Estimating Elasticity Function of Jordanian Aggregate Import Demand

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Abstract

This article estimates aggregate import demand function for Jordan using three fully co-integrating regressions over the (1980−2015) period. The bounds testing approach has been employed to test co-integration, while ARDL approach is used to analyze long-run elasticities. The results show a co-integration phenomenon among variables when import volume is dependent variable. In addition, the estimated long-run elasticities of import demand with respect to income and relative prices are 1.16 and -1.03, respectively. The understanding of import demand behavior is crucial for significant import forecasts, international trade planning, and exchange rate policy design.

JEL: A1; C5; G1.

Keywords: ARDL, co-integration, elasticity, Jordan

1. Introduction

The cure objective of this article is to investigate co-integration and long-run elasticities between Jordanian's import demand and its determinants (i.e., income and import prices). However, numerous studies have been conducted to identify co-integration and estimate long-run elasticities of import demand function. Among them are Alam and Ahmed (2010) for Pakistan; Awang (1988), Tang and Mohammad (2000), and Tang and Nair (2002) for Malaysia; Babatunde and Egwaikhide (2010) for Nigeria; Tang (2002) for Indonesia.

A few empirical studies that conducted to examine the determinants of import demand on the Jordanian case contain certain methodological drawbacks (Kreishan, 2007; Majeed, 2007). The methodological techniques that employed in these studies such as Engle and Granger (1987) and Johansen and Juselius (1990) co-integration tests could affect the results obtained from them. For example, Johansen and Juselius (1990) multivariate co-integration test fails to recognize the mixture of stationary time-series variables (i.e., I(0), I(1), and I(2)). Harris (1995) argued that trace and maximum eigenvalues under Johansen and Juselius (1990) multivariate co-integration test could lead to statistical explosive if the I(0) variables are present in the system. In addition, Mah (2000) stated that the conventional co-integration tests (i.e., Engle and Granger (1987) and Johansen and Juselius (1990)) are not reliable for studying small sample size. Thus, a more robust estimation approach – the bounds testing – proposed by Pesaran et al. (2001) is employed in this study. The balance of this paper is organized as the following way. Section 2 discusses methodology and empirical results. Section 3 provides concluding remarks.

2. Methodology and Empirical Results

In this study, the following specification is considered for import demand function see Tang and Nair (2002):

$$M_t = f(Y_t, MP_t) \tag{1}$$

Where, M_t is the aggregate imports quantity (goods and services) demanded at period t expressed in local currency unit Jordanian Dinar (JD); Y_t is the income, gross domestic product (GDP) per capita, expressed in JD; MP_t is the import value index (2010 = 100). However, the sample used in the current study covers annual observations for the (1980−2015) period. The raw time-series data is obtained from World Bank, Development Indicators Databases (2016). The import demand function in economy can be fully modeled by two factors (i.e., the GDP per capita and import value index). The import value index includes commodity adjusted for exchange rate, which gives a measure of real exchange rate. The log-linear formulation is more appropriate than the linear one (Eq. (1)). The log-linear specification avoids

some estimation problems, particularly skewness, heteroscedasticity, and multicollinearity (Mugableh, 2015a). Thus, the log-linear specification is shown as in Eq. (2).

$$\text{LogM}_t = \beta_0 + \beta_1 \text{LogY}_t + \beta_2 \text{LogMP}_t + \varepsilon_t \tag{2}$$

Where, ε_t is the white noise term distributed with zero mean and constant variance (i.e., $\varepsilon_t \sim N(0, \sigma^2)$). Based on the economic theory, the signs of coefficients are expected to be as follows: $\beta_1 > 0$ and $\beta_2 < 0$. A positive relationship is hypothesized between income and imports, while an inverse relationship is expected between price and imports. However, the results of correlation matrix in Table 1 show that the variables are linearly correlated between each other. This implies the appropriate estimation of import demand function in Jordan.

