

## **Exchange Rate and External Debt Nexus: ARDL Model Approach to Sri Lanka**

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### **Introduction**

In recent decades a vast number of studies have focused on the link between exchange rates (ER) and different causal factors. The ER is one of the most crucial macroeconomic factors in the emerging and transition economies. It affects public debt, inflation, trade and other economic activities. The ER has long been thought to have significant impact on the import and export of goods and services. Therefore, ER is expected to stimulus the price of those products that are traded. Shaheed (2015) concludes that external debt, debt service payment and foreign reserves have a positive impact on ER in the long run. Although, most of the economies currently facing issue of currency depreciation, which makes the trade balance and balance of payment (BOP) favorable and moves towards the surplus and boosts the country's economy. However, the situation of Sri Lanka is totally different that it. Even though, Sri Lanka has experienced continuous currency depreciation since 1977, it has recorded that the deficits in the trade balance and BOP. The one way of solving the budget deficit (BD) or BOP problem is to allow the currency depreciation. Another ways are to use internal and external sources of deficit financing. Since Sri Lanka faces difficulties in accumulating the internal sources, the demand for external sources of deficit financing has been increased. As a result, external debt of the country has increased. On the contrary, BOP deficit and BD tend to decrease the foreign reserves (FR). The currency depreciation leads to increase the value of interest rate than

the real value. As a result, real value of debt servicing will be higher than value of debt.

The significant number of existing literature identified a positive relationship between exchange rate and external debt (e.g., Alam and Taib, 2013; Awan et al. > 2015; Shaheed et al., 2015; Draz and Ahmed, 2015). However, the quantitative assessment of the relationship between ER and external debt is inadequate and limited in the context of Sri Lanka. Thus, this study attempts to fill this gap by investigating the ER and external debt nexus in the context of Sri Lanka.

### **Objectives**

The main objective of this research is to identify relationship between exchange rate and external debt in the long run and in the short run.

### **Methodology**

Annual data of Sri Lanka over the period of 1977-2015 has been used in this study. The data of exchange rate (ER), external debt (ED), foreign reserve (FR), budget deficit (BD), and debt service payment (DSP) were extracted from annual reports of Central Bank of Sri Lanka (CBSL) and consumer price index (CPI) was collected from the World Development Indicator (WDI) data base. Further, political instability (PI) and exchange rate regime (ERR) were used as dummy variables. All the variables, except PI and ERR, are transformed in to natural logarithm. ADF and PP unit root test methods were adapted to test that the series are not containing I(2) variables. Akaike Information Criterion (AIC) is applied to determine the optimal lag length of each series. Following the empirical literature in determinants of ER, we develop the long-run relationship between the variable as below:

$$\text{LER}_t = \beta_0 + \beta_1 \text{LED}_t + \beta_2 \text{LBD}_t + \beta_3 \text{LFR}_t + \beta_4 \text{LCPI}_t + \beta_5 \text{LDSP}_t + \beta_6 \text{PI}_t + \beta_7 \text{ERR}_t + \varepsilon_t \quad (1)$$

where,  $\varepsilon_t$  is a white noise error term,  $t = 1, 2, \dots, T$ .

The Engel Granger method and Johansen method requires that the all of the variables in equation (1) should be integrated in same order and the error term should be integrated in order zero in order to form the long run relationship. However, if variables in equation (1) have different order, that is I(1) and I(0) we can use new co-integration method which was developed by Pesaran et al., (2001). This procedure, also known as autoregressive distributed lag (ARDL) approach to co-integration. The ARDL co-integration bound testing procedure is given by equation (2):

$$\Delta LER_t = \rho_0 + \vartheta' LZ_{t-1} + \sum_{i=1}^p \eta_i \Delta LER_{t-i} + \sum_{i=0}^p \pi_i' \Delta LZ_{t-i} + \delta' D_t + u_t \quad (2)$$

