Long-run Relationship in an ARDL Framework

Empirical Models	F-statistics		
	No Intercept, No Trend	With Intercept, No Trend	With Intercept, With Trend
Model I: $\widehat{M}_t = f(\hat{h}_t, \hat{p}_t, x_t^*)$	69.184*	98.103*	40.353*
Model II: $\widehat{M}_t = f(\hat{a}_t, \hat{p}_t)$	58.089*	24.893*	49.469*
Model III: $\widehat{M}_t = f(\hat{h}_t, \hat{p}_t, \hat{f}_t)$	78.158*	96.589*	16.766*

where $\widehat{M}_t$ = log value of imports, $\hat{h}_t$ = log value of domestic consumption, $\hat{p}_t$ = log value of relative prices, $\hat{f}_t$ = log value of foreign exchange reserve, and x_t^* = scarcity premium, (((GDP + Imports – Exports)/CPI)/F multiplied by trade liberalization dummy), where CPI is consumer price index and F is foreign exchange reserves. * denotes significant at one percent level of significance.

Since there are strong evidence of the existence of a long run relationship among the variables included in the long run import demand model, we estimate the long-run cointegration relation (long-run coefficients) for imports using the ARDL and DOLS single equation estimation methods. The optimal lag length for the ARDL model was chosen by the SBC starting from 4 lags. In the case of DOLS estimation, sufficient lags and leads of first difference terms are included in the regression in order to eliminate the problem of serial correlation. The DOLS model involves two lags in case of Model I. The results from the ARDL and DOLS estimation of the long run demand relationship are reported in Table 8.

It can be seen from the bottom panel in Table 8, the regression diagnostic tests show that the residuals from the estimated regressions display no problem of serial correlation and/or non-normality in the case of ARDL and DOLS estimated methods.[6] The estimated coefficients for income and relative price satisfy the theoretical sign restrictions over the examined sample period regardless of the estimation method. Both of the estimated coefficients are highly statistically significant at 5% level of significance in the ARDL model as well as in the DOLS method.[7]

For income coefficient, the magnitude of ARDL estimate is lightly higher than that of DOLS. The estimates of income coefficient vary from 1.065 (ARDL) to 0.98 (DOLS). However, the ARDL estimate of relative price coefficient is slightly lower in absolute magnitude as compared with the DOLS estimate over the examined period. The ARDL and DOLS estimates of relative price coefficient are -0.918 and -0.948, respectively. The ARDL and DOLS estimates of coefficients of scarcity premium variable have correct negative sign; however, the coefficient appears statistically significance only in case of ARDL. The statistical significance of the coefficient confirms the existence of a binding foreign exchange constraint on aggregate imports for pre-trade liberalization period in Pakistan.

Table 8

Estimates of Long-run Relationships

Variables	Long-run Estimates	
	ARDL	DOLS
Log (Real Domestic Consumption)	1.065 (7.01)	0.980 (8.13)
Log (Relative Import Prices)	-0.918 (-4.87)	-0.948 (-1.05)
Scarcity Premium	-0.219 (-2.23)	-0.014 (-1.08)
Intercept	-2.258 (-1.43)	3.456 (2.73)
Diagnostic Tests		
Serial Correlation Test	3.563 [0.18]	2.362 [0.35]
Normality Test	1.364 [0.50]	0.382 [0.82]

Note: t-statistics are given in parentheses and p-values are in square brackets.

[6] The values are given in the brackets below the test statistics are p-values.
[7] The estimated t-statistics are reported in the parentheses.

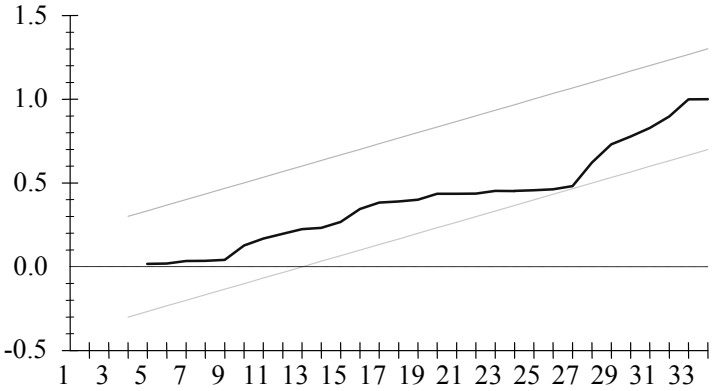
4.2. Stability of the Estimated Parameters

Instability of the estimated elasticity parameters is a major issue in policy analysis. For instance, Marquez (2003) reports evidence of parameter instability in the case of income elasticity for U.S. imports. Such parameter instability could result from mis-specification of the long run import relationship particularly when span over a very long time horizon. Therefore, we test for the stability of the estimated parameters from both ARDL and DOLS by using the Chow break point, CUSUM, and CUSUMSQ tests. According to the Chow breakpoint tests, the ARDL estimates of the parameter are stable over the time and do not show any instability (the estimated F-statistic is 1.78 with P-value (0.15)). The results from CUSUM and CUSUMSQ tests for ARDL estimations are presented in Figures 1a and 1b.

