__Original Research Article__

The Effects of Currency Devaluation on the Bilateral Trade Balance of Sudan: Cointegration and Error-Correction Modeling

Abstract

The purpose of this research paper is to investigate the effect of exchange rate, income and money supply on the trade balance of Sudan over the period from 1970 to 2020. The empirical model for this investigation is developed using the absorption, elasticity and monetary approaches to the trade balance. The present research paper uses cointegration and error-correction techniques to examine specifically the effect of devaluation on Sudan's bilateral trade balance with its four major trading partners. The bounds tests suggest that the variables of interest are bound together in the long run when trade balance is a dependent variable. The associated equilibrium correction is significant, thus confirming the existence of a long-term relationship. Results from the variance decomposition show that innovations in foreign income highly contribute to the forecast error variance of the trade balance compared with other explanatory variables in the short run while the domestic money supply highly contributed to the trade balance compared to other variables in the long run. A key finding of the study suggests that the devaluation of Sudan's currency is not an appropriate step toward improving the country's trade balance position.

***Keywords*:** ARDL cointegration, exchange rate, trade balance, Sudan.
***JEL Code*:** C23, F10, F31

Introduction

Currency devaluation is a stabilization policy measure that some countries undertake to improve the competitive advantage situation of their economy, by reducing imports and fostering exports of goods and services with the aim to positively influence the balance of payments, and regain economic growth (Pegou et al., 2012). Currency devaluation is a highly controversial issue in many countries. A major policy option for a country facing a persistent balance of payments deficit is said to be the devaluation of its currency. Within international trade, it is not uncommon to find arguments about whether devaluation will improve the trade balance or the balance of payments. Each theoretical approach has its own set of arguments. For example, proponents of the elasticity approach describe the necessary and sufficient conditions for an improvement in the trade balance in terms of the elasticities of demand and supply referred to as the Marshall-Lerner condition (Robinson, 1947; Metzler, 1948). If the demand elasticities are sufficiently large and the supply elasticities sufficiently small, devaluation should improve the trade balance. Proponents of the absorption approach describe how devaluation may change the terms of trade, increase production, and switch expenditures from foreign to domestic goods, or have some other effect in reducing domestic absorption relative to production, thus improving the trade balance (Alexander, 1952; Johnson, 1971). International monetarists argue that devaluation reduces the real value of cash balances and/or changes the relative price of traded and nontraded goods, thus improving both the trade balance and the balance of payments (Miles, 1979, pp. 600–601; Bahmani-Oskooee, 1985, p. 500).

Opponents have viewed devaluation as stagflationary, causing a decrease in real output and an increase in the rate of inflation of the domestic economy. This view caused policymakers in many countries to avoid devaluation wherever possible. Proponents of devaluation have argued that it is an important policy tool that assists in stimulating balance of payments, affecting relative and absolute prices and real and nominal variables. Convinced by such arguments, some countries, mostly in Latin America and Asia, have been actively pursuing the exchange rate devaluation policy in an effort to maintain a balance of payments equilibrium. The pursuit of these policies has contributed to the International Monetary Fund (IMF) view that devaluation is a useful policy in resolving the problem of balance of payments (Nicholas, 1983; Karim, 1983; Asheghian,1988).

During 1980s, Sudan suffered from an unprecedented economic crisis. This was characterized by heavy debt burden, which was associated with negative macroeconomic indicator indices. The drastic fall of the macroeconomic indicators along with structural disequilibrium in the balance of payments pushed the country to devalue the Sudanese pound in 1978. The main objective of the devaluation was to restore the competitive advantage of the Sudanese economy through the amelioration of the trade balance position. In this study, our main question is to find out whether or not the devaluation of the pound enabled the country to reach this objective. In other words, did the episodes of Sudanese pound devaluation contribute to restoring the imbalances in Sudan's balance of trade? To be able to answer this question effectively, we carried out the study from 1970 to 2020.

The main objective of this article is to determine which of the three instruments of policy—fiscal policy, monetary policy, and exchange rate—has a long-term relationship with the trade balance in Sudan. The rest of the paper is organized as follows: Section 2 reviews the literature in the field. Section 3 describes the model, data, and econometrics methodology. Section 4 discusses the empirical results. Finally, Section 5 concludes with findings and policy recommendations.

