Effectiveness of Currency Devaluation to Improve the Trade Balance in the Small Open Economy of Sri Lanka
A Co-integration Approach

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1. Introduction

In economic literature, the currency devaluation is recognized as one of key macroeconomic policy instruments owing to its substantial implication on foreign trade and balance of payment issues. The theoretical viewpoint is that devaluation policy supports to improve the trade balance since it provides incentives to exports and disincentives to imports (Fan, 2004; Cosar, 2003; Senhadji & Montenegro, 1999). However, the net effect on the trade balance depends on trade elasticities since they are critical parameters in international trade. In this connection, the basic theory outlined in trade literature is the Marshall-Lerner (M-L) condition which states that for a currency devaluation to have a positive impact in trade balance, the sum of price elasticity of exports and imports (in absolute value) must be greater than one. Therefore, the effect of trade and exchange rate policies highly depend upon the size of import and export demand elasticities (Amelia, 2002). In view of this, most researches in the field of international trade have attempted to assess the exchange rate policy in terms of balance of payment issues.

Since 1977, Sri Lanka has implemented far reaching economic reforms under the open economic framework. Under these reforms, exchange rate devaluation has been used as the main policy tool to enhance the exports (Weliwita & Tsujii, 2000). Sri Lankan exports have continued to play an important and pivotal role in the national economy in last three decades owing to these favorable policies. During the period of 1977 to 2006, the exports increased from U$ 767.1 million to U$ 6882.7 million by 797 percent. During the same period, imports increased from U$ 726.2 million to U$ 10253 million by 1311 percent. The country continued to have a negative trade balance and the trade deficit widened during the open economic phase although continuous depreciation was seen in the exchange rate (see figure 1). Therefore, there is controversial discussion on the effectiveness of devaluation policy in terms of trade balance issue in Sri Lanka. On

the other hand, the existing literatures on trade provide rather blend results by employing different estimating techniques. However, sufficient studies which empirically assessed the impact of devaluation on Sri Lankan trade deficit could not be seen, although it was one of the main macroeconomic tools in the liberalization period. Therefore, the main objective of this study is to estimate the long run trade elasticities under the cointegration framework to test for the existence of Marshall-Lerner condition, while identifying the long run impact of devaluation on Sri Lankan trade deficit.