It can be observed from the figures that both of the tests (CUSUM and CUSUMQS) do not provide any evidence of instability in the estimated parameters at 5 percent level of significance for the ARDL estimation method. The results from CUSUM and CUSUMSQ tests for DOLS estimations are given in Figure 2a and Figure 2b, respectively. Since the plot of CUSUM of recursive residuals lies within the critical bound at 5% level of significance, there is no evidence of instability in the estimated parameters for DOLS estimation method. However, as can be observed from the figure, the plot of CUSUMSQ of recursive residuals is crossing the critical lower bound at 5% level of significance. This implies that the estimated parameters are not stable over the time. Overall, the results from the ARDL estimation are relatively better than the DOSL estimation.

Figure 1a

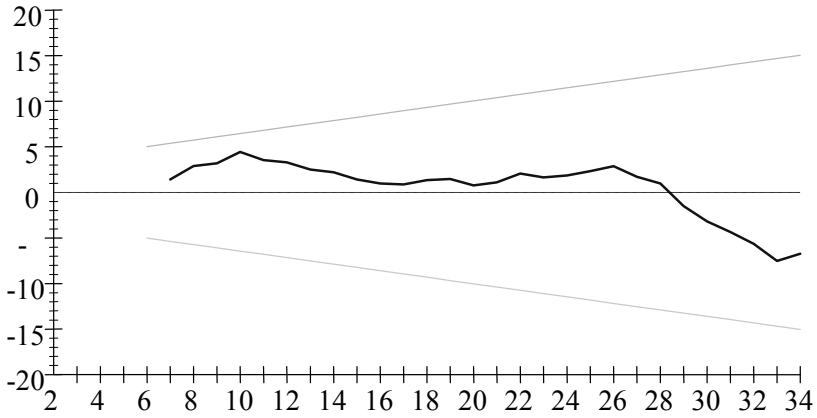
Plot of CUSUMQ of Recursive Residuals (ARDL)



The straight lines represent critical bounds at 5% significance level

Figure 1b

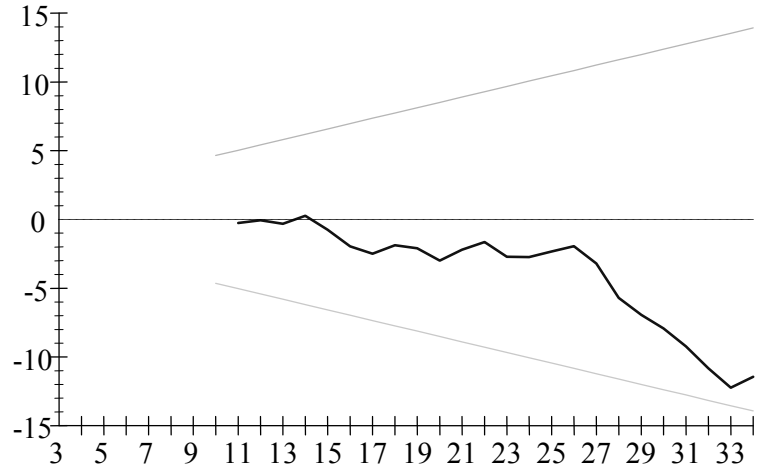
Plot of CUSUMS of Recursive Residuals (ARDL)



The straight lines represent critical bounds at 5% significance level

Figure 2a

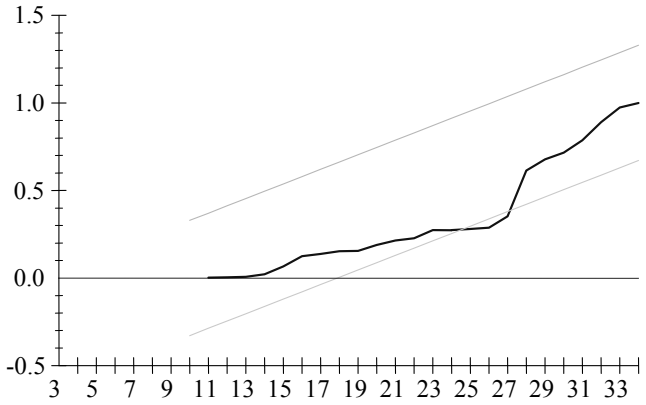
Plot of CUSUM of Recursive Residuals (DOLS)



The straight lines represent critical bounds at 5% significance level

Figure 2b

Plot of CUSUMSQ of Recursive Residuals (DOLS)



The straight lines represent critical bounds at 5% significance level

4.3. Comparison with Alternative Models

4.3.1. Modified Traditional Model

In this sub-section, we present the results of the empirical analysis of the modified traditional model (in our case it called Model II). Model II excludes x_t^*. We also estimate the Model III which incorporates the foreign exchange availability.

