JOURNAL OF ECONOMIC DEVELOPMENT
Volume 25, Number 2, December 2000

The Exchange Rate and Sri Lanka's Trade Deficit

Ananda Weliwita and Hiroshi Tsujii*

This paper examines the responsiveness of Sri Lanka's trade deficit to devaluation during the post 1977 period. The results show that notwithstanding persistent devaluation the trade deficit continued to move in the wrong direction suggesting that exchange rate policy was unable to create a favorable balance of trade position. Individual trade volumes also were not responsive to the changes in real exchange rates. While the increase in Sri Lanka's imports has a positive correlation with the rise in domestic income the growth in its exports is positively correlated with the rise in incomes in importing countries.

I. Introduction

Soon after taking office in 1977, the new government in Sri Lanka introduced extensive reforms in economic and financial policies, thus, ending years of protectionist, inward-oriented development strategies espoused by the previous regime. New outward-oriented development policies included liberalizing imports by removing price and quantity restrictions, announcing an incentive scheme to attract foreign direct investment, creating an export processing zone to enhance manufactured exports, removing restrictions on capital transactions to integrate domestic and foreign capital markets, and imposing ceilings on interest rates to bring them down to realistic levels (Athukorale and Jayasuriya (1994)). Also, steps were taken by the new government to reduce welfare expenditures and rationalize various subsidies to ease budget related pressures on interest rates, prices, and the balance of payments.

An integral part of the reform process was the reform of the trade regime as part of a program for stabilization and structural adjustment. Central to the reform of the trade regime was the switch in the exchange rate policy from a fixed exchange rate system to a managed floating system. From 1948 when Sri Lanka achieved its independence from Britain until 1977, the rupee had been pegged to the sterling. In November 1977, the new government set the exchange rates at new devalued levels after which the rupee was brought under a managed floating system (White and Wignaraja (1992)). The switch in the exchange rate regime was quickly followed by an unprecedented devaluation of the rupee against all major

* Research Fellow, Natural Resource Economics Division, Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan, and Professor, Natural Resource Economics Division, Graduate School of Agriculture, Kyoto University, Kyoto 606-8502, Japan, respectively. The authors gratefully acknowledge an anonymous reviewer for useful comments and the Japan Society for the Promotion of Science for financial support.

currencies.[1] Between 1977 and 1978, the rupee was devalued from 8.41 to 15.61 against the US dollar (*International Financial Statistics*). This is an 85 percent fall within a single year. The rupee was continuously devalued against all major currencies during the post 1977 period. By the end of 1997, the nominal effective exchange rate of the rupee against a basket of currencies of fifteen major trading partners fell by over 340 percent compared to the level in 1977.[2]

Ever since its introduction in 1977, successive governments have relied on devaluation as the main policy tool to enhance exports. Between 1978 and 1997, real exports increased from 54805 million rupees to 133641 million rupees (1990 rupees). This is an increase of 145 percent. However, during the same period real imports rose by almost 200 percent, from 62727 million rupees in 1978 to 186439 million rupees in 1997. Although devaluation has been quite successful in increasing the export volume, ever growing imports have resulted in persistent trade deficits throughout the post 1977 period (Figure 1). During the 1978-97 period, the real trade deficit increased by over 560 percent, from a modest level of 7923 million rupees in 1978 to a staggering 52798 million rupees in 1997.

The objective of this paper is to examine the responsiveness of the trade deficit to devaluation during the post 1977 period by employing a popular model of the balance of trade. The results show that the trade deficit was not responsive to persistent devaluation of the rupee. Neither export volume nor the import volume was found to be responsive to the changes in real exchange rates. The real exchange rates were not able to keep up with the falling nominal rates. The growth in Sri Lanka's exports was found to have a positive correlation with the rise in incomes in its trading partners. Despite the continuous fall in the nominal rupee Sri Lanka's real imports rose since 1984. The increase in domestic income has positively influenced the growth in real imports.

The rest of the paper is organized as follows. The "two country" model of trade is presented in Section II. Section III describes construction of variables and data sources. In Section IV, choice of estimation techniques and empirical results are discussed. Section V concludes the paper.

1. Nominal exchange rate is defined as the number of rupees per unit of a foreign currency. Thus, a rise in the exchange rate implies depreciation while a fall implies appreciation.

2. The Central Bank adjusts the exchange rate periodically considering the domestic price movements in relation to those of Sri Lanka's major trading partners. Thus, the managed floating system is expected to help maintain a realistic exchange rate to ensure that Sri Lankan products are competitive in the international market. The managed-float has undergone several changes since its inception in 1977. Initially, the Bank quoted rupee's daily buying and selling rates against six major currencies: US dollar, Sterling pound, Deutsche mark, French frank, yen, and Indian rupee. In 1982, the Bank began quoting the rate for the US dollar only, thus, allowing the other rates to be determined in the market. At the beginning, the managed floating system was operated with a narrow band of trading. The spread between buying and selling rates was only 0.5 percent. The spread was later widened to 1 percent, 1.5 percent, 2 percent, and 5 percent in 1986, 1989, 1994, and 2000 respectively (*Annual Report*, Central Bank of Sri Lanka).

II. Model

The "two-country" model of trade, also known as the "elasticity approach", has been the standard tool used in the analysis of the effect of devaluation on the balance of trade (Mann (1986), Rose and Yellen (1989), Brada *et al.* (1993, 1997)). The model, which assumes imperfect substitutability between imports and domestically produced goods, postulates that a country's demand for imports is determined by the real income in the importing country and the relative price of imports:

$$Q_D = Q_D(Y_D, P_D), \tag{1}$$

where Q_D is the quantity of goods imported by the domestic country, Y_D is the real income in the domestic country, and P_D is the relative price of imports, defined as the ratio of the price of imported goods to the price of domestically produced goods both measured in domestic currency. The quantity of goods imported by the other country, or the rest of the world (ROW), is assumed to be affected by the real income in ROW and the relative price of imports in ROW:

$$Q_{ROW} = Q_{ROW}(Y_{ROW}, P_{ROW}), \tag{2}$$

where Q_{ROW} is the quantity imported by ROW (that also equals the quantity exported by the domestic country), Y_{ROW} is the real income in ROW, and P_{ROW} is the relative price of imports in ROW, defined as the ratio of the price of goods imported by ROW to the price of goods produced in ROW both measured in ROW currency.