Literature Review

There are three different approaches to a country's balance of payments. The first is the elasticity approach, which identifies the exchange rate as a major determinant of trade balance and adheres to devaluation as a policy to cope with trade deficit. The second is the Keynesian income approach, which identifies the level of economic activity, measured by domestic income as a major determinant of trade balance, and recommends any income-reducing policy (contractionary fiscal policy), to reduce a country's trade deficit. The third and last approach is the monetary approach, which argues that any balance of payments deficit is due to an excess supply of money. Thus, after identifying money as a major determinant, the monetary approach favors the use of the monetary policy to cope with the disequilibrium in balance of payments. In emphasizing the use of the monetary policy, monetarists take some additional steps and criticize the two other approaches. They argue that the Keynesian balance-of-payments adjustment models focus on the short run, and these models, such as the IS-LM-BP model (investment-savings, liquidity preference-money supply and balance of payment), fail to recognize that in the long run, the cause and cure of any disequilibrium in the balance of payments lie in the application of the monetary policy. They hold that fiscal policy and exchange rate changes do not cause and cannot be used to change the position of the balance of payments (Bahmani-Oskooee, 1992, p. 85). Alexander's absorption model supposes that the current account balance of a nation is determined by the difference between real revenue and absorption. He went on further by stating that devaluation affects two things: firstly, on gross domestic product (GDP), and secondly, through the revenue effect on expenditure.

The elasticity approach is mainly criticized for being a partial equilibrium approach, which does not account for the macroeconomic effects arising from price changes and production fluctuations in response to currency devaluation. In fact, it only accounts for value and volume responses to price changes. On the other hand, in the case of the absorption and monetary approaches, depreciation is related to macroeconomic variables that usually undermine the favorable impact of exchange rate devaluation on trade balance. The absorption approach merges the elasticity approach with Keynesian macroeconomics. The monetary approach suggests that devaluation should be understood in a monetary context. Thus, a balance of payments deficit is solely a monetary phenomenon mainly caused by excessive money supply. Currency devaluation has an impact on the balance of payments only through its effect on real money supply. Therefore, devaluation increases the balance of payment by increasing domestic prices, and thereby, reducing real money supply (Ali et al., 2014, pp. 4–5).

Theoretically, one could cite numerous studies that have tried to identify the determinants of trade balance by incorporating flavors of elasticities, Keynesian and monetary approaches. The empirical studies in this area include the works by Dornbusch (1975), Johnson (1976), Frenkel et al. (1980), Bahmani-Oskooee (1985, 1992), Murlid et al. (1996), Nachane and Prasad (1998), Upadhyaya et al. (1999), Pegou et al. (2012) and Ali et al. (2014). On the empirical ground regarding Sudan, the authors did not come across studies on Sudan that used the three abovementioned approaches. The current study aims to investigate the long-term relationship between Sudan's trade deficits and some macroeconomic variables such as exchange rate, money supply, and income.

In conclusion, the absorption approach to the balance of trade emphasizes that an increase in domestic income relative to the income of the rest of the world (trading partners) would lower the trade balance due to increased demand for imports. The monetary approach, on the other hand, identifies a relative decline in domestic money supply, which creates excess demand for money and a desire to hoard cash as a way to lower the trade deficit. Lastly, the elasticity approach focuses on the exchange rate as a major determinant of trade balance and recommends devaluation to eliminate trade balance.

Model, Data and Econometrics Methodology

Estimated Econometric Model Specification

Following Miles (1979), Himarios (1985, 1989), Bahmani-Oskooee and Pourheydarian (1991), Murldi et al. (1996), and Upadhyaya et al. (1999), this study uses a linear regression model incorporating all the variables. We specify the trade balance as a function of some macroeconomic variables as follows:

$$TB_t = \beta_0 + \beta_1 DY_t + \beta_2 FY_t^* + \beta_3 DM2_t + \beta_4 FM2_t^* + \beta_5 ER_t + \mu_t \quad (1)$$

where:

TB = trade balance

DY = domestic national income (real GDP)

FY* = foreign national income (major trading partners GDP)

DM2 = domestic money supply

FM2* = foreign money supply

ER = real exchange rate

μ= an error term

Data Sources

All data are annual and measured in terms of US dollars and cover the period between 1970–2020. They are taken from both national and international sources. The data are derived from national statistical yearbooks and the Central Bank of Sudan. The primary international source of data was the IMF's direction of trade statistics and international financial statistics.