The second step is to determine the order of integration, I(d), for the variables before applying co-integration analysis, like bounds F-statistics test. The application of bounds F-statistics test is based on assumption that none of variables are integrated at level more than one (Pesaran et al., 2001). Phillips and Perron (1988) unit root test is designed to be robust for the presence of autocorrelation. The results of Phillips and Perron (1988) test in Table 2 show that all variables are stationary at I(1). Thus, the current study employs bounds F-statistics test under the ARDL approach framework (see Eq. (3)). This approach has a major advantage over conventional co-integration tests (i.e., Engle & Granger, 1987; Johansen & Juselius, 1990). That is, it can be applied irrespective of whether the series variables are integrated of order I(1), I(0), or mixed (Almsafir et al., 2011; Bekhet & Mugableh, 2012; Bekhet & Mugableh, 2013; Bekhet & Mugableh, 2016; Mugableh, 2015b; Mugableh, 2015c; Mugableh, 2015d; Mugableh, 2013; Narayan, 2005). In fact, if the variables are stationary at I(0), the regression analysis might yield biased results when using conventional co-integration tests. These tests are applicable when variables are stationary at same order of integration (i.e., I(1) or I(2)).

$$\Delta \text{LogM}_t = \alpha_0 + \alpha_1 \text{Log M}_{t-1} + \alpha_2 \text{LogY}_{t-1} + \alpha_3 \text{LogMP}_{t-1} +$$

$$\sum_{s=0}^{h} \alpha_4 \Delta \text{LogM}_{t-s} + \sum_{s=0}^{h} \alpha_5 \Delta \text{LogY}_{t-s} + \sum_{s=0}^{h} \alpha_6 \Delta \text{LogMP}_{t-s} + \text{EcM}_{t-1} + \varepsilon_t \tag{3}$$

Where, Δ signifies the first difference operator; α_0 is the drift component; ε_t stands for white noise error term; α_1, α_2, and α_3 represent the long-run coefficients of one lagged variables; h is the lag length; α_4, α_5, and α_6 are the short-run coefficients of first difference variables.

Narayan (2005) proposed that the bounds test is based on Wald or F-statistics for co-integration analysis. In Eq. (3), the null Hypothesis (H$_0$) of no co-integration considers the coefficients of one lagged variables (i.e., LogM$_{t-1}$, LogY$_{t-1}$, and LogMP$_{t-1}$). For conventional significance levels of 1%, 5%, and 10%, if the computed F-statistics value is lesser than the F-statistics critical value at level I(0), the H$_0$ would be accepted. In contrast, if the computed F-statistics value is larger than the F-statistics critical value at level I(1), the H$_0$ would be rejected, implying the existence of long-run relationships among variables. From the estimated ARDL approach, the long-run elasticities are the coefficients of one lagged independent variables multiplied by negative signs and divided by coefficient of one lagged dependent variable (Bardsen, 1989). Therefore, the long-run relative price elasticity and income elasticity are $-(\alpha_3/\alpha_1)$ and $-(\alpha_2/\alpha_1)$, respectively. The short-run effects are captured by the coefficients of first differenced variables in Eq. (3).

In selecting the lag length (h), a set of estimations is conducted with h = 1, 2, and 3. Nevertheless, the Akaike information criterion (AIC) and Schwartz information criterion (SIC) fail to give a final decision. The h = 1 is selected based on AIC and h = 2 is selected based on SIC. To select the best-fit specification, the Ramsey RESET test with h = 2 is chosen. For h = 2, the log likelihood computed value is 0.30 (probability = 0.62), accepting the H$_0$ of no misspecification. For h = 1, the Ramsey Reset test was statistically significant at the 5% level, hence, rejecting the H$_0$ of no misspecification.

Table 1. Screening data statistics tests

	LogM$_t$	LogY$_t$	LogMP$_t$
Mean	3.71	1270.13	140.33
Standard deviation	1.10	204.805	118.46
Jarque−Berra	4.79	2.81	10.7
P-value	0.10	0.25	0.11
R^2	0.86		
Adjusted R^2	0.85		
Correlation matrix			
LogM$_t$	1.00		
LogY$_t$	0.67	1.00	
LogMP$_t$	0.82	0.75	1.00

Notes: (1) R^2 denotes the coefficient of determination. (2) Source: E−Views econometrics software package.