The relative price of imports, P_D, can be expressed as

$$P_D = \frac{ER * P^*_{ROW}}{PI_D} = \left(\frac{ER * PI_{ROW}}{PI_D}\right)\left(\frac{P^*_{ROW}}{PI_{ROW}}\right) = RER * RPF, \tag{3}$$

where ER is the nominal exchange rate, defined as the units of domestic currency per unit of ROW currency, P^*_{ROW} is the price of goods imported by the domestic country measured in ROW currency, PI_D is the domestic price index, PI_{ROW} is the price index in ROW, RER (= $ER * PI_{ROW} / PI_D$) is the real exchange rate, and RPF (= P^*_{ROW} / PI_{ROW}) is the relative price of goods in ROW. Analogous to (3), the relative price of imports in ROW, P_{ROW}, can be expressed as

$$P_{ROW} = \frac{P^*_D}{ER * PI_{ROW}} = \left(\frac{PI_D}{ER * PI_{ROW}}\right)\left(\frac{P^*_D}{PI_D}\right) = \frac{RPD}{RER}, \tag{4}$$

where P^*_D is the price of goods exported from the domestic country measured in domestic currency, and RPD (= P^*_D / R_D) is the relative price of goods in the domestic country.

The supply of exportables in the domestic country (S_D) and *ROW* (S_{ROW}) each is assumed to be a function of the level of the production and the relative price of goods in respective countries:

$$S_D = S_D(RPD, Y_D), \quad and \quad S_{ROW} = S_{ROW}(RPF, Y_{ROW}). \tag{5}$$

The quantities traded between the two countries and the relative prices of imports are determined by the following equilibrium conditions:

$$Q_D = S_{ROW}, \quad and \quad Q_{ROW} = S_D. \tag{6}$$

The trade balance (*TB*) in the domestic country is

$$TB = Q_{ROW} * RPD - Q_D * RPF * RER. \tag{7}$$

In Equation (7), the right-hand-side (*RHS*) first term is real exports and the second term is real imports. Equations (1), (2), and (5) are all structural equations that can be solved together with the equilibrium conditions in (6) for Q_{ROW}, *RPD*, Q_D, and *RPF*, each as a function of *RER*, Y_D, and Y_{ROW}. Substitute these into Equation (7) and rewrite it, in reduced form, as

$$TB = TB\,(RER,\ Y_D,\ Y_{ROW}). \tag{8}$$

Let us now examine the effect of a change in each of the *RHS* variables in Equation (8) on the balance of trade. An increase in the real income in *ROW*, Y_{ROW}, will increase the demand for domestic country's exports, Q_{ROW}, in Equation (2), and hence real exports in Equation (7). An increase in Y_{ROW} will also increase the supply of exportables in *ROW*, S_{ROW}, in Equation (5). Because $S_{ROW} = Q_D$ at the equilibrium, an increase in Y_{ROW} will also increase real imports in Equation (7). Since both real exports and real imports in Equation (7) will increase we cannot predict *a priori* the direction of the movement of the trade balance following an increase in the real income in *ROW*. Which of the two effects dominates will determine the net effect on the trade balance of a change in income in *ROW*. The same line of reasoning will ensure that the effect on the trade balance of a change in the domestic real income cannot be predicted *a priori*.

The formal relationship between devaluation and the trade balance is provided by the *Bickerdike-Robinson-Metzler* (*BRM*) condition (Dornbush (1975)).[3] If the *BRM* condition is

3. Using our notation, the *BRM* condition is

$$\frac{\partial TB}{\partial RER} = \frac{Q_{ROW}RPD(1+\boldsymbol{e})\boldsymbol{h}^*}{\boldsymbol{h}^* + \boldsymbol{e}} - \frac{RERQ_D\,RPF(1-\boldsymbol{h})\boldsymbol{e}^*}{\boldsymbol{h}+\boldsymbol{e}^*} > 0\,,$$

satisfied, the effect of a devaluation on the trade balance will be positive. If supply elasticities are infinite and the trade is balanced initially, then the *BRM* condition will reduce to well-known the *Marshall-Lerner* condition: a devaluation will improve the trade balance only if the sum of import and export demand elasticities is greater than one.[4]

III. Data

Quarterly data for the 1978I-97IV period were used for estimation. The first quarter of 1978 was chosen as the start of the sample period to coincide with the initiation of the flexible exchange rate regime. Real GNP for Sri Lanka was used for domestic income (Y_D). Published quarterly data on nominal GNP are not available for Sri Lanka. Therefore, it was necessary to interpolate the existing annual series on nominal GNP to quarterly basis. The procedure outlined in Goldstein and Khan (1976) was used for the interpolation. This method has also been used by many others (e.g., Arize (1994), Weliwita and Ekanayake (1998)). Quarterly nominal GNP series was deflated by the CPI (1990=100) to express it in real terms. The real series was expressed as an index with 1990 = 100. The annual nominal GNP series was taken from *International Financial Statistics*.

An index of multilateral real effective exchange rate was used as the measure of real exchange rate. Following Edwards (1989), the import share weighted multilateral real effective exchange rate index is defined as

$$RER_t = \frac{\sum_{i=1}^{15} \alpha_i \, ER_{it} \, CPI_{it}}{CPI_t} , \qquad (9)$$

where ER_{it} is the number of units of domestic currency per unit of *i*th trading partner's currency in period *t*, CPI_{it} is the *i*th trading partner's consumer price index in period *t* (1990 = 100), and CPI_t is Sri Lanka's consumer price index in period *t* (1990 = 100). α_i is the ratio of exports to Sri Lanka from the *i*th country to the total exports to Sri Lanka from fifteen countries in 1990. The following countries were used to calculate import shares: Australia, Belgium, France, Germany, India, Italy, Japan, the Netherlands, Pakistan, Singapore, South Korea, Thailand, the UK., the USA., and Sweden. Data on bilateral exchange rates and CPIs were taken from *International Financial Statistics*. Nominal values on Sri Lanka's exports and imports and data to compute import shares were taken from *Direction of Trade Statistics*. Following Bahmani-Oskooee and Malixi (1992), index of industrial production in OECD countries was used as a proxy for the real income in *ROW*

where $\eta(\eta^*)$ and $\varepsilon(\varepsilon^*)$ are absolute values of the price elasticities of demand and supply, respectively, in the domestic country (*ROW*). The *BRM* condition states that if the terms of trade improve or remain unchanged, that is $\eta^*/(\eta^* + \varepsilon) \geq \varepsilon^*/(\eta + \varepsilon^*)$, a devaluation will improve the balance of trade.

4. If $e = e^* = \infty$ and $Q_{ROW} * RPD = RER * Q_D * RPF$, then the *BRM* condition in footnote 3 will reduce to the Marshall-Lerner condition: $\eta^* + \eta > 1$.

(1990 = 100). The use of this measure is reasonable because a significant portion of Sri Lanka's total trade takes place with the OECD countries. For example, over 60 percent of Sri Lanka's total trade in 1990 was accounted for by the trade with OECD countries (*Direction of Trade Statistics*). Data on industrial production in OECD countries are available in *OECD Main Economics Indicators*.