Method of Estimation

In this paper, we adopt the vector autoregression (VAR) approach to time series analysis to investigate the three policy tools including fiscal policy, monetary policy and exchange rate effects on Sudan's trade balance. This analysis involves cointegration analysis, an error correction model, impulse response functions and variance decomposition. The VAR is useful in forecasting systems of interrelated time series and analyzing the dynamic impact of random disturbances on the system of variables (Ibrahim & Bashir, 2020).

Testing for unit root

Prior to testing for a causal relationship between the time series, we check the stationarity of the variables used as regressors in the models to be estimated by employing the Augmented Dickey-Fuller (ADF) test. It has become standard practice to begin the analysis by examining the time series properties of the data. We utilize two asymptotically equivalent procedures for detecting unit roots in the data: the ADF and the Phillip and Perron (PP) tests, which are widely used for testing stationarity in macroeconomic data (Ibrahim & Bashir, 2019).

Coitegration Process

Cointegration analysis is used to examine the long-term relationship between trade balance and some macroeconomic variables (DY, FY, DM2, FM2, ER). The basic idea of cointegration is that two or more variables may be regarded as defining a long-term equilibrium relationship if they move close together in the long run, even though they may drift apart in the short run. This long-term relationship is referred to as a cointegrating vector.

When the variables are stationary, they move together in the long run. The existence of cointegration thus suggests a long-run equilibrium among the series. An approach to testing for cointegration is to construct test statistics from the residuals of cointegrating regression. The short-run dynamics and movement toward equilibrium can be captured using a vector error-correction model (VECM), in which the long-run equilibrium relationship is entered into a short-run model. If the unit root analyses suggest that all the variables are I(1) and the residuals in the model are stationary, we can conclude that the series are cointegrated of order I(1). The advantage of cointegration and error correction techniques is that they provide more efficient short-run and long-run coefficient estimates and avoid the problems of spurious regression (Bashir& Ibrahim, 2020). The ARDL bounds testing procedure is sensitive to the selection of the lag structure. The determination of optimal lag can be used to set the value of lag based on the Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC) tests, which result in minimum value.

ARDL model specification

To empirically analyze the long-run relationships and dynamic interactions among the variables of interest, the model has been estimated by using bounds testing (or the ARDL cointegration) procedure developed by Pesaran et al. (2001). This approach involves two stages. The first stage involves testing the existence of a long-run equilibrium relationship between observed variables, i.e., cointegration among variables (TB), (DY), (FY) (DM2), (DM2) and (ER) exists if the coefficients $\theta_1, \theta_2, \theta_3, \theta_4, \theta_5\ and\ \theta_6$ are different from zero. The second stage involves defining the error-correction term, in particular the cointegration vector (Ibrahim & Bashir, 2020).

Error Correction Model (ECM)

Since tests involving differenced variables can be mis-specified and some important information can be lost if the variables are cointegrated, the error correction term (ECT), which is derived from long-run relationships using the ARDL procedure, is included as an independent variable. Since all the variables are stationary in the system, the short-run adjustment mechanism can be modeled as an ECM. This ECT, lagged by one year, is used in the ECM, together with the current and past differenced fundamentals and other variables that affect the trade balance and its determinants in the short run.

This procedure of differencing results in a loss of valuable "long-run information" in the data. The theory of cointegration addresses this issue by introducing an ECT. The ECT lagged for one period (i.e. EC_{t-1}) integrates short-run dynamics in the long run of determinants' trade balance. This leads us to the specification of a general ECM:

$$\Delta TB_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1\, \Delta DGDP_{t-1} + \sum_{i=1}^{n} \alpha_2 \Delta FGDP_{t-1} + \sum_{i=1}^{n} \alpha_3\, \Delta DM2_{t-1} + \sum_{=1}^{n} \alpha_4\ \Delta ER_{t-1} + \sum_{i=1}^{n} \alpha_5 \Delta FM2_{t-1} + \alpha_1 EC_{t-1} + \mu_t \qquad (2)$$

where EC_{t-1} is an ECT lagged by one period.

To determine the determinants of TB, we estimate an ECM after carrying out Granger causality and testing for cointegration. In other words, to test the determinants of TB, we must incorporate short-run dynamics into the long-run model, an error-correction modeling below (Pesaran et al., 2001). Since the observations are annual, we choose 2 lags as the maximum order of the lags in the ARDL model and carry out the estimation over the period 1970–2020.

