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Do South Asian Countries Experience Intertemporal Budget Constraint? The ARDL Bound Test Approach

Md Rabiul Karim[1]
Md. Jahedul Islam[2]

Abstract

The main purpose of this paper is to bring forth a contemporary and strong estimation of the long-run relationship between exports and imports for five South Asian countries from 1965 to 2019. Applying Autoregressive Distributed Lag (ARDL) bound testing approach to cointegration with individual country, it is found that there exists a long-run cointegration between exports and imports in Bangladesh, India, Nepal, Pakistan, and Sri Lanka. This study also found that Nepal, Pakistan, and Sri Lanka have fulfilled the sufficient condition for intertemporal budget constraints except for Bangladesh and India. However, the trade deficit of Pakistan and Sri Lanka is sustainable in the long run, meaning that it has a long-run trade balance as well as a current account balance while Bangladesh and India's current account position is unsustainable implying a long-run trade imbalance. The cointegration results were complemented with the CUSUM and CUSUMSQ tests for parameter stability and found stable over the period.

Keywords: Trade, Budget Constraint, ARDL, South Asia

1. Introduction

Current account deficits either in short-term or in long-term may have thoughtful implications for an economy. Especially, the long-run (LR) sustainability of the current account balance is mandatory since it bears the testimony of the overall healthiness of a good economy. Long-term current account deficits might raise the domestic interest rates, depreciate the home currency, and create a huge burden of interest payment leading to poor standards of living of the mass (Apergis, Katrakilidis & Tabakis, 2000). By contrast, the short-term deficits might not have

[1] Assistant Professor, Department of Economics, Jagannath University, Dhaka-1100, Bangladesh
Email: rabiul@eco.jnu.ac.bd

[2] Assistant Director, Research Department, Bangladesh Bank, Head Office, Dhaka-1000, Bangladesh
Email: jahedul.islam@bb.org.bd
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serious problems other than that of a reallocation of capital among trading countries (Wu, 2000). If a country's export and import are cointegrated or have a LR relationship, then it implies that it does not violate its intertemporal budget constraint, which further suggests that trade deficit is a short-run (SR) phenomena and is sustainable in the LR. It advocates that macroeconomic strategies have been operative in leading exports and imports to a LR equilibrium relationship, hence the productivity gap between trading countries of the world and domestic countries will not be persistent. It implies that domestic countries have a deficiency in permanent technological shock (Irandoust & Ericsson, 2004). Thus, the condition of whether exports and imports are cointegrated or has a LR relationship or not is mandatory for achieving trade balances to plan and assess the present and forthcoming macroeconomic strategies (Bahmani-Oskoee & Ree, 1997).

Over the past decades, several studies have been found on the LR association between exports and imports in different developed, under-developed, and developing countries (See Appendix Table 1A). For instance, Bahmani-Oskoee (1994), Arize (2002), Narayan and Narayan (2005), Dulger and Ozedemir (2005), Kalyoncu (2006), Kim et al. (2009), Tang (2006), Awokuse (2006), Konya and Singh (2008), Dumitriu et al. (2009), Çelik (2011), Murad (2012), Al-Khulaifi (2013), Ali (2013), Husein (2014), Pillay (2014), Baek (2015), Murad, Shahjahan and Hussain (2015) these researchers have found some thoughtful conclusions over the decades. Some studies found that exports and imports are cointegrated while other found that there is no cointegrating relationship between the said variables. But in most of the cases, a cointegrated relationship between the variables have been found. Below is a short review of contemporary studies that explored the equilibrium association between the said variables in the LR.

By applying different co-integration methods, Baharumshah (2003) found that except Malaysia, there is a LR association between the said variables in the Philippines, Indonesia, and Thailand. To examine the LR association between exports and imports of developed countries, for example, Germany, France, Italy, UK, Sweden, and the USA, Irandoust and Ericsson (2004) summarized that exports and imports of Sweden, Germany, and the USA are found to be cointegrated but not in the perspective of UK from the statistical outcome. However, Tang (2006) found the existence of a LR association between the variables for 9 out of the 27 Organization of Islamic Conference (OIC) member nations. By applying different cointegration testing approaches with structural breaks among the Middle East and North African (MENA) countries, Gregory and Hansen (1996) also found no cointegration for Algeria, Egypt, Iran, Jordan, Syria, and Tunisia but Morocco, while Husein (2014) found a LR association for Israel, Iran, Jordan, and Tunisia.