In the empirical model, the trade balance is expressed as a ratio of exports to imports instead of the difference between the two. There are several advantages of expressing the trade balance as a ratio of exports to imports. First, the ratio allows us to express the trade balance in natural logarithms. Second, the ratio will remain unchanged whether exports and imports are measured in nominal or real terms. Third, the ratio is insensitive to the units of measurement of exports and imports, whether they are measured in domestic currency or foreign currency (Bahmani-Oskooee (1991)).[5] All the variables, except the real effective exchange rate, were seasonally adjusted to remove seasonal variability. Following Lee and Siklos (1991), real rather than nominal data were seasonally adjusted. All four variables are expressed in natural logarithms.

IV. Estimation Procedure and Empirical Results

Equation (8) characterizes that much of the variation in the trade balance is brought about by the changes in the real effective exchange rate, real domestic income, and real income in *ROW*. The exact correlation among the variables can easily be examined by estimating (8) by a standard econometric technique such as the OLS. However, since all the variables in (8) have been generated through stochastic time series processes, there exists a possibility that at least some of the variables are nonstationary. When variables used in a regression are nonstaionary, a standard econometric technique such as the OLS could result in what has become known as a "spurious regression." Since recently developed cointragation modeling techniques take into account the nonstationarity of the time series used in regressions they have become the preferred tool used in modeling nonstationary variables.

Before testing for cointegration, variables in (8) must be tested for unit roots. The Augmented Dickey-Fuller (ADF) test was performed on $\ln TB$ (Figure 1), $\ln RER$ (Figure 2), $\ln Y_D$, and $\ln Y_{ROW}$ (Figure 3). The ADF test was performed on the levels of the variables both with and without a time trend in the ADF equation. The ADF test evaluates the null hypothesis that a variable has a unit root against the alternative that it is stationary. The ADF test results are presented at the top half of Table 1. At the conventional significance levels,

5. Some studies have found that the units of measurement of exports and imports have a significant effect on the outcome in the analysis of the effect of devaluation on the balance of trade. For example, when Miles (1979) analyzed export and import data that were denominated in domestic currencies in a sample of countries, he found that devaluation did not have any significant effects on the trade balance. However, when Himarios (1985) used the US dollar denominated export and import data, the same sample of countries produced quite the opposite result - that there was a significant effect of devaluation on the balance of trade. In order to avoid such potential discrepancies in the outcome of the analysis, the trade balance is expressed as a ratio of logarithms of exports to imports.

the null hypothesis is not rejected for $\ln RER$, $\ln Y_D$, and $\ln Y_{ROW}$ but it is rejected for $\ln TB$. These results indicate that while $\ln RER$, $\ln Y_D$, and $\ln Y_{ROW}$ have unit roots $\ln TB$ is stationary. To confirm these findings, the ADF test was also performed on the first difference of the variables that were shown to have unit roots. Again the tests were carried out both with and without a time trend in the ADF regressions. With the first difference of a variable, the null hypothesis that the variable is integrated to order two is tested against the alternative that it is integrated to order one. For all three variables, the null hypothesis is rejected at the 95 percent significance level. These results confirm that while $\ln RER$, $\ln Y_D$, and $\ln Y_{ROW}$ are integrated to order one $\ln TB$ is integrated to order zero. An alternative approach to testing for the presence of a unit root is provided by Phillips (1987) and Phillips and Perron (1988). The Phillips-Perron test results are presented at the bottom half of Table 1. These tests also were performed on the levels as well as the first difference of the variables. The results confirm our previous findings that while $\ln RER$, $\ln Y_D$, and $\ln Y_{ROW}$ have unit roots $\ln TB$ is stationary.

Table 1 Unit Root Test Results

ADF Test				
	$\ln RER$	$\ln Y_D$	$\ln Y_{ROW}$	$\ln TB$
ADF^1	−1.82	−2.35	−0.15	-3.88^{***}
ADF^2	−1.48	-3.90^{**}	−2.71	-4.11^{***}
	$\Delta \ln RER$	$\Delta \ln Y_D$	$\Delta \ln Y_{ROW}$	
ADF^1	-6.43^{***}	-5.86^{***}	-4.08^{***}	
ADF^2	-6.54^{***}	-6.13^{***}	-4.11^{***}	
Phillip-Perron Tests				
	$\ln RER$	$\ln Y_D$	$\ln Y_{ROW}$	$\ln TB$
$Z(t_{\tilde{a}})$	-3.27^{**}	−2.62	−0.22	-5.79^{***}
$Z(t_{a^*})$	−2.84	−2.45	−2.12	-5.81^{***}
	$\Delta \ln RER$	$\Delta \ln Y_D$	$\Delta \ln Y_{ROW}$	
$Z(t_{\tilde{a}})$	-9.39^{***}	-5.35^{***}	-4.89^{***}	
$Z(t_{a^*})$	-9.40^{***}	-5.55^{***}	-4.87^{***}	

Notes: indicates first difference. ADF^2 and ADF^1 are, respectively, the ADF test statistics when the test was carried out with and without a time trend. *** and ** indicate statistical significance at the 99 and 95 percent level, respectively. Critical values for the ADF and the Phillips-Perron tests from Mackinnon (1991) are: −3.52 (99 percent) and −2.89 (95 percent) for ADF^1 and $Z(t_{a^*})$; −4.08 (99 percent) and −3.47 (95 percent) for ADF^2 and $Z(t_{\tilde{a}})$. The optimal lag lengths in the ADF regressions were chosen based on the Akaike criterion.

Since three of the four variables in Equation (8) have unit roots, variables in (8) were tested for the presence of any cointegrated relationships. The trace test and the maximum eigenvalue test of cointegration (Johansen (1988), Johansen and Juselius (1990)) were conducted with the four variables in levels. The trace statistics are 64.42 (for $r = 0$), 21.12 (for $r \leq 1$), 8.79 (for $r \leq 2$), and 2.56 (for $r \leq 3$).[6] These test statistics were compared with the critical values reported in Table I, Osterwald-Lenum (1992). The critical values for the trace test at the 95 percent significance level are 47.21(for $r = 0$), 29.68 (for $r \leq 1$), 15.41 (for $r \leq 2$), and 3.75(for $r \leq 3$). Based on these results the null hypothesis of zero cointegrating vectors is rejected. But the null hypothesis that there is one cointegrating vector cannot be rejected. However, since unit root test results confirm that $\ln TB$ is stationary, including $\ln TB$ in the system should result in a trivial cointegrating vector.[7] This is because one can always form a linear combination of a stationary variable with a set of nonstationary variables by assigning a unit coefficient to the stationary variable and zero coefficients to the nonstationary variables (Gardeazabal and Regulez (1992)). Since there is only one cointegrating vector in the system, which is the trivial cointegrating vector attributed to the stationary variable, it was concluded that the trade balance and the other three variables are not linked by any long run equilibrium relationships. The maximum eigenvalue test statistics are 43.3 (for $r = 0$), 12.32 (for $r = 1$), 6.23 (for $r = 2$), and 2.56 (for $r = 3$). Critical values for the maximum eigenvalues at the 95 percent significance level from Table I, Osterwald-Lenum (1992) are 27.02 (for $r = 0$), 20.97 (for $r = 1$), 14.07 (for $r = 2$), and 3.76 (for $r = 3$). The maximum eigenvalue test confirms that there is only one cointegrating vector in the system. To further confirm these findings, three variables that were found to have unit roots were considered as a separate system and tested for the presence of a cointegrated relationship. Using the same tests, the hypothesis that variables are cointegrated is rejected.