The AIC are used to decide on the number of lags to be included in the empirical models. The prime objective here is to select the optimal lag-length that eliminates any autocorrelation present in the residuals. Initially, the three VAR models i.e., first neither includes intercept nor trend, second includes only intercept and third one includes both intercept and a linear trend in cointegration equation, are estimated with four lags for both of the bounds "F" tests and the Johansen's cointegration technique. The estimated AIC statistics suggest three lags for first model and two lags for second and third models. The estimated trace statistics for the modified traditional model with their critical values are presented in Table 9.

Table 9

Johansen Cointegration Results based on Trace of the Stochastic Matrix

Hypotheses		F-Statistic					
		No Intercept, No Trend		With Intercept, No Trend		With Intercept, With Trend	
Null	Alternative	Test Statistics	Critical Value	Test Statistics	Critical Value	Test Statistics	Critical Value
$r = 0$	$r = 1$	43.484	39.810	52.015	53.480	76.156	58.930
$r \leq 1$	$r = 2$	15.431	24.050	18.502	34.870	24.736	39.330
$r \leq 2$	$r = 3$	3.991	11.030	4.191	20.180	1.948	23.830

Note: log of real imports, log of real domestic consumptions, and log of relative prices are included in cointegration vector.

The results in Table 9 provide significant evidences for the existence of the long run association among the said variable over the examined period. The estimated trace statistics are significantly greater than the critical values at five percent level of significance for all specifications.

The long-run parameters of the modified traditional model are estimated by the ARDL and the DOLS methods and are given in Table 10. The results show that the estimates have correct sign when the import equation is estimated in the ARDL framework. Both the estimates (income elasticity and price elasticity) are also statistically significant at 5 percent level of significance. It is interesting to note that the magnitude of income elasticity is very close to one. However, the magnitude of price elasticity (-0.658) is significantly less than one in absolute term.

Table 10

Estimates of Long-run Relationship based on Traditional Modified Model

Variables	Long-run Estimates	
	ARDL	DOLS
Log (Real Domestic Consumption)	1.0015 (7.467)	0.05 (1.235)
Log (Relative Import Prices)	-0.658 (-4.573)	0.89 (1.035)
Intercept	-1.631 (-1.167)	-2.342 (-1.765)
Diagnostic Tests		
Serial Correlation Test	3.480 [0.062]	2.760 [0.154]
Normality Test	1.328 [0.515]	1.234 [0.768]

Note: t-statistics are reported in parentheses and p-values are given in brackets.

Although the DOLS estimate of income elasticity has the correct positive sign but is statistically insignificant. The magnitude of income elasticity, according to the DOLS estimates, is also implausibly small (0.05). Regarding price elasticity in case of DOLS estimations, the estimates provide evidence that the price coefficient has a positive sign and is statistically insignificance at the 5% level of significance. By doing the comparison between both estimation methods, we find that the results from the ARDL model are relatively better as both the price and income elasticity have the correct signs and are statistically significant.

4.3.2 Foreign Exchange Rate Availability Formulation

Finally, we estimated the Model III which incorporates the foreign exchange availability. Initially, the three VAR models – first neither includes intercept nor trend, second includes only intercept, and third one includes both intercept and a linear trend in cointegration equation – are estimated with four lags for both of the bounds "F" tests[8] and Johansen's cointegration technique. To estimate the

[8] The bounds F-test results are presented in Table 3.

Johansen's cointegration test statistics, as suggested by the AIC, we use two lags for first model and one lag for both second and third models. The estimated trace statistics with their critical values are presented in Table 11.