Table 2. Unit root test results

Variable	t-statistics computed values		t-statistics critical values		
	I(0)	I(1)	1%	5%	10%
$LogM_t$	-1.90	-5.28[***]			
$LogY_t$	-0.81	-4.15[**]	-4.27	-3.56	-3.21
$LogMP_t$	0.26	-5.89[***]			

Notes: (1) The estimation has been conducted using intercept and time trend. (2) Parzen Kernel estimation method has been selected to choose the bandwidth: 2. (3) [***], [**] denote the significance at 1% and 5% levels, respectively based on Mackinnon (1996) one side p-values. (4) Source: E−Views econometrics software package.

The estimated long-run and short-run elasticities results are reported in Table 3. The estimated long-run income elasticity and relative price elasticity are 1.16 and -1.03, respectively. These results are found to be closer with the previous study's results of Tang and Nair (2002) in Malaysia. They found that the long-run income elasticity and relative price elasticity are 1.55 and -1.30, respectively. The coefficient of EcM_{t-1} (-0.67) is negative and is statistically significant, confirming that the series is non-explosive and that long-run equilibrium is satisfied.

Table 3. The estimated ARDL approach for Jordanian import demand function

Variable	Coefficient	t-statistics
Constant	12.1[***]	2.90
$LogM_{t-1}$	0.37[*]	1.88
$LogY_{t-1}$	0.43	1.02
$LogMP_{t-1}$	-0.38[*]	-1.74
$\Delta LogY_t$	-0.01	-0.06
$\Delta LogMP_t$	0.26[***]	3.81
EcM_{t-1}	-0.67[***]	-4.20

Notes: (1) [***],[*] denote the significance at 1% and 10% levels, respectively. (2) The dependent variable is $\Delta LogM_t$. (3) Sample: 1980−2015 included 36 observations. (4) Durbin-Watson statistics value: 1.57. (5) F-statistics value: 6.17 (p-value: 0.00). (6) Source: Micro-Fit econometrics software package.

To ascertain the existence of a long-run relationship or co-integration among the variables, the bounds F-statistics test is employed under the ARDL approach framework. However, the results of the bounds F-statistics test (Table 4) show that the computed F-statistics value (6.55) exceeds the bounds F-statistics critical value (5.82) at the 1% significance level. This implies that volume of imports and its determinants (i.e., national income and relative price) are co-integrated or co-moving.

Table 4. Co-integration test results

Function	Computed F-statistics value	Tabulated F-statistics values					
		1%		5%		10%	
		I(1)	I(0)	I(1)	I(0)	I(1)	I(0)
$LogM_{t-1} = f\ (LogY_{t-1}, LogMP_{t-1})$	6.55[*] (Lag structure, h = 2)	5.82	4.43	4.19	3.16	3.53	2.62

Notes: (1) The tabulated F-statistics values were retrieved from Narayan (2005, Case II: restricted intercept and no trend, p. 1987). (2) [*] denotes the significance at 1% level. (3) Source: The computed F-statistic value was obtained from Micro-Fit econometrics software package.

3. Concluding Remarks

The main objective of this article is to reexamine the Jordanian import demand function over the (1980−2015) period using a more robust estimation model, namely the ARDL approach. The results of bounds F-statistics test disclose that the import volume and its determinants are co-integrated. The findings of estimated long-run elasticity for income and relative prices are 1.16 and -1.03, respectively. From the above conclusions, two policy implications could be briefed. First, the Marshall-Lerner condition is satisfied. That is, Salvatore (1995) argued that a stable foreign exchange market exists if the sum of price elasticities of demand for imports and exports, in absolute value, is larger than one. Second, based on the estimated relative price elasticity, the import volume is sensitive to the increases in domestic price levels. Therefore, any increase in domestic inflation rates would generate a higher volume of imports. In this manner, the Jordanian policy makers ought to employ severe fiscal and monetary policies to keep inflation at reasonable rates.

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