Apart from that, Baek (2016) reexamined the LR association for G-7 countries (Group of Industrious Countries) and found cointegration between the said variables for Canada, France, Germany, Japan, and the United Kingdom except for Italy and the USA.

In recent years, the cointegration relationship between export and import is increasing attention and has been investigated for many countries. Several studies have found regional-based analyses such as G-7, MENA, Organization for Economic Co-operation and Development (OCED), European Union (EU), transition economies, OIC, etc. On the other hand, the existing research has focused mainly on either country-wise panel data or time-series data of grouped countries. The studies that have adopted time series data for specific countries mostly run with comparatively small sample sizes. Thus dealing with the small sample size, the tendency of under-rejection or over-rejection the null whether it is false (true) remains and hence increasing the query regarding the soundness of the true results. Hence, a contemporary investigation for this theme has been required. Thus to the best of the authors' knowledge, existing studies are yet to examine the LR relationships between exports and imports based on the South Asian region. The South Asian countries that are made up of India, Pakistan, Bangladesh, Bhutan, Maldives, Afghanistan, Nepal, and Sri Lanka comprise 21% of the world's population, 4.21% (USD 3.67 trillion) of the global economy, and 3% of the world's area as of 2019 (Baek, 2016). Due to the deficiency of sufficient data, this study excludes Afghanistan, Bhutan, and the Maldives. Thus, the major concern of this paper is to investigate the long-run relationship between exports and imports for the selected South Asian countries as well as to examine whether these countries follow intertemporal budget constraints or not by using advanced sophisticated econometric modeling from the period 1965-2019.

The rest of this study has been arranged as follows. After an introduction, section two represent the theoretical background of the model, section three present estimation technique, data and empirical results are analyzed in section four and finally section five represents the conclusions.

2. Theoretical Background of the Model

A simple theoretical framework has been developed by Husted (1992) for a small open economy to explore the association between exports and imports in LR equilibrium. This theoretical model assumes that an individual economy harvests and trades a particular good without governmental intervention, can advance and borrow at the prevailing world interest rate from the international markets, and its prime concern is to maximize utility for a given budget constraint. Typical individual economy's budget constraint in period t is given by

$$C_0 = Y_0 + B_0 - I_0 - (1 + r_0)B - 1 \qquad (1)$$

Where, C_0 is the current consumption; Y_0 is the output; I_0 is the investment, B_0 is the international borrowing which could be negative or positive; r_0 is the one period world interest rate and $(1 + r_0)B_{-1}$ is the primary size the individual economy's external debt. The above equation (1) has to be held for every single period, and accordingly, the intertemporal budget constraint of an individual economy can be derived by combining every single period meaning the amount of an individual economy advances (borrows) from international markets is equals to the present value of the future trade deficits (surplus).

To drive a pragmatic provable model from equation (1), Husted (1992) made various assumptions, for instance, the world interest rate will be stationary with mean r and both imports and exports shall be non-stationary meaning that both follow a random walk with drifts.

The equation (1) modifies in the following form:

$$EX_t = \alpha + \beta_1 IM_t + e_t \qquad (2)$$

Where, IM and EX means imports and exports of goods and services respectively. This equation (2) can be accustomed to examine *strong* and *weak* conditions for the intertemporal budget constraint. The necessary condition (*weak* form) for the intertemporal budget constraint holds if e_t to be stationary or I(0). If this condition is not encountered, this implies that the economy is not truly operating and fails to satisfy its budget constraints. Accordingly, it is expected to default on its debt (Hakkio & Rush, 1991) as well as it also provides evidence contrary to the robustness of the current account stability (Narayan & Narayan, 2005). On the contrary, the sufficient and necessary condition (*strong* form) for the intertemporal budget constraint holds if $\beta_1 \; equal \; 1$ and e_t is found to be a stationary then the equation (2) represents a theoretical framework to determine the sustainability of the current account surplus (deficit).

3. Estimation Technique

To examine the LR association between exports and imports in the South Asian countries this study used the autoregressive distributive lag (ARDL) bound testing co-integration methods for individual countries developed by Pesaran et al. (2001). The bounds test results for co-integration is performed better and provide more robust results for finite samples size than the other common cointegration analysis. On the other hand, this test is certainly free from the burden of accomplishing the equivalent order of integration (i.e. I (1) or integrated of order one) among different variables. Thus, when the variables are not known with certainty whatever the series are I (0) or I (1) it is a very effective method to investigate the true cointegrating association among various variables.