To get a feel on the underlying nature of the relationships among the variables in (8), the Granger causality test was conducted. Our particular interest is to know whether the Granger causality exists between $\ln TB$ and $\ln RER$, $\ln Y_D$, and $\ln Y_{ROW}$. Testing for the Granger

6. The system was modeled as a vector error correction model of order four ($m = 4$).

$$\Delta X_t = \boldsymbol{m} + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + \dots + \Gamma_{k-1} \Delta X_{t-k+1} - \prod X_{t-k} + \boldsymbol{e}_t, \tag{10}$$

where m is the vector of constants, the Γ matrices contain short-run parameters, the $\prod$ matrix contains the long-run parameters, and $\boldsymbol{e}$ is the vector of white noise residuals. If the rank of the $\prod$ matrix r is $0 < r < m$, then there are two matrices $\boldsymbol{a}$ and $\boldsymbol{b}$ each with dimension $m \times r$ such that $\boldsymbol{ab}' = \prod$. r represents the number of cointegrating relationships between the variables in X_t. The matrix $\boldsymbol{b}$ contains the elements of r cointegrating vectors and has the property that the elements of $\boldsymbol{b}' X_t$ are stationary. $\boldsymbol{a}$ is the matrix of error correction parameters that measure the speed of adjustment in ΔX_t. The trace test evaluates the null hypothesis that the rank of the $\prod$ matrix is less than or equal to r or, in other words, there are at most r cointegrating vectors. The maximum eigenvalue test, on the other hand, evaluates the null hypothesis that there are r cointegrating vectors in the model.

7. The cointegrating vector initialized on $\ln TB$ is $\ln TB = -2.75 - 0.002\ (0.28)\ \ln RER + 0.564\ (0.16)\ \ln Y_D - 0.014\ (0.42)\ \ln Y_{ROW}$. Figures in parentheses are standard errors.

causality requires that variables used in the regression be either stationary or nonstationary but cointegrated (Granger (1988)). Although variables in (8) were not found to be cointegrated, $\ln TB$ in levels and the other three variables in first difference are stationary. Therefore, the Granger causality test was conducted with $\ln TB$ in levels and $\ln RER$, $\ln Y_D$, and $\ln Y_{ROW}$ in first difference. The results are presented in Table 2. The test statistic used is an F test. The results reveal a unidirectional Granger causality running from $\Delta \ln Y_{ROW}$ to $\ln TB$.

Table 2 Granger Causality Test Results

Direction of Causality	F-statistic	Significance Level
$\ln TB \rightarrow \Delta \ln Y_D$	0.70	0.74
$\Delta \ln Y_D \rightarrow \ln TB$	1.12	0.36
$\Delta \ln Y_{ROW} \rightarrow \ln TB$	1.93	0.05^*
$\ln TB \rightarrow \Delta \ln Y_{ROW}$	0.56	0.70
$\ln TB \rightarrow \Delta \ln RER$	0.50	0.90
$\Delta \ln RER \rightarrow \ln TB$	1.19	0.32

Notes: X $\rightarrow$ Y implies X Granger causes Y. * indicates significance at the 90 percent level. A lag length of twelve was used for each equation.

Given that (a) there is no cointegrated relationship among the variables in (8) and (b) variables in (8) are integrated to different orders, Equation (8) was modeled as a VAR: $\ln TB$ in levels and the other three variables in first difference. Since all four variables are now stationary, VAR estimation should result in consistent regressions (Granger (1981)). The VAR system suggests that it is not the levels of the real exchange rate, the domestic income, and the income in *ROW* that change the trade balance; it is the *changes* in the exchange rate, the domestic income, and the *ROW* income that change the trade balance. The VAR system was estimated over the sample period with eight period lags on each of the four endogenous variables.[8] The Akaike final prediction criterion was used to find out the optimal lag length for the VAR system. A lag length of eight was found to be the optimal.

Variance decompositions and impulse response functions were used to draw conclusions on the underlying relationships among the variables. Variance decompositions provide information about the relative importance of random innovations. More specifically, variance decompositions split N-step ahead forecast error variance of each variable into percentages attributed to innovations in each variable in the system. The results are presented in Table 3. The first column is the number of quarters ahead that we are looking into in analyzing the variance decompositions. The second column gives the forecast error of each variable for different forecast horizons. The source of this error is the variation in the current and future

8. The model was checked for any structural breaks during the sample period. Recursive residuals were used to conduct the CUSUMSQ test (Brown, *et al.*). The test confirmed that there was no structural break in the relationship between the variables over the sample period. Eight seasonal indicator variables were included in the VAR system to account for seasonal effects.

values of the innovations. The remaining columns give the percentage of the variance due to specific innovations. Specifically, a value in a column for a given horizon gives the percentage of the forecast error variance of the series written in parentheses attributed to the series in the column. For example, in $\Delta \ln Y_{ROW}$ - $\Delta \ln Y_D$ - $\Delta \ln RER$ - $\ln TB$ ordering, 1.12 is the percentage of the forecast error variance of $\Delta \ln Y_{ROW}$ attributed to $\Delta \ln Y_D$ six quarters ahead. The results for all four orderings are quite similar. Both *ROW* income and the domestic income appear to be *weakly exogenous* to the system because most of the variation in the changes in both variables is accounted for by their own innovations.[9] While no less than 75 percent (the average for the four orderings) of the variation in $\Delta \ln Y_{ROW}$ is accounted for by its own innovations, over 78 percent of the variation in $\Delta \ln Y_D$ is explained by its own innovations. Effect on the exchange rate of the other three variables appears to be quite similar. On average, 15, 18, and 23 percent of the uncertainty of $\Delta \ln RER$ is accounted for by $\Delta \ln Y_{ROW}$, $\ln TB$, and $\Delta \ln Y_D$, respectively. Other than the effect of its own innovations, the biggest influence on the variable of our most interest, the trade balance, comes from the changes in the *ROW* income and the domestic income. The exchange rate does not seem to have any significant influence on the trade balance. On average, over 28 percent of the variation in $\ln TB$ is accounted for by $\Delta \ln Y_{ROW}$ while over 26 percent of the variation in $\ln TB$ is attributed to $\Delta \ln Y_D$. On average, only about 7 percent of the uncertainty in $\ln TB$ is attributed to $\Delta \ln RER$. In $\Delta \ln RER$ - $\Delta \ln Y_{ROW}$ - $\Delta \ln Y_D$ - $\ln TB$ ordering, while a 35 percent of the variance in the trade balance is attributed to the changes income in *ROW*, a mere 4 percent of the variations in the trade balance is accounted for by the changes in the exchange rate.