The error-correction version of the ARDL (2,2,2,2,2) model pertaining to the variables in (1) is defined as follows:

$$\Delta \ln TB_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta TB_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta \ln DGDP_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta ln\, FGDP_{t-i}$$
$$+ \sum_{i=1}^{n} \delta_i \, \Delta \ln DM2_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta ln\, ER_{t-i} + \sum_{i=1}^{n} \delta_i \, \Delta \ln FM2_{t-i} + \delta_1 \, ln\, TB_{t-1}$$
$$+ \delta_2 \ln DGDP_{t-1} + \delta_3 \ln FGDP_{t-1} + \delta_4 \ln DM2_{t-1} + \delta_5 \ln ER_{t-1}$$
$$+ \delta_1 \ln FM2_{t-1} + \mu_t \quad (3)$$

If $(\delta_1 - \delta_1)$ are jointly significant, the variables are said to be cointegrated.

The short-run effects of the determinants of TB are inferred by the estimates of δ_i'.

Granger Causality Test

Statistically, we can detect the direction of causality when temporally there is a lead-lag relationship between two variables. The Granger causality test assumes that the information relevant to the prediction of the respective variables Y and X is contained solely in the time series data of these variables.

Impulse Response Functions (IRFs) and Variance Decomposition within a VAR Framework

To investigate the determinants of trade balance, we will use two different econometric frameworks, both of which are based on the VAR framework.

Impulse Response Function (IRF). A shock to the *i*-th variable not only directly affects the *i*-th variable but is also transmitted to all other endogenous variables because of the dynamic (lag) structure of the VAR. An IRF traces the effect of a one-time shock to one of the innovations on the current and future values of the endogenous variables. The IRF provides the dynamic responses of the dependent variable to innovations of other variables included in the system. It is a process that traces through the effect of a shock (or change in residuals, $\varepsilon_1, \varepsilon_2 \ldots$) to each endogenous variable in the system (Bashir & Ibrahim, 2022).

Variance Decompositions (VDCs). To provide further insight into the dynamic relationships of the variables in the system, the forecast error variance decomposition is calculated. Variance decomposition shows the proportion of the forecast error of each endogenous variable that is accounted for by each of the other variables. The forecast error variance decomposition technique is employed to account for the error variance in each of the variables in the VAR system, to innovations in own as well as other variables in the system.

Empirical Results

Unit Root Tests

The unit root tests are performed to determine the stationarity of the series, as non-stationary series can lead to “spurious regression” results. The results of the ADF test on the levels and first differences of the variables are presented in Table 1. The lag length was selected using AIC. Table 2 reports the results of the PP tests for unit root on both levels and first differences of the variables.

Table 1

Unit Root Test: Augmented Dickey-Fuller (ADF) Test

Variable	Level (Test Statistic)			First Difference (Test Statistic)		
Series	Intercept	Trend & Intercept	Lag	Intercept	Trend & Intercept	Integrated Order
TB	-2.89 (-2.92))	-2.91 (-3.50)	2	-1.11 (-2.92)	-1.01 (-3.50)	I(1)
lnFY	-0.59 (-2.92)	-1.93 (-3.50)	2	-1.97 (-2.92)	-1.98 (-3.50)	I(1)
LnFM2	-0.71 (-2.92)	-2.14 (-3.50)	2	-1.91 (-2.92)	-1.85 (-3.50)	I(1)
lnER	0.28 (-2.92)	-1.89 (-3.50)	2	-1.12 (-2.92)	-1.10 (-3.50)	I(1)
lnDY	-0.55 (-2.92)	-2.71 (-3.50)	2	-5.31 (-2.92)	-5.25 (-3.50)	I(1)
LnDM2	-0.54 (-2.92)	-0.13 (-3.50)	2	-3.42 (-2.92)	-4.43 (-3.50)	I(1)

Note: Figures between brackets are critical values at the 5% level.
Source: Authors' calculations based on Eviews (10) outcomes.