Moreover, the bound test approach allows using various numbers of lags on different variables in a model compared to that of other standard cointegration methods. So, this method helps to suit comprehensive and appropriate investigations for recognizing the exact cointegrating relationships between imports and exports. For bound testing methods, this study formulates unrestricted error correction (UEC) as follows:

$$\Delta lnEX_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \, \Delta lnEX_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \, \Delta IM_{t-i} + \alpha_3 EX_{t-1} + \alpha_4 \, IM_{t-1} + \varepsilon_{1t} \qquad (3)$$

$$\Delta lnIM_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \, \Delta lnIM_{t-i} + \sum_{i=0}^{q} \beta_{2i} \, \Delta EX_{t-i} + \beta_3 EX_{t-1} + \beta_4 \, IM_{t-1} + \varepsilon_{2t} \qquad (4)$$

Here, EX and IM are exports and imports respectively, α_0 is the constant, α_1 and α_2 represents the short run and α_3 and α_4 represent the LR parameters.

By applying the bound testing procedure in equation (3) we can identify the association between EX_t and IM_t in the LR via the testing of the lagged levels of variables (EX_{t-1} and IM_{t-1}). The null hypothesis (showing no co-integration between the variables H_0: $\alpha_3 = \alpha_4 = 0$) against the alternative hypothesis (showing co-integration between the variables H_1: $\alpha_3 \neq \alpha_4 \neq 0$) is tested using the standard F-test. It shall be noted that Pesaran et al. (2001) provide asymptotic critical value, the upper and the lower bound values, whatever all the variables are I(1) or I(0) processes covering all possible classifications. A conclusion can be made based on the calculated F-statistics value by comparing it with the critical bound value.

For example, if the computed F-statistics is greater than the upper bound of critical values then the alternative hypothesis of cointegration is accepted and vice versa. The inference will be undetermined if the value of computed F-statistics is remaining the same as critical bound value. The LR coefficient can be found by applying the ARDL bound testing approach based on Akaike Information Criterion (AIC). For further evidence within the ARDL framework, this study has estimated the error correction term as well.

To get more reliability of the empirical findings this study also implied three different methods – Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS), and Canonical Cointegration Regression (CCR) on the same dataset. The stability of the parameters is examined by performing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ).

4. Data and Empirical Results

This study has used annual time series data on exports and imports of goods and services for all countries from1965[3] until 2019 which are measured in current US dollars, obtained from World Bank-World Development Indicators. All data series has been transformed to natural logarithm also.

4.1 Unit Root Tests

Unit root test is a prerequisite to check the stationary of the variables in any conventional cointegration approach. Since, the bound test methods are inapplicable if *I*(2) processes persists it is mandatory to run a unit root test to confirm, whether this study has *I*(2) variables or not. Hence, this study applied the Dickey Fuller generalized least squares (DF-GLS) test (Elliot et al.1996) to check if there is any *I*(2) variables in the model. The DF-GLS unit root tests results of 10 variables are shown in table 2.

[3] Though Bangladesh achieved independence in 1971, due to the availability and homogeneity of long time-series data as well as better result and interpretation, this study considered 1965 as an inception period of Bangladesh.

Table 2: Dickey-Fuller Generalized Least Squares (DF-GLS) Unit root Test Results

Variables	Bangladesh	India	Nepal	Pakistan	Sri Lanka
InEX	-1.46 (1)	-2.06 (1)	-1.66 (1)	-1.29 (1)	-4.07** (7)
ΔlnEX	-9.69** (0)	-4.68** (0)	-7.67** (0)	-7.02** (0)	___
Decision	I (1)	I (1)	I (1)	I (1)	I (0)
InIM	-2.41 (0)	-2.69 (1)	-2.99 (0)	-1.85 (0)	-3.31 (0)
ΔlnIM	-8.40** (0)	-4.84** (0)	-6.63** (0)	-6.24** (0)	-5.19** (3)
Decision	I (1)	I (1)	I (1)	I (1)	I (1)

Note: *** and ** indicate significant at the 1% and 5% levels, respectively. These values for the DF-GLS are -3.58 and - 3.03 for constant and trend respectively. The lag lengths selected by AIC (MAIC) shows in parentheses.

The results from the table exhibit that the null hypothesis of a unit root cannot be rejected at a 5% significance level for the 9 variables out of the 10. But after the first difference or integration of order *I*(1) all the variables are rejected except one which is stationary at *I*(0). Hence, from the above results, this study ensured that the ARDL bound test to cointegration approach can be pursued safely on data because of the mixed approach meaning that all the variables are either *I* (0) or *I* (1).