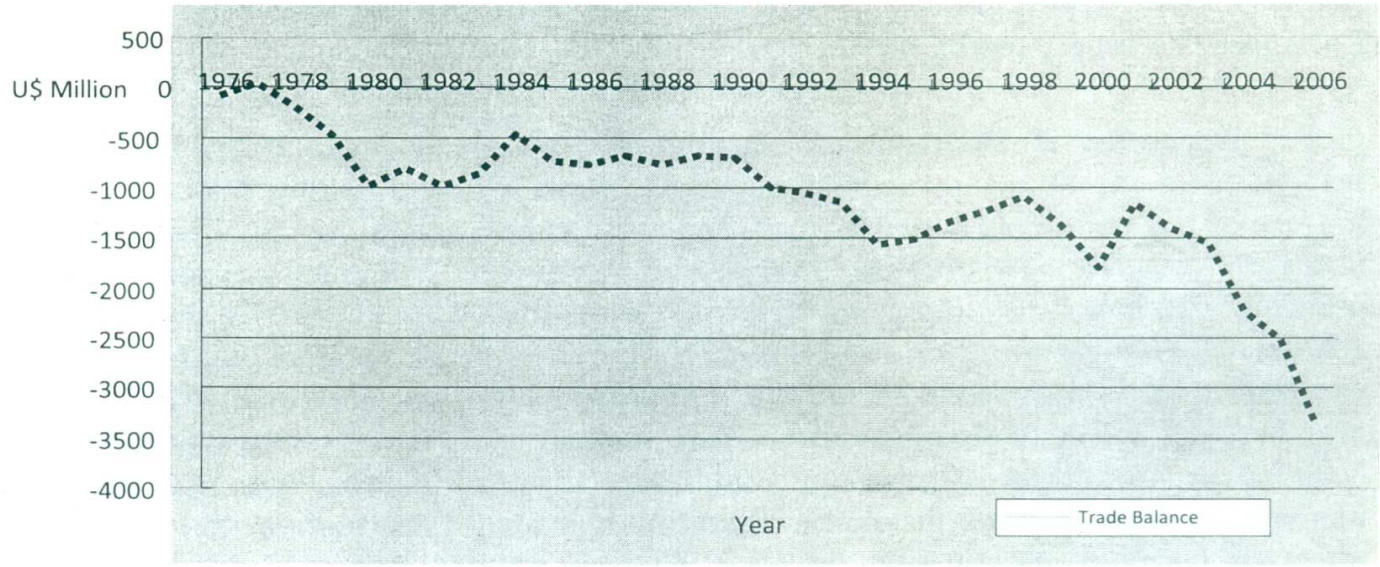

Figure 1 Sri Lankan Trade Deficit, 1976-2006
Source: Central Bank Report, 2006

2. Literature Review

The study of effect of currency devaluation on trade balance is quiet interesting area among the economists. Many researchers, scholars and practitioners have contributed many to the existing state of knowledge in the field. However, very little theoretical and empirical works have been undertaken to assess the effect of currency devaluation on trade balance in Sri Lanka.

Mohsen (1998) estimated the long run trade elasticities for the less developed countries by employing the Johansen cointegration technique. The study reveal the satisfaction of Marshal Lerner condition in case of less developed countries (LDCs) indicating that devaluation could improve their trade balance. Aziz (2008) estimated the effect of exchange rate on balance of trade of Bangladesh by using 34 annual

observations 1972 to 2005. His estimations reveal that there is a significant impact of real exchange rate on trade balance in both short run and long run. By using the quarterly data of three countries; Thailand, Malaysia and Indonesia for 1980 to 2001, on bilateral trade with Japan and USA, Onafowara (2003) also supports to the conclusion derived by Aziz, indicating existence of Marshal-Lerner condition in the long run. The findings of his study show the existence of long-run steady state relationship among the variables; real trade balance, real exchange rate, real domestic income and real foreign income. The similar result was derived by Mohammad (2010) in case of Pakistan by applying Johansen Cointegration procedure and Musila and Newark (2004) by estimating the IS-LM aggregate supply model.

According to Weliwita and Tsujii (2000), trade balance in Sri Lanka is not responsive to the incessant devaluation of the rupee. By employing popular model in balance of payment, elasticity approach, further state that increase in Sri Lanka's imports positively correlate with domestic income and increase in Sri Lanka's exports positively correlate with income of importing countries. In contrast, Lal et al (2002), by performing Johansen Cointegration test, reveal that depreciation of South Asian Countries' currency can lead to an improvement in its trade balance in long run. However, Agbola (2004) estimated the effect of devaluation on trade balance in Ghana by employing Johansen Multivariate Cointegration procedure and state that devaluation does not support to improve the trade balance in Ghana. Therefore it is clear that existing investigations on effect of currency devaluation on trade balance provide rather blend results under different estimating techniques.

Table 1 Data and Techniques used in previous research on effect of currency devaluation on trade balance

Researchers	*Data Description*	*Analytical tool used*
Aziz N. (2008)	34 annual observations (1972-2005)	Engle-Granger and Johansen Technique, Error Correction Mechanism
Mohsen B.O. (1998)	Annual time series data	Cointegration technique
Onafowora O. (2003)	Quarterly data for 1980 to 2001of three Asian countries; Thailand, Malasia and Indonesia	Cointegrating Vector Error Correction Model
Weliwita A and H. Tsujii (2000)	Quarterly data for 1978 to 1997	Elasticity Approach
Mohammad S.D. (2010)	34 annual observation (1975 to 2009)	Johansen Cointegration test
Lal et al (2002)	Quarterly data 1985 to 1998	Johansen Cointegration test
Agbola F.W.(2004)	Annual data for 1970 to 2002	Johansen Multivariate Cointegration procedure
Musila and Newark (2004)	Annual data for 1967 to 1996	IS-LM Aggregate Supply Model