An impulse response function traces the response of a variable to a change in one of the innovations. Specifically, it traces the effect of a one standard deviation shock to one of the innovations on the current and future values of a variable. Since the focus of this study is on the effect of devaluation on the trade balance, the attention is limited to impulse response functions of the trade balance to the unit shocks in all four variables. The results are presented in Table 4. Since the results for all four orderings are quite similar, the results for only one ordering is presented. In the first quarter, the greatest effect on $\ln TB$ comes from its own innovations followed by the effect of changes in $\ln Y_{ROW}$. Both income variables have quite similar effects on $\ln TB$. The change in *ROW* income has a significant positive effect on $\ln TB$ in four out of twelve quarters. This effect becomes more prominent in the fifth and the seventh quarters before starting to die down in the eighth quarter. This indicates that the change in *ROW* income has a positive effect on $\ln TB$. The change in the domestic income, on the other hand, seems to have both negative and positive effects on $\ln TB$ in different time horizons. As in the case of *ROW* income, the effect of the domestic income also vanishes after seven quarters. A shock to the change in real effective exchange rate has no effect on $\ln TB$.

9. If variable *A* fails to explain any of the forecast error variance of variable *B* at all forecast horizons *B* is said to be exogenous with respect to *A*.

Table 3 Percentage of Forecast Error Variance *N* Quarters Ahead Attributed to Innovations in Respective Series

$\Delta \ln Y_{ROW}$ - $\Delta \ln Y_D$ - $\Delta \ln RER$ - $\ln TB$ ordering

Step	S.E.	$\Delta \ln Y_{ROW}$	$\Delta \ln Y_D$	$\Delta \ln RER$	$\ln TB$
			($\Delta \ln Y_{ROW}$)		
1	0.006	100.00	0.00	0.00	0.00
6	0.009	94.47	1.12	1.05	3.34
12	0.009	94.11	1.13	1.14	3.40
			($\Delta \ln Y_D$)		
1	0.014	6.01	93.98	0.00	0.00
6	0.017	5.03	75.43	13.06	6.46
12	0.018	5.45	74.41	13.01	6.82
			($\Delta \ln RER$)		
1	0.024	0.18	17.71	82.10	0.00
6	0.027	3.56	19.17	73.15	4.11
12	0.027	4.83	19.02	71.94	4.19
			($\ln TB$)		
1	0.108	0.71	1.75	3.85	93.17
6	0.123	16.52	3.63	3.98	75.85
12	0.127	21.12	3.47	3.82	71.56

$\ln TB$ - $\Delta \ln Y_D$ - $\Delta \ln Y_{ROW}$ - $\Delta \ln RER$ ordering

Step	S.E.	$\ln TB$	$\Delta \ln Y_D$	$\Delta \ln Y_{ROW}$	$\Delta \ln RER$
			($\ln TB$)		
1	0.108	100.00	0.00	0.00	0.00
6	0.123	81.67	3.40	14.06	0.85
12	0.127	77.04	3.79	18.28	0.87
			($\Delta \ln Y_D$)		
1	0.014	2.22	97.77	0.00	0.00
6	0.017	9.46	75.77	0.89	13.86
12	0.018	9.97	75.11	1.01	13.89
			($\Delta \ln Y_{ROW}$)		
1	0.006	0.71	5.53	93.75	0.00
6	0.009	1.98	7.04	89.36	1.60
12	0.009	2.08	7.17	89.05	1.68
			($\Delta \ln RER$)		
1	0.024	5.63	15.01	0.50	78.85
6	0.027	9.75	16.86	2.99	70.39
12	0.027	9.76	16.95	3.99	69.28

Table 3 (Continued)

$\Delta \ln Y_D$ - $\Delta \ln Y_{ROW}$ - $\Delta \ln RER$ - $\ln TB$ ordering

Step	S.E.	$\Delta \ln Y_D$	$\Delta \ln Y_{ROW}$	$\Delta \ln RER$	$\ln TB$
			($\Delta \ln Y_D$)		
1	0.014	100.00	0.00	0.00	0.00
6	0.017	79.65	0.81	13.06	6.46
12	0.018	79.19	0.96	13.01	6.82
			($\Delta \ln Y_{ROW}$)		
1	0.006	6.01	93.98	0.60	0.00
6	0.009	6.88	88.71	1.05	3.34
12	0.009	7.04	88.40	1.14	3.40
			($\Delta \ln RER$)		
1	0.024	17.51	0.38	82.10	0.00
6	0.027	19.78	2.95	73.15	4.10
12	0.027	19.89	3.96	71.94	4.19
			($\ln TB$)		
1	0.108	2.22	0.24	3.85	93.67
6	0.123	5.73	14.42	3.98	75.85
12	0.127	5.99	18.60	3.82	71.56

$\Delta \ln RER$ - $\Delta \ln Y_{ROW}$ - $\Delta \ln Y_D$ - $\ln TB$ ordering

Step	S.E.	$\Delta \ln RER$	$\Delta \ln Y_{ROW}$	$\Delta \ln Y_D$	$\ln TB$
			($\Delta \ln RER$)		
1	0.024	100.00	0.00	0.00	0.00
6	0.027	90.12	3.49	2.28	4.10
12	0.027	88.61	4.74	2.45	4.19
			($\Delta \ln Y_{ROW}$)		
1	0.006	0.18	99.81	0.00	0.00
6	0.009	1.78	93.85	1.02	3.34
12	0.009	1.86	93.49	1.23	3.40
			($\Delta \ln Y_D$)		
1	0.014	17.51	5.18	77.30	0.00
6	0.017	25.05	4.35	64.11	6.46
12	0.018	24.81	4.77	63.58	6.82
			($\ln TB$)		
1	0.108	5.63	0.55	0.14	93.67
6	0.123	5.42	16.21	2.50	75.85
12	0.127	5.28	20.77	2.37	71.56