Table 2

Unit Root Test: Phillips – Perron (PP) Test

Variable	Level (Test Statistic)		First Difference (Test Statistic)		
Series	Intercept	Trend & Intercept	Intercept	Trend & Intercept	Integrated Order
TB	-3.00 (-2.92)	-2.93 (-3.50)	-1.19 (-2.92)	-1.11 (-3.50)	I(0)
lnDY	-0.57 (-2.92)	-2.22 (-3.50)	-5.79 (-2.92)	-5.19 (-3.50)	I(1)
lnER	0.17 (-2.92)	-2.20 (-3.50)	-1.15 (-2.92)	-1.14 (-3.50)	I(1)
LnFM2	-0.71 (-2.92)	-2.19 (-3.50)	-1.91 (-2.92)	-1.85 (-3.50)	I(1)
lnFY	-0.10 (-2.92)	-1.93 (-3.50)	-1.97 (-2.92)	-1.98 (-3.50)	I(1)
LnDM2	0.24 (-2.92)	-1.77 (-3.50)	-5.51 (-2.92)	-5.41 (-3.50)	I(1)

Note: Figures between brackets are critical values at the 5% level.

Source: Authors' calculations based on Eviews (10) outcomes.

Both tables show that in all cases, the unit root hypothesis cannot be rejected. It can, therefore, be concluded that most of the variables are I(1), except for trade balance, which was stationary at level, a result that is confirmed by many other papers.

Lag Length Criteria

Determining lag length in a VAR model is one of the most important requirements. The determination of an optimal lag length can require the use of several criteria, such as the methods of sequential modified likelihood ratio (LR) test, final prediction error (FPE) statistic, AIC, SIC and the Hanan-Quinn Criteria (HQC). As shown in Table 3, it appears that based on the criteria of AIC and SC, the optimal lag length is 2 for AIC.

Table 3

VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-710.8573	NA	205305.5	29.25948	29.49113	29.34737
1	-425.1851	489.7229*	7.793930*	19.01880*	20.19031*	19.18402*
2	-407.2188	21.32177	17.42048	19.80189	22.81831	20.94944

Note: * indicates lag order selected by the criterion.

Source: Authors' calculations based on Eviews (10) output.

ARDL Bounds for Cointegration

To empirically analyze the long-run relationships and short-run dynamic interactions among the variables of interest, we apply the ARDL cointegration technique. ARDL testing is performed by Wald statistics in the form of the F-test. If the calculated value of the F statistic is significant (higher than the upper bound), one rejects H_0 in favor of H_1, thus showing that the long-run equilibrium relationship between TB, DY, FY, DM2, FM2 and ER exists.

Table 4

F-Bounds Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	2.433197	10%	2.08	3
k	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.01	4.15

Source: Authors' calculations based on Eviews (10)

Since f(TB, DY, FY, DM2, FM2 and ER) = 2.43 exceeds the upper bound of the critical value band at the 5% level, which is given by 2.39 and 3.38 that represent the lower and upper bonds, respectively, we can reject the null hypothesis that says there is no long-run relationship between variables, irrespective of the order of their integration, I(0) or I(1). The test results are above the upper-bound critical value indicating a rejection of the null hypothesis of no co-integration, thereby suggesting that there exists a long-run relationship between the variables; therefore, DY, FY, DM2, FM2 and ER can be treated as the ‘long-run forcing’ variables to explain the TB. This means that all the variables move together in the long-run.

Error Correction Model

Once a cointegration relationship is established, then an ECM can be estimated to determine the dynamic behavior of TB determinants. We apply the Wald test to measure how close the unrestricted estimates come to satisfying the restrictions under the null hypothesis.

Table 5

ARDL Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LONLNDY)	-5193.947	2927.208	-1.774319	0.0847
D(LONLNDY(-1))	1450.975	2901.552	2.219410	0.0330
D(LONLNFY)	-52.18987	308.3010	-0.170904	0.8153
D(LONLNFY(-1))	-184.5133	329.3429	-2.078573	0.0451
D(LONLNER)	-118.9414	492.7155	-1.357173	0.1833
D(LONLNER(-1))	-2400.131	495.5797	-4.843087	0.0000
CointEq(-1)*	-0.273923	0.011324	-4.411791	0.0001

The coefficient of ECT (EC_{t-1}) that represents the proportion by which a long-run disequilibrium in GDP can be corrected in each year, estimated as -0.273923, is statistically significant at the 5% level, and correctly negatively signed. It suggests the validity of a long-run equilibrium relationship among the variables in the model, as well as a moderate speed of convergence to equilibrium.