where,  $\vartheta' = [\vartheta_1, \dots, \vartheta_6]$  refers to the long run coefficients;  $LZ_{t-1} = [LER_{t-1}, LED_{t-1}, LBD_{t-1}, LFR_{t-1}, LCPI_{t-1}, LDSP_{t-1}]$  is the vector of explanatory variables with lag one;  $\eta_i$  and  $\pi_i' = [\pi_{1i}, \dots, \pi_{5i}]$  refers to the short run dynamic coefficients,  $\Delta LZ_{t-i} = [\Delta LED_{t-i}, \Delta LBD_{t-i}, \Delta LFR_{t-i}, \Delta LCPI_{t-i}, \Delta LDSP_{t-i}]$  denotes the vector of explanatory variables with lag  $i$  and  $u_t$  is the white noise error term.

The equation (2) can be further transformed as in equation (3) to accommodate the error correction term with one period lagged (ECT<sub>t-1</sub>):

$$\Delta LER_t = \beta_0 + \sum_{i=1}^p \eta_i \Delta LER_{t-i} + \sum_{i=0}^p \pi_i' \Delta LZ_{t-i} + \delta' D_t + \gamma ECT_{t-1} + \mu_t \quad (3)$$

where,  $\gamma$ : speed of adjustment, which should have statistically significant and negative sign to support the co-integration between the variables,  $\mu_t$ : pure random error term.

To investigate the existence of long-run relationships between the variables, bound testing procedure is used, which is based on the F-test (Wald test). The F-test is actually a test of the hypothesis of no co-integration among the variables ( $H_0: \vartheta_1 = \dots = \vartheta_6 = 0$ ) against the existence of cointegration among the variables ( $H_1: \vartheta_1 \neq \dots \neq \vartheta_6 \neq 0$ ) in equation (2). Finally, we used Granger causality test to determine the direction of the causality between the variables.

## Results and Discussion

The results of ADF and PP unit root test indicate that the variables are integrated in order zero (LER, LBD and LED) and order one (LCPI, LFR and LDSP). AIC advocated that to use ARDL (1, 0, 1, 2, 1,1) model for this analysis. The long-run results of the corresponding ARDL (1, 0, 1, 2, 1, 1) model are presented in Table 1 below:

Table 1: The results of ARDL (1, 0, 1, 2, 1, 1) Model

Dependent Variable: LER						
Panel A: The Results of Long run Coefficients						
Cons	LED	LBD	LCPI	LFR	LDSP	R <sup>2</sup>
	0.072* (0.041)	0.135* (0.047)	0.363** (0.027)	0.097* (0.053)	-0.156** (0.048)	0.758
Panel B: The Results of Short run Coefficients						
Lag order	$\Delta$ LER	$\Delta$ LED	$\Delta$ LBD	$\Delta$ LCPI	$\Delta$ LFR	$\Delta$ LDSP
0		-0.0007 (0.993)	0.067* (0.066)	-0.014 (0.936)	0.026 (0.488)	-0.035 (0.550)
1	0.215 (0.339)		-0.027 (0.509)	0.535* (0.084)	0.022 (0.649)	0.025 (0.623)
2				-0.257 (0.315)		
Panel C: The Results of the Diagnostics Test						
Serial Correlation [LM Test: $\chi^2_{(df)}$ ]					Prob. = 0.634	
Normality Test (Jarque-Bera)					Prob. = 0.377	
Heteroscedasticity (BPG Test)					Prob. = 0.351	
Omitted Variable (Ramsey's RESET)					Prob. = 0.525	

Note: Probability values are given in the parenthesis. \*, \*\* represents the variables are statistically significant at 10 % and 5 % level of significance respectively. Two dummy variables results are not presented here since they are not statistically significant even at 10 % level of significance.