3. Theoretical Modeling, Econometric Methodology and Data Source

The study uses annual time series data for the period from 1977 to 2006 to estimate the export and import demand equations. The data series used were obtained from Central Bank of Sri Lanka, International financial statistics of International Monetary Fund, Trade Statistics of World Trade Organization etc. The different methodologies used to estimate the long run equilibrium relationship between the value of exports and its determinants and the value of imports and its determinants could be seen in trade literature. Following existing literature the export and import demand functions for Sri Lanka were derived as follows:

$$X_t = f\left[\left((XP/WXP)_t, WY_t, NEER_t\right)\right] \text{---------- (1)}$$

and

$$M_t = f[((MP/DP)_t, DY_t, NEER_t)] \text{---------- (2)}$$

where X_t represents the value of exports; XP = the export price; WXP = the world export price; WY = the world income; $NEER$ = the nominal effective exchange rate; MP = the import price; DP = Domestic price and DY = the domestic income. The Gross National Income of the ten best trade partners of Sri Lanka was used as the proxy variable for the world income. As most studies employed (Alawattage, 2005; Cosar, 2003; Senhadji & Montenegro, 1999; Weliwita & Tsujii, 2000), the index of nominal effective exchange rate (NEER) was used as the indicator of external competitiveness. Due to lack of data on NEER for the entire period, it was newly derived using the method of weighted geometric average of the bilateral nominal exchange rates of the domestic currency in terms of foreign currencies by using the following formula.

$$NEER = \prod_{i=1}^{5} (e/e_i)^{w_i} \text{ ----------(3)}$$

In equation (3), e is the exchange rate of the Sri Lankan rupee against the US dollar, e_i represents the exchange rate of country i against the US dollar and $w_i$represents the weights attached to the country divided by currency i in the index form. The Sri Lankan trade shares in the best trade partner's markets (USA, UK, Japan, India and Singapore) were used as the weight, based on the year 1999. The selected five currencies of the main trade partners are US dollar, Yen, Sterling Pound, Indian Rupee and Singapore dollar. In order to estimate the trade elasticities and to manage the high magnitudes of the series, the equation (1) and (2) were transformed into linear logarithmic regression form;

$$LnX_t = \beta_1 + \beta_2 Ln(XP/WXP) + \beta_3 LnWY_t + \beta_4 LnNEER_t + u_t \text{---------- (4)}$$

and

$$LnM_t = \propto_1 + \propto_2 Ln(MP/DP)_t + \propto_3 LnDY_t + \propto_4 LnNEER_t + u_t \text{ ---------- (5)}$$

The coefficients β_2, β_3 *and* β_4 are the export elasticity with respect to XP/WXP, WY and $NEER$ coefficients of $\propto_2, \propto_3$ and $\propto_4$ are import elasticity with respect toMP/DP,DY, and $NEER$, since first difference reflect the rate of change of each variables. u_{t1} and u_{t2} are stochastic error terms with usual classical properties. Theoretically, it is expected that price elasticity of each equation is negative and income elasticity is positive. Moreover, in terms of export demand equation, coefficient of NEER is expected to be negative indicating that the depreciation of domestic currency leads to encourage exports. Conversely, in terms of import demand equation, it is expected to be positive indicating that the depreciation of domestic currency leads to discourage imports.

Therefore, NEER is an indicator of external competitiveness. Since the Marshal-Lerner condition is a long-run condition, cointegration framework is an appropriate method to investigate the long-run relationship between the variables incorporated in equation (4) and (5), since it directly derivates the long-run elasticities. In this case, the Maximum-Likelihood cointegration procedure of Johansen (1988) and Johansen and Juselius (1990) is followed beginning with the examination of integration properties of the data.