Table 4 Impulse Response Functions of ln *TB* to Unit Shock in Innovations

$\Delta \ln Y_{ROW}$ - $\Delta \ln Y_D$ - $\Delta \ln RER$ - ln*TB* ordering

Period	$\Delta \ln RER$	$\Delta \ln Y_{ROW}$	$\Delta \ln Y_D$	ln*TB*
1	−0.021	0.009	−0.014	0.104***
	(1.74)	(0.73)	(1.16)	(12.25)
2	0.003	−0.001	0.012	0.017
	(0.27)	(0.07)	(1.10)	(1.48)
3	−0.009	0.006	0.01	0.008
	(0.74)	(0.58)	(0.95)	(0.75)
4	−0.007	0.013	−0.008	0.014
	(0.64)	(1.17)	(0.76)	(1.29)
5	0.001	0.037***	−0.004	0.004
	(0.06)	(3.39)	(0.38)	(0.42)
6	−0.002	0.03**	−0.004	−0.004
	(0.23)	(2.86)	(0.51)	(0.60)
7	−0.003	0.021**	−0.003	0.001
	(0.40)	(2.16)	(0.40)	(0.18)
8	0.001	0.015	−0.001	−0.005
	(0.08)	(1.62)	(0.18)	(0.74)
9	−0.001	0.012	0.001	−0.001
	(0.11)	(1.37)	(0.10)	(0.22)
10	−0.001	0.007	−0.001	−0.000
	(0.23)	(0.83)	(0.22)	(0.08)
11	−0.001	0.005	−0.000	−0.000
	(0.22)	(0.59)	(0.05)	(0.06)
12	−0.000	0.002	−0.000	−0.000
	(0.21)	(0.30)	(0.07)	(0.0)

Notes: Figures in parentheses are absolute *t*-ratios. *** and ** indicate statistical significance at the 99 and 95 percent level, respectively.

Despite persistent devaluation, why did the trade deficit continued to move in the wrong direction? The answer to this question depends on whether the rupee in real terms actually fell during the period under investigation. Between 1978I and 1997IV, the nominal effective exchange rate against the basket of fifteen currencies fell by over 340 percent, a fall of over 4 percent per quarter. During the same period, however, the real effective exchange rate fell only by 12 percent (Figure 2).[10] Disparities in the movements of the nominal and

10. Unlike the nominal effective exchange rate, the movements in the real effective exchange rate were not uniform during the period under consideration. Between 1978I-1979III period, the real exchange rate depreciated by over 21 percent. The fall in the real exchange rate during this period cl osely matched that of the nominal rate. During the next sixteen quarters, the real exchange rate stagnated around the 1979IV level. It then began a short period of appreciation in 1983II. By 1984III, the real exchange rate appreciated by 10 percent, reaching the lowest level during the post 1980 period. A relatively longer period of depreciation in the real exchange rate began in 1984IV,

real exchange rates are even more noticeable in the movements of the bilateral exchange rates between Sri Lanka and its top trading partners. The rupee was devalued by over 350 percent against the US dollar during the 1978I-97IV period.[11] Yet, the real exchange rate fell merely by 15 percent. Even more astonishing is the fact that the rupee in nominal terms fell by 860 percent against the yen, compared to only a 30 percent fall in the real exchange rate. Moreover, against the sterling, and the mark the rupee fell by 290 percent and 435 percent, respectively. But the real exchange rate in each case fell only by 27 percent.

Considerably high domestic inflation was the main cause of the failure of the real exchange rates to keep up with the falling nominal rates (Figure 4). The average rate of inflation during the sample period was 13 percent. From relatively a low level in 1977, the rate of inflation soared to a staggering 34 percent in 1978III and stayed at that level for the next three quarters.[12] Although it remained at a much lower rate of about 15 percent over the 1980III-84I period, this was still higher than the sample period average. The lowest rate of inflation during the post 1977 period of 8 percent was recorded in the 1984III-89IV period. Low rate of inflation within this period resulted in the greatest fall in the real effective exchange rate during the post 1977 period. During the next seven years, the average rate of inflation was about 13 percent. The higher rate of inflation in this period corresponds to the continued appreciation of the real exchange rate in the latter part of the sample period.

The lack of responsiveness of the trade deficit to devaluation will become even clearer in the impact of changes in real exchange rates on individual trade flows. Tables 5 and 6 present the OLS estimates for the export and import demand equations (Equations (1), and (2)).[13] The dependent variables are measured in 1990 rupees. The explanatory variables are

with frequent fluctuations, reaching the highest level in 1989IV. This is a depreciation of over 32 percent compared to 1983III level. It then began to appreciate in 1990I and continued to do so over the next seven years. By the end of 1997, the real exchange rate had appreciated to a level that is comparable to the level that prevailed in 1978IV. This is an appreciation of over 20 percent compared to the level in 1989IV.

11. The USA is one of Sri Lanka's major trading partners in both export and import markets. In 1990, over 40 percent of Sri Lanka's exports to the industrialized countries went to the U.S. while 16 percent of Sri Lanka's imports came from the U.S..

12. The new government in 1977 initiated three major investment projects: (1) creation of an export processing zone near Colombo to increase manufactured exports, (2) initiation of a massive public housing scheme targeted for the poor, and (3) implementation of the accelerated Mawaheli river project. The Mahaweli development program had initially been year marked to be completed within thirty years. The new government in 1977 decided to complete the project in six years. This required a large sum of money most of which came in forms of foreign aid and loans. Massive injection of funds within a relatively short period of time bid up the prices of domestic resources resulting in high inflation during the 1978-84 period. (For details see Dunham and Kelegama (1997), Athukorala and Jayasuriya (1994)).

13. We tested for the presence of cointegrated relationships between the variables in each equation. According to the ADF and Phillip-Perron tests statistics, both real exports and real imports (in natural logs) have unit roots. However, the trace test and the maximum eigenvalue tests both rejected the hypothesis that the variables in each equation were cointegrated. Since all the variables in both equations have unit roots, we estimated each equation as a VAR: $\Delta \ln$ (real exports), $\Delta \ln RER$, and $\Delta \ln Y_{ROW}$ in the export demand equation and $\Delta \ln$ (real imports),