The estimated trace statistics are significantly greater than the critical values at five percent level of significance for all specifications in case of at least one cointegrating vector. Thus, we can conclude that there is a unique long-run statistically significant association among the variables included in cointegration regression. However, as it can be observed from the table, the estimates with specification of both intercept and linear trend provide evidence of the significance of second cointegrating vector as well. Since the first cointegrating vector has the highest eigenvalue, we consider only the first one to estimate the long-run coefficient

Table 11

Johansen Cointegration Results based on Trace of the Stochastic Matrix

Hypotheses		F-Statistic					
		No Intercept, No Trend		With Intercept, No Trend		With Intercept, With Trend	
Null	Alternative	Test Statistics	Critical Value	Test Statistics	Critical Value	Test Statistics	Critical Value
$r = 0$	$r = 1$	101.086	39.810	151.281	53.480	174.404	58.930
$r \leq 1$	$r = 2$	23.100	24.050	29.355	34.870	104.983	39.330
$r \leq 2$	$r = 3$	9.845	11.030	14.011	20.180	19.357	23.830
$r \leq 3$	$r = 4$	3.078	4.160	6.146	9.160	6.999	11.540

Note: log of real imports, log of real domestic consumptions, log of relative prices, and log of foreign exchange reserves are included in the cointegration vector.

The long-run parameters with foreign exchange availability formulation are also estimated by using the two alternative methods (the ARDL and the DOLS). The estimates are reported in Table 12. The income and price elasticity estimates for the ARDL estimation method bear the sign as described by theory (positive in case of income elasticity and negative for price elasticity) and are statistically significant at the 5% level of significance. The income and price elasticity magnitudes are 1.018 and -1.197, respectively. The income elasticity is approximately one which clearly shows the strength of the near identity problem. One the other hand, the estimate of price elasticity is significantly higher than one. The ARDL estimate of the coefficient of foreign exchange availability is relatively small however, it has correct sign. Further, it is highly statistically significant at the 5% level of significance. Finally, the estimates of diagnostic tests provide evidence that the residuals for the ARDL estimation are normally distributed and free from the problem of serial correlation.

The DOLS estimates of income and price elasticity have right signs and are statistically significant at conventional level of significance. However, both estimates are significantly lower as compared to the ARDL estimates. The income elasticity is 0.779 which is less than one as well as than the ARDL estimate of income elasticity. Similarly, the estimate of price elasticity (-0.945) is considerably less than the ARDL estimate of price elasticity in absolute term. Quite contrary to

the ARDL estimates, the DOLS estimate of the coefficient of foreign exchange availability is relatively small and has also implausibly negative sign which does not match with the theory. It is, however, statistically insignificant at the 5% level of significance.

Table 12

Estimates of Long-run Relationship in Foreign Exchange Availability Model

Variables	Long-run Estimates	
	ARDL	DOLS
Log (Real Domestic Consumption)	1.018 (7.224)	0.779 (6.116)
Log (Relative Import Prices)	-1.197 (-6.847)	-0.945 (-5.345)
Log (Foreign Exchange Reserves)	0.472 (2.935)	-0.239 (-1.416)
Intercept	0.318 (0.191)	-0.506 (-0.417)
Diagnostic Tests		
Serial Correlation Test	2.180 [0.156]	3.170 [0.189]
Normality Test	0.328 [0.786]	0.543 [0.762]

Note: t-statistics are reported in parentheses and p-values are given in brackets.

5. Summary and Conclusions

In this paper we test the model of aggregate imports developed by Emran and Shilpi (2010) for Pakistan. The empirical results from both the bounds cointegration tests and the Johansen's method provide strong evidence of the existence of a long-run relationship among the variables included in the long-run import demand models. The long-run estimates of income and price elasticities are highly significant and follow the sign restriction embodied in the theoretical and empirical model. The magnitude of income elasticity is 1.065. The neoclassical economic theory implies that long-run income elasticity should be equal to one; if it is slightly higher than one, then it is supported by new trade theory. The magnitude of income elasticity that we reported in this analysis suggests that for the improvement of trade balance, it is need to adopt certain measures that cause a reduction in income elasticity.

The magnitude of relative price elasticity is -0.918. It is closer to one and is greater than most of the previous studies done in Pakistan. One of the possible explanations for this is that our sample covers the period in which the volume of Pakistan's imports has been increased significantly due to improvements in price related factors, such as the reduction in tariff rates as a result of trade liberalization efforts and relative more competitive exchange rate policies. In addition to this, the reduction in long-run transportation costs or pricing strategies at firm or industry level can also be considered one of the causes of improvement in the price elasticity of imports.

The ARDL estimate of the coefficient of scarcity premium is also significant with correct sign. It confirms the presence of a binding foreign exchange constraint on aggregate import demand for pre-trade liberalization periods. In general, the results confirm the validity of modified form of traditional model. However, when we remove the variable of scarcity premium, the elasticity estimates receive lesser values as compared to the structure import demand model (Model I). Our findings are important for policy analyses in the number of areas, such as exchange rate policy, tariff reduction programs, and imposition of an optimal tax on imports.

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