The recent development in time series econometrics have shown that most of the macro economic variables appear to be non stationary or integrated order one. However, their first differences are stationary; if the series is found to be of order one $I=(1)$ (Nelson & plosser, 1982). So it is generally true that any linier combination of these variables will also be I(0) order. If the variables are non stationary, estimating regressions using the technique of OLS can rise to the phenomenon of spurious regression (Granger & Newbold, 1974; Philips, 1987). In this study, we applied both Augmented Dickey Fuller (ADF) test (1981) and Pillips & Peron (PP) test (1988) with lagged differences to test the presence of unit root. The ADF approach controls the higher-order correlation by adding lagged difference terms of the dependent variable Y to the right-hand side of the regression. The basic form of the equation is as follows;

$$\Delta Y_t = \beta_1 + \beta_2 t + \alpha Y_{t-1} + \alpha_i \sum \Delta Y_{t-i} + u_i \text{ ---------- (6)}$$
$$i = 1 \ldots\ldots n$$

Phillips and Perron (1988) proposed a nonparametric method of controlling for higher-order serial correlation in a series. PP test which accounts for possible correlation in the first difference of the time series using non parametric correction is more powerful than the ADF test particularly for small samples and is simpler to estimate (Balamurali & Bogahawatte, 2004).

As the results of ADF and PP tests revealed that all the variables are integrated of order $I=(1)$. Therefore, the next step is to confirm whether there is a long run equilibrium relationship between the variables incorporated in export and import demand models. Maximum-Likelihood cointegration test which was developed by Johansen (1988) and Johansen and Juselius (1990) was applied since it provides a unified framework for the estimation and testing of cointegrating relations in the context of VAR error correction models. Johansen (1988) has proposed two methods to decide the number r of cointegrating vectors which are the lambda – max test and trace test. The lambda-max test is based on the log-likelihood ratio $Ln[L_{max}(r)/L_{max}(r+1)]$ and is conducted sequentially for $r = 0,1,\ldots..k-1$. The test statistics involved is a maximum generalized eigenvalue. This test tests the null hypothesis that the cointegration rank is equal to r against the alternative that the cointegration rank is equal to $r+1$. The trace test is based on the log likelihood ratio $Ln[L_{max}(r)/L_{max}(k)]$ and is conducted sequentially for $r = k-1,\ldots..,1,0$. The test statistics involved is the trace of a diagonal matrix of generalized eigenvalues. This test tests the null hypothesis that the cointegration rank is equal to r against the alternative that the cointegration rank is k.

Finally, to investigate the dynamic behavior of each model, we need to specify and estimate the error correction model (ECM) including the error correction term. A vector error correction (VEC) model which is designed for the use with non stationary series that are known to be cointegrated restricts the long run behavior of the endogenous variables to converge to their cointegrating relationships while allowing a wide range of short run dynamics. The size of the ECM term indicates the speed of any disequilibrium towards a long run equilibrium state.

4. Results and Discussion

In this study, export and import trade elasticities are estimated using the cointegration approach since it provides the coefficients on long-run elasticities by directly using non stationary time series data. The data on all variables in both export and import demand functions are in logarithmic terms. Prior to econometric analysis, all the variables in log form were tested to verify their time series properties. In the first stage,

the testing procedure involves if the series are non stationary. The classical regression model requires that the dependent and independent variables be stationary in order to avoid the spurious regression (Granger & Newbold, 1974). Table 2 presents the results of both ADF and PP tests. The lag parameter was determined by the Akaike information criterion and was chosen for serial correlation in the residuals. The results reflect that both ADF and PP tests do not reject unit root null hypothesis on levels. However, unit root null hypothesis is rejected by the first difference data. Therefore it was found that series are integrated order one $I(1)$.

Table 2 ADF and PP unit root test for stationary

Series	Levels		First differences	
	ADF	PP	ADF	PP
X	0.635286	1.283813	-5.317531**	-7.249611**
XP/WXP	0.135105	0.825950	-4.844798**	-5.794016**
WY	-1.623555	-5.166516	-0.706562**	-4.095798*
NEER	-0.921609	-7.286505*	-4.872067**	-25.12628**
M	-0626300	-0.700500	-5.769400**	-4.954900**
MP/DP	-2.343070	-3.414861	-3.851651**	-4.688806**
DY	-3.216891	0.512728	-3.755696**	-8.914854**

Note: **,* Rejection of null hypothesis at 1% and 5% levels respectively. Numbers in the parentheses indicate the number of lags in the particular ADF regressions and non parametric correction for serial correlation.