real income in the importing market and a distributed lag of the real effective exchange rate (Krugman and Baldwin (1987)). It was assumed that distributed lag coefficients lie on a third degree polynomial curve with no end-point constraints. All possible lags up to a maximum of 24 were considered. In the absence of any standard procedure for choosing the optimal lag length, we looked at the algebraic sign and the statistical significance of all parameter estimates and the magnitude of the diagnostic tests statistics such as the Durbin-Watson and the adjusted R^2 for selecting the final equations. In the export demand equation, early lags of the real exchange rates show negative effects on the export volume while the lags at the latter periods of the lag structure show positive effects. The coefficients for the lag variables can be considered as indicating the short run response of export volume to the changes in real exchange rates. The sum of the lag coefficients, on the other hand, can be considered as representing the long run effects. The long run estimate of 0.17 is not statistically significant, implying that the real exchange rate had no long-run effect on the volume of exports. The positive and significant coefficients for the lag variables at the latter part of the lag structure are an indication that the exporters did not and possibly could not immediately adjust their production levels to take advantage of the falling exchange rate. The lags in response to falling exchange rates indicate that exporters make long term commitments with buyers and in this case up to a period of four to five years. On the other hand, the effect on exports of changes in the real income in the rest of the world is shown to be much stronger and rapid. No significant lag effects were observed in the real income variable. Turning to the import demand equation, it is indicative that almost all the variation in the real imports are accounted for by the increase in the domestic real income.[14] As in the case of the export demand equation, the real exchange rate plays no role in determining the import volume. Furthermore, it is important to note that the Marshall-Lerner condition does not hold here. This further confirms what has already been established empirically - the trade deficit was not responsive to the persistent devaluation of the rupee.

$\Delta \ln RER$, and $\Delta \ln Y_D$ in the import demand equation. Thus, in both equations variables are confirmed to be stationary. According to the variance decomposition and impulse response function estimates almost all the variation in the changes in the export and import volumes are accounted for by their own innovations. Changes in price and income variables in both equations do not explain a significant variation in the changes in export and import volumes. To conserve the space, these estimates are not reported here. Although not quite appropriate given the fact that all the variables in both equations are nonstationary, we still estimated the export and import demand equations by the OLS in order to get an idea about the income and price elasticities of the export and import demand equations.

14. The results reported in Table 6 are for the import demand equation estimated over the 1984I-97IV period. When the equation was estimated for the entire 1978I-97IV period, the coefficient for the real income turned out to be very small and insignificant. The poor fit can be due to the fall in real imports during the 1980I-1984I period. Between 1978I and1980I, real imports increased by more than 80 percent. The sharp increase in imports within such a short period is the direct result of the removal of restrictions on imports that were in effect until late 1977. During the 1980I-84I period, however, real imports declined by 21 percent. Although nominal imports during this period still shows an increase of 32 percent, this a modest increase compared to the 146 percent increase in nominal imports between 1978I-1980I period.

Table 5 Determinants of Export Volume, 1978 I-97 IV
(Dependent Variable is log of Real Exports)

Independent Variables	Parameter	t-ratio
Constant	−15.528	−1.29
ln Y_{ROW}	1.002***	9.67
ln RER_t	−0.183***	−3.45
ln RER_{t-1}	−0.128***	−3.98
ln RER_{t-2}	−0.083***	−4.12
ln RER_{t-3}	−0.048***	−2.59
ln RER_{t-4}	−0.021	−0.96
ln RER_{t-5}	−0.001	−0.03
ln RER_{t-6}	0.012	0.52
ln RER_{t-7}	0.021	0.92
ln RER_{t-8}	0.025	1.26
ln RER_{t-9}	0.026	1.54
ln RER_{t-10}	0.025	1.66
ln RER_{t-11}	0.022	1.48
ln RER_{t-12}	0.019	1.12
ln RER_{t-13}	0.017	0.86
ln RER_{t-14}	0.017	0.74
ln RER_{t-15}	0.019	0.81
ln RER_{t-16}	0.024	1.11
ln RER_{t-17}	0.035	1.80
ln RER_{t-18}	0.051***	2.90
ln RER_{t-19}	0.074***	3.19
ln RER_{t-20}	0.104***	2.69
ln RER_{t-21}	0.143***	2.29
Sum of ln RER_{t-I}	0.172	1.01

$R^2 = 0.87$	DW = 1.97	SE = 1.11	F = 75.39	$Z_1 = 1.65$	$Z_2 = 0.00$
$Z_3 = 1.61$	$Z_4 = 2.09$	$Z_5 = 2.2$	$Z_6 = 0.78$	$Z_7 = 1.01$	$Z_8 = 1.12$
$Z_9 = 1.42$	$Z_{10} = 17.91$	$Z_{11} = 1.13$			

Notes: *** indicates statistical significance at the 99 percent level. SE is the standard error of the estimate, DW is the Durbin-Watson test statistic, F-test tests the H_0 that all the coefficients, except the constant, are jointly equal zero, Z_1 is the Jarque-Bera test statistic for normality, Z_2, Z_3, Z_4, and Z_5 are Breush-Godfrey test statistics for the first, second, third, and fourth-order serial correlations, respectively, Z_6, Z_7, Z_8, and Z_9 are LM test statistics for first, second, third, and fourth order ARCH effects, respectively, Z_{10} is the White test for heteroskedasticity and model misspecification [χ^2 (15)], and Z_{11} is the Ramsey RESET for functional misspecification and omitted variables (degree one).

Table 6 Determinants of Import Volume, 1984 I-97 IV
(Dependent Variable is log of Real Imports)

Independent Variables	Parameter	t-ratio
Constant	24.824	1.19
ln Y_D	0.828***	9.12
ln RER_t	−0.053	−0.53
ln RER_{t-1}	−0.051	−1.03
ln RER_{t-2}	−0.050	−1.03
ln RER_{t-3}	−0.047	−0.89
ln RER_{t-4}	−0.044	−0.88
ln RER_{t-5}	−0.037	−0.91
ln RER_{t-6}	−0.026	−0.74
ln RER_{t-7}	−0.011	−0.28
ln RER_{t-8}	0.010	0.24
ln RER_{t-9}	0.038	1.03
ln RER_{t-10}	0.075	1.91
ln RER_{t-11}	0.122	1.41
Sum of ln RER_{t-I}	−0.075	−0.54

$R^2 = 0.91$	DW = 1.95	SE = 0.84	F = 87.25	$Z_1 = 1.91$	$Z_2 = 0.05$
$Z_3 = 2.69$	$Z_4 = 2.98$	$Z_5 = 3.15$	$Z_6 = 1.74$	$Z_7 = 1.64$	$Z_8 = 1.66$
$Z_9 = 2.13$	$Z_{10} = 15.07$	$Z_{11} = 1.28$			

Notes: See Table 5.