As expected to the theory and most of the existing literature (e.g., Saeed et al., 2012; Awan et al., 2015; Draz and Ahmed, 2015) ED, BD, CPI and FR (at 10 %) have positive and statistically significant relationship with ER in the long run, whereas, DSP affects the ER negatively in the long run. At the same time BD and CPI have

significant (10 % level of significance) and positive impact on ER in the short run while other variables do not affect significantly.

The Lagrange Multiplier (LM) test of autocorrelation advocates that the residuals are not serially correlated. According to the Jarque-Bera (JB) test, the null hypothesis of normally distributed residuals cannot be rejected. The Breusch-Pagan-Godfrey (BPG) test of heteroscedasticity suggests that the disturbance term in the equation is homoscedastic. The Ramsey RESET test result confirms that there is no specification error in the estimated model (See Table 1, Panel C above). The CUSUM plots lie between the lower and upper critical bounds at the 5 % level of significance, which confirms the stability of the parameters. The result of Wald test confirms that there is long run relationship between ER and other variables under considered in this study since we reject the null hypothesis of no cointegration among the variables due to the computed F-statistics (3.92) greater than the upper bound critical value (3.79) at 5 % level of significance (The both results of stability and the Wald test are not presented here due to concerning the page limit).

Next, the results of short run dynamic and long run adjustment coefficients are estimated using Equation (3), which is presented in Table 2. The ECM model passed all the diagnostics tests (see Table 2, Panel B below). Panel A of Table 2 reports the short run dynamics coefficient estimates of ARDL-ECM. Accordingly, as expected, one period lagged value of ER and one and two period lagged value of CPI have positive and significant impact on ER in the short run whereas one period lagged value of FR has negative and significant impact on it. Further, ECT(-1) carries an expected negative sign, which is highly significant, indicating that, there should be an adjustment toward steady state line in the long run one period after the exogenous shock. That is, about 19.4 % of the disequilibrium in the ER is offset by short-run adjustment in each period.

Table 2: Error Correction Representation of ARDL Model

Dependent Variable: $\Delta$ LER			
Variables	Lag order		
	0	1	2
$\Delta$ LER		0.632*** (0.003)	
$\Delta$ LED	0.019 (0.772)		
$\Delta$ LBD	0.031 (0.290)	0.001 (0.998)	
$\Delta$ LCPI	0.003 (0.980)	0.278* (0.095)	0.281* (0.081)
$\Delta$ LFR	0.039 (0.153)	-0.12*** (0.000)	
$\Delta$ LDSP	0.004 (0.904)	-0.083 (0.015)	
PS	-0.004 (0.983)		
ERR	-0.010 (0.516)		
ECT(-1)	-0.194*** (0.000)		
R <sup>2</sup>	0.774		
F – Stat	4.907(0.000)		
Panel B: The Results of the Diagnostics Test			
Serial Correlation [LM Test: $\chi^2_{(df)}$ ]			Prob. = 0.231
Normality Test (Jarque-Bera)			Prob. = 0.852
Heteroscedasticity (BPG Test)			Prob. = 0.268
Omitted Variable (Ramsey's RESET)			Prob. = 0.657

Note: Probability values are given in the parenthesis. \*, \*\* represents the variables are statistically significant at 10 % and 5 % level of significance respectively.

Finally, Granger causality test detected only unidirectional causality that stemming from FR to ER and DSP to ER in the long run (The results are not shown here due to space constraint).

### Conclusion and Policy Implications

This study concludes that the both cointegration approach to ARDL and error correction version of ARDL passed all the diagnostics and the stability test. The Wald test confirms that the variables are cointegrated. The CPI affects the ER positively and significantly in the long run and in the short run. ED, BD, and FR have positive and significant impact on ER in the long run while DSP has negative affect on it. But, lagged value of FR negatively affects the ER in the short run. Further, this

model confirms that whole system can get back to long run steady state line at the speed of 19.4 % in each year one period after the exogenous shocks. In sum, the government of Sri Lanka should take necessary action to reduce the BD, ED and CPI in order to bring the economy well off.

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