However, despite being individually non-stationary, a linear combination of two or more time series can be stationary. That means cointegration of two or more time series suggests that there is a long run or equilibrium relationship between variables. To find the cointegration between non-stationary variables, at least two of the variables have to be $I= (1)$. As outlined in methodology, trace and lambda tests were used to determine the number of cointegrated vectors. Also, lag parameter used in the Johansen test was determined by Akaike information criterion and was chosen to eliminate the serial correlation in the residuals. Table 3 and 4 show the Johansen cointegration test results. According to the results, we can reject the hypothesis that no cointegration exists, but fails to reject the hypothesis of the existence of more than one stationary linear combination.

Table 3 Johansen Cointegration Test Results for Export Demand Function

Eigenvalue	Likelihood ratio	5% Critical Value	1% Critical Value	Hypothesized No. of CE(s)
0.669510	56.73410	47.21	54.46	None **
0.424550	25.73307	29.68	35.65	At most 1
0.217223	10.26018	15.41	20.04	At most 2
0.114433	3.402770	3.76	6.65	At most 3

Note: *(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Table 4 Johansen Cointegration Test Results for Import Demand Function

Eigenvalue	Likelihood ratio	5% Critical Value	1% Critical Value	Hypothesized No. of CE(s)
0.696023	65.51598	53.12	60.16	None **
0.456125	33.36428	34.91	41.07	At most 1
0.305522	16.92031	19.96	24.60	At most 2
0.230553	7.076234	9.24	12.97	At most 3

Note: *(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level

The normalized coefficients of export demand function are estimates for long run elasticity of exports with respect to $XP/WXP, WY$ and $NEER$ and normalized coefficients of import demand function are estimates for long run elasticity of imports with respect to the MP/DP, DY and $NEER$ for the period of 1977 - 2006.

$$LnX = -17.28 - 0.84(XP/WEP) + 0.31GDP - 0.67N$$

and

$$LnM = 8.78 - 0.058(MP/DP) + 1.52DY + 0.38NEER$$

The results of export demand equation shows that the relative price elasticity is 0.84 and it is highly inelastic (0.058) for import demand equation. The less price responsiveness of import demand is mainly due to the heavy reliance on imports such as intermediate goods, such as petroleum, textiles and investment goods. However, the results on price elasticities do not confirm the satisfaction of Marshal-Lerner condition in the long-run as the sum of absolute own price elasticities of export and import demand functions is not greater than one, indicating that devaluation could not have positive impact to improve the trade balance of Sri Lanka. The income elasticity of main trade partners with regard to Sri Lankan exports is inelastic (0.31), while it is elastic (1.52) for import demand indicating increase of Sri Lankan Gross National Income which leads to

increase the demand for imports significantly. However, export and import elasticity with respect to the NEER are inelastic representing their less responsiveness to the export and imports in long term. It further indicates that any depreciation of the exchange rate will not have a strong impact on the trade balance in long term.

Finally, we performed the VEC model to investigate the dynamic behavior of each model. Table 5 and 6 show the error correction representation for export and import demand models respectively. The error correction term ECt-1 represent the speed of adjustment from any disequilibrium toward long run equilibrium level. In export demand model, the error correction term is statistically significant in the X, WY and $NEER$ and in the import demand model, it is significant in the MP/DP and$NEER$. According to the results, significant of error correction term in the export demand model implies that when relationship is above or below its equilibrium level, it adjusts by 30 percent within the first year. However, error correction term is not significant in the import demand model.