4.2 ARDL Bound Test

To determine the association between the said variables for the selected South Asian economies, in the LR, this study used the F-test from the bound testing to co-integration approach. For calculating the F-statistics each variable (EX, IM) has been considered as the dependent variable because of the possibility of bi-directional or unidirectional causality between the variables. The bound test approach outcomes are shown in the table 3 below.

Table 3: Results of ARDL bound testing Methods

Country	F (EX_t/IM_t)		F (IM_t/EX_t)	
	F-statistics	$\chi^2(1)$	F-statistics	$\chi^2(1)$
Bangladesh	8.39	0.15	9.58	0.65
India	31.84	0.33	43.40	0.58
Nepal	8.38	0.50	9.84	0.17
Pakistan	12.36	0.35	10.49	0.58
Sri Lanka	29.47	0.27	24.80	0.26

Note: The upper and lower critical value of bound are 5.58 and 4.94 respectively at 5% significance level. $X^2(1)$ is LM statistic for testing no serial correlation against order 1.

The outcomes indicate that, when it is considered exports as a dependent variable (EX_t/IM_t), then the calculated value of F-statistics at the 5% level is higher than the upper critical value 5.58 for all countries (Bangladesh, Nepal, India, Pakistan, and Sri Lanka). Therefore, it indicates the acceptance of the alternative hypothesis of cointegration. Conversely, the same result happened when it has been taken imports as a dependent variable (IM_t/EX_t). Hence, the above outcomes suggested that there exists a LR association between the variable for all countries. The Lagrange multiplier (LM) test is applied against in order 1, $\chi^2(1)$ to check no serial correlation of the error term ε_t in equation (3). The outcomes are depicted in table 3 which exhibits that the null hypothesis is accepted at any level of significance for all cases, recommending that there is no serial correlation in the above model.

Since there is a LR association between imports and exports for Bangladesh, Nepal, India, Pakistan, and Sri Lanka, the LR coefficients can be estimated on the basis of Akaike Information Criterion (AIC), the study used the ARDL model outlined by equation (3).

Table 4: Estimated Long-run Results

Country	Long-run coefficient	EC_{t-1}	CUSUM	CUSUMSQ
Bangladesh	1.12*** (0.000)	-0.24*** (0.000)	unstable	stable
India	1.05*** (0.000)	-0.37*** (0.000)	stable	stable
Nepal	0.80*** (0.000)	-0.24*** (0.000)	stable	stable
Pakistan	0.98*** (0.000)	-0.13*** (0.000)	stable	stable
Sri Lanka	0.95*** (0.000)	-0.55*** (0.000)	unstable	stable

Note: *** denote significant at 1% levels. EC_{t-1} Present an error-correction term. The p values are in parentheses.

The results of Table 4 indicate that at a 1% significance level the error correction coefficients are statistically significant and negatives for all countries. This assures the confirmation of cointegration between exports and imports and specifies that SR trade deficits are temporary phenomena and are sustainable in the LR. Results obtained from ARDL are significant statistically and positive at the 1% significance level. The estimated LR coefficient of Bangladesh and India are more than one that means they violate the intertemporal budget constraints, indicates that a 1% rise in exports persuades more than 1% rise in imports, precisely, a 1% rise in exports is corresponding with a 1.12% and 1.05% rise in imports respectively in Bangladesh

and India, indicating LR trade deficit and unsustainable current accounts positions. In addition, the estimate of the slope coefficients for the total exports and imports of Pakistan and Sri Lanka were very close to unity for the ARDL. This is demonstrating that one dollar of imports is matched by one dollar of exports in the long-run, following in a LR trade balance as well as a current account balance meaning that the trade deficit is sustainable in the LR. However, the estimated coefficients of Nepal are less than one meaning that imports of this country are fully covered by export earnings, and therefore suggesting that this country is not in violation of its intertemporal budget constraints. At last, by applying Cumulative Sum (CUSUM) and CUSUM of square tests. It is found that all variables are stable over a while hence the ARDL results to be more determined. In addition, to get the reliability of the empirical findings, this study used three alternative methods like Dynamic Ordinary Least Squares (DOLS), Fully Modified Ordinary Least Squares (FMOLS), and canonical cointegration regression (CCR) shown in table 5 below.

Table 5: The Estimated Long-run Coefficients Results using DOLS, FMOLS, and CCR Methods.