Test for Serial Correlation

It is advisable to compute the Breush-Godfrey statistic and respond to any indication of autocorrelation disturbances, as it is almost certainly more dangerous to incorrectly suppose that autocorrelation is not present than to incorrectly suppose that it is. As shown in Table 6, the result indicates that there was evidence of autocorrelation, as the p-value is more than 5%.

Table 6

Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.054138	Prob. F(2,33)	0.9419
Obs*R-squared	0.158421	Prob. Chi-Square(2)	0.9238

Source: output from Eviews(10).

Granger Causality Test

Since TB and GDP are stationary, we assume that their residuals are uncorrelated, which is a condition of the Granger Causality test, and the optimum lag is 2, which is the lowest AIC. After this, we can proceed to test Granger causality. We test the null hypothesis using the F-test, the guidelines for which include the p-value and a 5% level of significance. As shown in Table (7), we cannot reject the hypothesis that neither variable Granger-causes the other.

Table 7

Pairwise Granger Causality Test

Null Hypothesis	Obs.	F-Statistic	Prob.
LONLNDY does not Granger Cause TB	48	0.17903	0.8317
TB does not Granger Cause LONLNDY		0.27411	0.7111

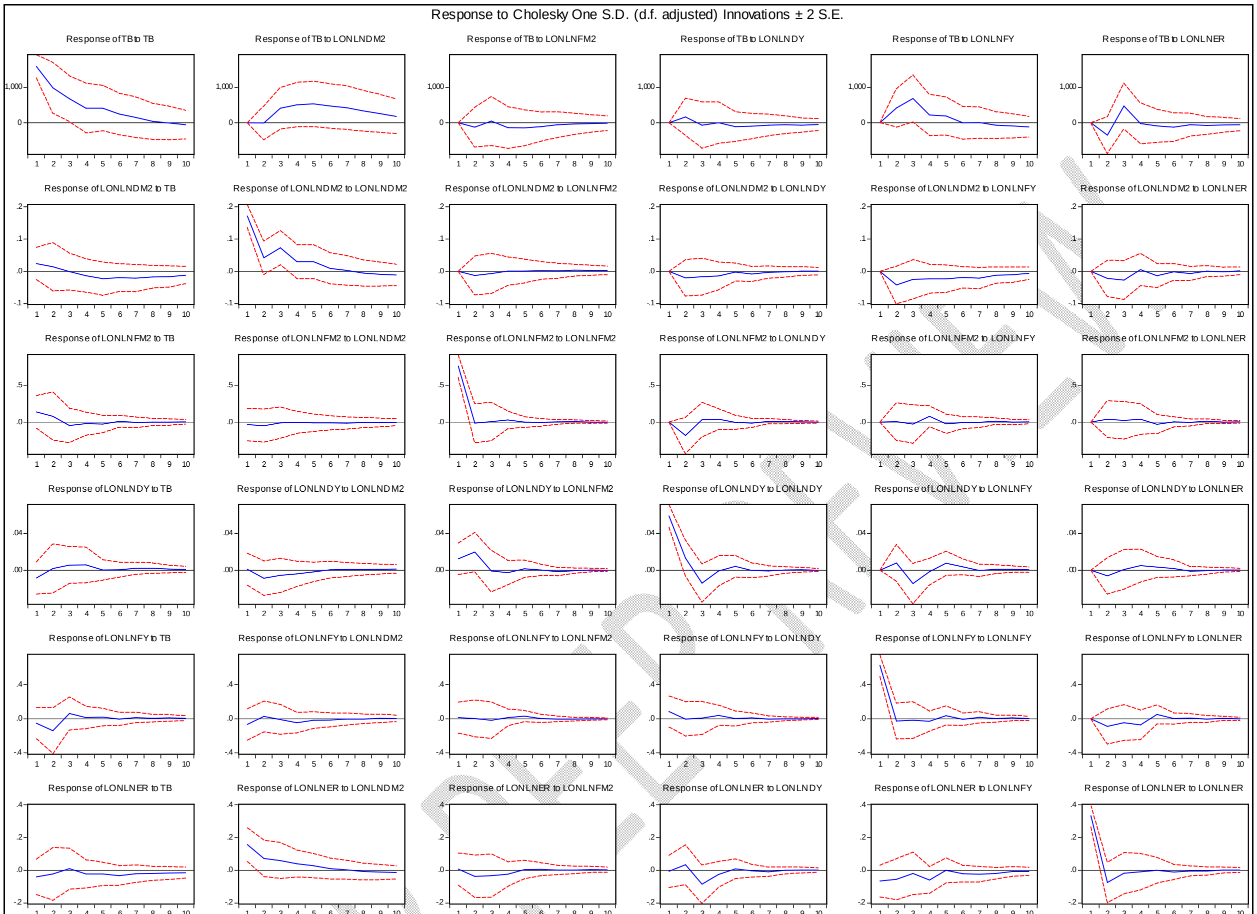
Source: Output from Eviews(10).