Table 5 Error Correction Representation for the Export Demand

Error Correction:	D(X)	D(XP/WXP)	D(WY)	D(NEER)
ECt-1	-0.307356	-0.076704	-0.105772	0.088072
	(0.10112)	(0.12703)	(0.03408)	(0.01691)
	(-3.03945)	(-0.60384)	(-3.10396)	(5.20758)
D(X) (-1)	-0.533294	-0.509335	-0.024615	0.045757
	(0.27121)	(0.34069)	(0.09140)	(0.04536)
	(-1.96632)	(-1.49501)	(-0.26932)	(1.00876)
D (XP/WXP) (-1)	0.358826	0.328407	-0.087895	-0.030426
	(0.22873)	(0.28733)	(0.07708)	(0.03825)
	(1.56876)	(1.14297)	(-1.14031)	(-0.79535)
D (WY) (-1)	0.755474	1.329029	0.242902	0.005061
	(0.52513)	(0.65965)	(0.17696)	(0.08783)
	(1.43865)	(2.01476)	(1.37264)	(0.05763)
D(NEER) (-1)	-0.096849	-0.115882	-0.326513	-0.138167
	(0.59475)	(0.74710)	(0.20042)	(0.09947)
	(-0.16284)	(-0.15511)	(-1.62914)	(-1.38905)

Note: Standard errors & t-statistics in parentheses

Table 6 Error Correction Representation for the Import Demand

Error Correction:	D (M)	D (MP/DP)	D(DY)	D(NEER))
ECt-1	-0.225979	-0.332309	0.002701	-0.063900
	(0.15367)	(0.09731)	(0.07686)	(0.02239)
	(-1.47050)	(-3.41503)	(0.03514)	(-2.85334)
D(M) (-1)	0.146536	0.021240	0.084687	0.030460
	(0.26598)	(0.16842)	(0.13303)	(0.03876)
	(0.55092)	(0.12611)	(0.63660)	(0.78585)
D(MP/DP) (-1)	0.180462	0.572836	0.077619	-0.021157
	(0.28299)	(0.17919)	(0.14154)	(0.04124)
	(0.63769)	(3.19676)	(0.54840)	(-0.51302)
D (DY) (-1)	0.267783	0.458361	0.151020	0.077564
	(0.51870)	(0.32845)	(0.25942)	(0.07559)
	(0.51626)	(1.39555)	(0.58213)	(1.02612)
D (NEER) (-1)	-1.064391	-0.756425	-0.567930	-0.301454
	(1.29796)	(0.82187)	(0.64916)	(0.18915)
	(-0.82005)	(-0.92037)	(-0.87486)	(-1.59374)

Note: Standard errors & t-statistics in parentheses

5. Concluding remarks

With the introduction of liberalization economic policies in 1977, Sri Lanka's exchange rate policy was changed from fixed exchange rate to flexible exchange rate. The main limitation of this study was with the data source because, in practice, monetary authority indirectly intervened to exchange rate control particularly since last quarter of 1990s. In addition, study was mainly dependent on aggregate data on exports and imports. However, in the disaggregate levels, it is posited that import of military equipments, which is characterized as economically unproductive, dominates considerable share in the imports. However, it was very difficult to take into account these expenses to the analysis. Given this limitations, this paper examined the effectiveness of currency devaluation as a macroeconomic policy tool to improve the trade balance, investigating the long-run trade elasticities and the existence of Marshall-Lerner condition which is a prominent theory in trade literature. The study used the cointegration framework to derive the long-run trade elasticities. The estimated long-run trade elasticities reveal the inappropriateness of the devaluation policy to address the trade balance issues since the sum of absolute value of export and import price elasticities are less than one. It proves dissatisfaction of Marshall-Lerner condition. The price elasticities in both export and import demand models are inelastic. However, it is highly inelastic in the import demand model showing less responsiveness to the relative price change of imports. In contrast, the long run income elasticity of the import demand model

is highly elastic and it shows higher responsiveness to relative change of income. Both price and income elasticities of import demand model prove higher import dependency of the country. However, income elasticity in export demand model is inelastic. The study concludes stating the devaluation policy is less effective, with the existence of higher income and lower price elasticities in the import demand model, to improve the trade balance in Sri Lanka in the long-run.

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