V. Concluding Remarks

This paper has examined the responsiveness of Sri Lanka’s trade deficit to devaluation by applying the “two country” model of trade to quarterly data for the 1978I-97IV period. The results show that the trade deficit was not responsive to devaluation, a key policy instrument of economic reforms introduced in 1977. Not only the trade deficit but export and import volumes also were not responsive to the fall in the rupee. Real exchange rates were not able to match the ever falling nominal rates, showing only a modest fall in the real exchange rates. High domestic inflation is the main cause of the failure of the real exchange rates to keep up with the nominal rates. Considerably high domestic inflation sometimes resulted in appreciations of the real exchange rates. The results further indicate that the growth in Sri Lanka’s exports is positively influenced by the growth in incomes in the importing countries. Devaluation has failed to play a significant role in boosting exports. Furthermore, notwithstanding continued devaluation of the rupee, the volume of real imports increased since 1977. The increase in the domestic real income was found to be positively correlated with the rise in real imports.

The finding of the present study that the exchange rate policy did not play a significant role in Sri Lanka’s external trade further reinforces that of previous studies (e.g., Hulugalle (1989)). The growth in the country’s exports can be credited to effective export promotion programs and improvements in the production base, particularly of manufactured exports. A significant portion of Sri Lanka’s imports comprises of investment goods and inputs for manufactured exports. Thus, the growth in manufactured exports is partially responsible for the increased import volume. The rise in imports of consumer goods, on the other hand, is due to the liberalization of imports and the increase in Sri Lanka's per capita income.

References

Arize, A. (1994), "A Re-examination of the Demand for Money in Small Developing Economies," *Applied Economics*, 26, 217-228.

Athukorala, P., and S. Jayasuriya, (1994), *Macroeconomic Policies, Crises, and Growth in Sri Lanka, 1969-90*, The World Bank, Washington, D.C.

Bahmani-Oskooee, M. (1991), "Is There a Long-run Relation Between the Trade Balance and the Real Effective Exchange Rates of LDCs?" *Economic Letters*, 36, 403-407.

Bahmani-Oskooee, M., and M. Malixi (1992), "More Evidence on the J Curve from LDCs," *Journal of Policy Modeling*, 14, 641-653.

Brada, J.C., A.N. Kutan, and S. Zhou (1993), "China's Exchange Rate and the Balance of Trade," *Economics of Planning*, 26, 229-242.

_____ (1997), "The Exchange Rate and the Balance of Trade: The Turkish Experience," *The Journal of Development Studies*, 33, 675-692.

Brown, R.L., J. Durbin, and J.M. Evan (1975), "Techniques for Testing the Constancy of Regression Relationships over Time (With Discussion)," *Journal of the Royal Statistical Society*, B37, 149-192.

Central Bank of Sri Lanka, *Annual Report*, Colombo, Sri Lanka, various issues.

Direction of Trade Statistics, *International Monetary Fund*, Washington, D.C., various issues.

Dornbush, R. (1975), "Exchange Rate and Fiscal Policy in a Popular Model of International Trade," *American Economic Review*, 65, 859-871.

Dunham, D., and S. Kelegama (1997), "Stabilization and Adjustment: A Second Look at the Sri Lankan Experience," *The Developing Economics*, 35, 166-184.

Edwards, S. (1989), *Real exchange rates, devaluation, and adjustment*, MIT Press, Cambridge.

Gardeazabal, J., and M. Regulez (1992), *The Monetary Model of Exchange Rates and Cointegration: Estimation, Testing, and Prediction.* (*Lecture Notes in Economics and Mathematical Systems*), No. 385, Springer-Verlag: Berlin.

Goldstein, M., and M.S. Khan (1976), "Large versus Small Price Changes in the Demand for Imports," *IMF Staff Papers*, 23, 200-225.

Granger, C.W.J. (1981), "Some Properties of Time Series Data and Their Use in Econometric Model Specification," *Journal of Econometrics*, 16, 121-130.

_____ (1988), "Some Recent Developments in the Concept of Causality," *Journal of Econometrics*, 39, 199-211.

Himarios, D. (1985), "The Effects of Devaluation on the Trade Balance: a Critical View and Reexamination of Miles's New Results," *Journal of International Money and Finance*, 4, 553-563.

Hulugalle, S. (1989), "The Exchange Rate Policy of Sri Lanka and Its Implications for the Export Sector 1981-1988," *Economic Review*, 15, 30-33.

International Financial Statistics, *International Monetary Fund*, Washington, D.C., various issues.

Johansen, S. (1988), "Statistical Analysis of Cointegration Vectors," *Journal of Economic Dynamics and Control*, 12, 231-254.

Johansen, S., and K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money," *Oxford Bulletin of Economics and Statistics*, 52, 169-210.

Krugman, P.R, and R.E. Baldwin (1987), "The Persistence of the U.S. Trade Deficit," *Brookings Papers on Economic Activity*, 1, 1-43.

Lee, H.S., and P.L. Siklos (1991), "Unit Roots and Seasonal Unit Roots in Macroeconomics Time Series: Canadian Evidence," *Economic Letters*, 35, 273-277.

Mann, C.L. (1986), "Prices, Profit Margins, and Exchange Rates," *Federal Reserve Bulletin*, 72, 366-379.

MacKinnon, J. (1991), "Critical Values for Cointegration Tests," in *Long Run Economic Relationships: Readings in Cointegration*, eds. by R.F. Engle and C.W.J. Granger, Ch. 13, Oxford University Press.

Miles, M.A. (1979), "The Effects of Devaluation on the Trade Balance and the Balance of Payments: Some New Results," *Journal of Political Economy*, 87, 600-620.

OECD Main Economic Indicators, *Organization for Economic Cooperation and Development*, various issues.

Osterwald-Lenum, M. (1992), "A Note with Fractiles of the Asymptotic Distribution of the Maximum Likelihood Cointegration Rank Test Statistics," *Oxford Bulletin of Economics and Statistics*, 54, 461-472.

Phillips, P.C.B. (1987), "Time Series Regression with Unit Roots," *Econometrica*, 55, 277-301.

Phillips, P.C.B., and P. Perron (1988), "Testing for a Unit Root in Time Series Regression," *Biometrica*, 75, 335-346.

Rose, A.K., and J.L. Yellen (1989), "Is There a J-curve," *Journal of Monetary Economics*, 24, 53-68.

Weliwita, A., and E.M. Ekanayake (1998), "Demand for Money in Sri Lanka During the Post-1977 Period: A Cointegration and Error Correction Analysis," *Applied Economics*, 30, 1219-1229.

White, H., and G. Wignaraja (1992), "Exchange Rates, Trade Liberalization, and Aid: The Sri Lankan Experience," *World Development*, 20, 1471-1480.

JOURNAL OF ECONOMIC DEVELOPMENT
Volume 25, Number 2, December 2000

Figure 1 Trade Balance as a Ratio Between Exports and Imports, 1978 I-97 IV

Figure 2 Nominal and Real Effective Exchange Rates, 1978 I-97 IV

Figure 3 lnY_D and lnY_{ROW}, 1978 I-97 IV

Figure 4 Inflation in Sri Lanka, 1978 I-97 IV