Impulse Response Functions (IRFs)

IRFs seek the effects of a shock to endogenous variables on the other variables in the system. It is a shock to the VAR system. It is a unit shock that is applied to each variable to observe its effect on the VAR system. IRFs map out the dynamic response of Cholesky one standard deviation of innovation used to determine the TB determinants that exist in Sudan. Figure 1 shows the estimated orthogonalized IRFs for DY, FY, DM2, FM2, and ER, for a standard deviation innovation in the TB.

Figure 1

Impulse Response Functions



Variance Decompositions (VDCs)

Decomposes variation in an endogenous variable into the component shocks provides information about the relative importance (of each shock to the variable) of a random innovation. The VDCs are sensitive to the ordering of the variables. As all the variables are stationary in nature, given that VAR needs stationary variables, and also lag selection criterion advise us to use 2 lags as optimum.

Table 8

Variance Decompositions

Variance Decomposition of TB						
Period	S.E.	TB	LONLNDM2	LONLNFM2	LONLNDY	LONLNFY
3	2279.110	71.59074	3.270531	0.318392	0.103354	12.55821
10	2154.190	12.17912	19.10045	1.005198	0.931212	10.84119
Variance Decomposition of LONLNDM2						
Period	S.E.	TB	LONLNDM2	LONLNFM2	LONLNDY	LONLNFY
3	0.204101	1.905120	87.41119	0.481411	1.123791	5.729093
10	0.221132	1.158580	79.18918	0.499781	1.970052	9.221408
Variance Decomposition of LONLNFM2						
Period	S.E.	TB	LONLNDM2	LONLNFM2	LONLNDY	LONLNFY
3	0.803917	4.174812	0.599718	89.41119	5.311581	0.123419
10	0.812101	4.290211	0.189718	87.71071	5.457551	1.144915
Variance Decomposition of LONLNDY						
Period	S.E.	TB	LONLNDM2	LONLNFM2	LONLNDY	LONLNFY
3	0.070137	2.177237	2.305334	11.00137	78.13951	5.514211
10	0.071111	2.894171	2.177012	10.82128	75.31174	1.749718
Variance Decomposition of LONLNFY						
Period	S.E.	TB	LONLNDM2	LONLNFM2	LONLNDY	LONLNFY
3	0.114795	5.934318	1.202129	0.121133	1.119128	88.71231
10	0.177371	5.927351	1.711459	0.382911	1.991410	81.01071
Variance Decomposition of LONLNER						
Period	S.E.	TB	LONLNDM2	LONLNFM2	LONLNDY	LONLNFY
3	0.413712	1.300717	19.59027	1.484118	4.880410	4.475839
10	0.428979	2.989898	19.82089	1.739503	4.971791	1.854411

We divide the period into short and long runs. In the short-run, that is in year 3, impulse (or innovation or shock) to TB accounts for 71.59% variation of the fluctuation in the TB, or its own shock. The second shock is the shock to DM2 which can cause a 3.27% fluctuation in the TB. A shock to FM2, however, can contribute a 0.32% fluctuation in the TB. A shock to DY can contribute 0.1% fluctuation in TB. As a result, total fluctuations amount to 100%.

In the long run, that is in year 10, impulse to TB can contribute a 12.18% variation of fluctuation in the TB, or its own shock. The second shock is the shock to DM2, which can cause a 19.1% fluctuation in the variance of TB. A shock to FM2, however, can contribute a 1.00% fluctuation in TB. A shock to DY can contribute 0.94% fluctuation to TB. But a shock to FY can contribute 10.84% fluctuation to TB. As a result, total fluctuations become 100%.