Country	DOLS	FMOLS	CCR
Bangladesh	1.13***	1.14***	1.13***
	(0.000)	(0.000)	(0.000)
India	1.03***	1.01***	1.01***
	(0.000)	(0.000)	(0.000)
Nepal	0.81***	0.80***	0.81***
	(0.000)	(0.000)	(0.000)
Pakistan	0.99***	0.98***	0.99***
	(0.000)	(0.000)	(0.000)
Sri Lanka	0.96***	0.95***	0.96***
	(0.000)	(0.000)	(0.000)

Note: *** denote significant at 1% levels. p values are in parentheses.

The results exhibit the same as found by the ARDL bound testing methods and all the results are also very consistent for all countries. Thus, these three methods enlighten the findings that exports and imports are cointegrated meaning that a LR association exists in the South Asian countries. Apart from that, all countries specifically Nepal, Pakistan, and Sri Lanka, with the exception of Bangladesh and India, follow intertemporal budget constraint.

5. Conclusion

The aim of this study is to investigate a LR association between exports and imports in the selected South Asian countries to examine whether these countries follow intertemporal budget constraints or not. To estimate the LR elasticities, this study has applied autoregressive distributed lag (ARDL) bounds testing methods to

cointegration, FMOLS, DOLS, and CCR and found that there exists a LR association between exports and imports in Bangladesh, India, Nepal, Pakistan, and Sri Lanka. Since the estimated LR coefficients of Nepal is less than one it suggests long-run current account sustainability and thus constructive macroeconomic policies to lead exports and imports to equilibrium in the LR. For Pakistan and Sri Lanka, on the other hand, the coefficient values were nearly close to unity implying a LR trade balance as well as a current account balance meaning a sustainable trade deficit in the LR. In contrast, the coefficients' values of Bangladesh and India are more than one indicating trade imbalance in LR and therefore unsustainable current accounts position. The focuses of policy implication are rather straightforward. In the case of Bangladesh and India, trade imbalance could be reduced through proper exchange rate adjustments which would be quite favorable in boosting remittance inflow and export performances.

Appendix

Table 1A: Summary of the Selected Studies on a Long-Run Relationship between Exports and Imports

Authors	Countries	Methods	Data	Results
Bahmani-Oskoee (1994)	Australia	OLSQ	1966-1990 (quarterly)	Co-integrated
Arize (2002)	50 OCED and developing countries	Johansen co-integration test	1973-1998 (annually)	Co-integrated 35 countries out of 50
Dulger & Ozedemir (2005)	G-7 countries	Johansen co-integration test	1974-2001 (quarterly)	Co-integrated 3 countries out of 7
Narayan& Narayan (2005)	22 LDC	ARDL, DOLS, Engle Granger	1960-2000 (annually)	Co-integrated 3 countries out of 22
Kalyoncu (2006)	22 OCED countries	Panel unit root test	1960-2000 (annually)	Co-integrated
Kim et al. (2009)	Malaysia, Thailand, Korea, Indonesia and Philippines	Nonlinear unit root test	1981-2003 (quarterly)	Co-integrated for all countries
Tang (2006)	27 Organization of Islamic Conferences (OIC) member	Gregory and Hansen Cointegration Tests	1990-1999 (annually)	Co-integrated for 9 countries
Awokuse, T. O. (2006)	03 Transition economies	ADF, KPSS, ECM,	1994-2004 (annually)	Co-integrated

Authors	Countries	Methods	Data	Results
Konya & Singh (2008)	India	Johansen's trace test & Saikkonen-Lütkepohl cointegration test	1950-2005 (annually)	No co-integration
Dumitriu et al (2009)	Romania	Engle-Granger, Johansen & Breitung test	2005-2009 (Monthly)	No co-integration
Celik (2011)	Turkey	Johansen cointegration test & VECM	1990-2010 (annually)	No co-integration
Murad (2012)	Bangladesh	Johansen cointegration test & VECM	1973-2009 (annually)	Co-integrated
Ali (2013)	Pakistan	Johansen cointegration test	1972-2010 (annually)	Co-integrated
Al-Khulaifi(2013)	Qatar	Johansen cointegration test	1980-2011 (annually)	Co-integrated
Pillay (2014)	South Africa	Johansen cointegration test & VECM	1985-2012 (annually)	Co-integrated
Husein (2014)	MENA (Middle East and North Africa)	ARDL	2005-2009	Co-integrated for 4 countries
Baek (2015)	G-7 countries,	ARDL, DF-GLS, FMOLS, DOLS,CCR, ECM	1989-2013 (annually)	Co-integrated for 5 countries
Murad, Shahjahan & Hussain (2015)	Bangladesh with 19 major trading partners	Johansen-Juselius test, VAR, VECM,	1977- 2012 (annually)	Co-integrated

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