In the short-run, that is year 3, impulse to TB accounts for a 1.9% variation of the fluctuation in DM2. The second shock is the shock to DM2, which can cause an 87.42% fluctuation in DM2 or its own shock. A shock to FM2, however, can contribute a 0.48% fluctuation in DM2. A shock to DY can contribute a 1.12% fluctuation in DM2. Further, a shock to FY can contribute a 5.73% fluctuation in DM2. As a result, total fluctuations amount to 100%.

In the long run, that is in year 10, impulse to TB can contribute to a 1.11% variation of fluctuation in DM2. The second shock is the shock to DM2, which can cause a 79.19% fluctuation in the variance of DM2 or its own shock. A shock to FM2, however, can contribute to a 0.49% fluctuation in DM2. A shock to DY can contribute a 1.97% fluctuation in DM2. A shock to FY can contribute a 9.22% fluctuation to DM2. As a result, total fluctuations amount to 100%.

In the short-run, that is year 3, impulse to TB accounts for 4.17% variation of the fluctuation in FM2. The second shock is the shock to DM2, which can cause a 0.59% fluctuation in FM2. A shock to FM2, however, can contribute to a 89.47% fluctuation in FM2 or its own shock. A shock to DY can contribute a 5.31% fluctuation in FM2. Further, a shock to FY can result in a 0.12% fluctuation in FM2. As a result, the total fluctuations to TB amount to100%.

In the long-run, that is in year 10, impulse to TB can contribute to a 4.29% variation of fluctuation in FM2. The second shock is the shock to DM2, which can cause a 0.19% fluctuation in the variance of FM2. A shock to FM2 can contribute to an 87.71% fluctuation in FM2 or its own shock. A shock to DY can contribute to a 5.41% fluctuation in FM2. A shock to FY can contribute to a 1.14% fluctuation in FM2. As a result, the total fluctuation amount to 100%.

In the short-run, that is in year 3, impulse to TB accounts for a 2.18% variation of fluctuation in DY. The second shock is the shock to DM2, which can result in a 2.30% fluctuation in DY. A shock to FM2, however, can contribute to a 11.00% fluctuation in DY. Further, a shock to DY can contribute to a 78.14% fluctuation in DY or its own shock. A shock to FY can contribute to a 5.51% to DY. As a result, total fluctuations amount to 100%.

In the long-run, that is in year 10, impulse to TB can contribute to a 5.93% variation of the fluctuation in the FY. The second shock is the shock to DM2, which can cause a 1.72% fluctuation in the variance of FY. However, a shock to FM2 can contribute to a 0.38% fluctuation in FY. Furthermore, a shock to DY can contribute to a 1.99% fluctuation in FY. A shock to FY can contribute to an 81.01% fluctuation to in FY or its own shock. As a result, total fluctuations amount to 100%.

In the short-run, that is in year 3, impulse to TB accounts for a 1.30% variation of fluctuation in the ER. The second shock is the shock to DM2, which can cause a 19.59% fluctuation in ER. However, a shock to FM2 can contribute to a 1.48% fluctuation in ER. A shock to DY can contribute to a 4.88% fluctuation in ER, and a shock to FY can contribute a 4.47% fluctuation in ER. As a result, the total fluctuations add up to 100%.

In the long-run, or in year 10, impulse to TB can contribute a 2.99% variation of fluctuation in the ER. The second shock is the shock to DM2, which can cause a 19.82% fluctuation in variance in the ER. A shock to FM2, however, can contribute a 1.74% fluctuation in the ER. A shock to DY can contribute to a 4.98% fluctuation in ER. A shock to FY can contribute a 1.85% fluctuation to ER. As a result, total fluctuations amount to 100%.

Stability Diagnostics

We apply the well-known CUSUM and CUSUMQ tests to the residuals of the optimum model to test them for stability of short-run and long-run coefficient estimates all together. Since the blue lines lay inside the red lines, it means that the model is stable. As shown in Figure 2, the CUSUM of squares test reflects that the blue trend line lies within the red lines, which confirms that the model is dynamically stable. However, the CUSUMSQ test in Figure 3 shows greater instability between 1994 and 2019, a period in which the trade balance suffered a large deficit and the exchange rate experienced huge and multiple depreciations.

Figure 2

CUSUM of Squares Test

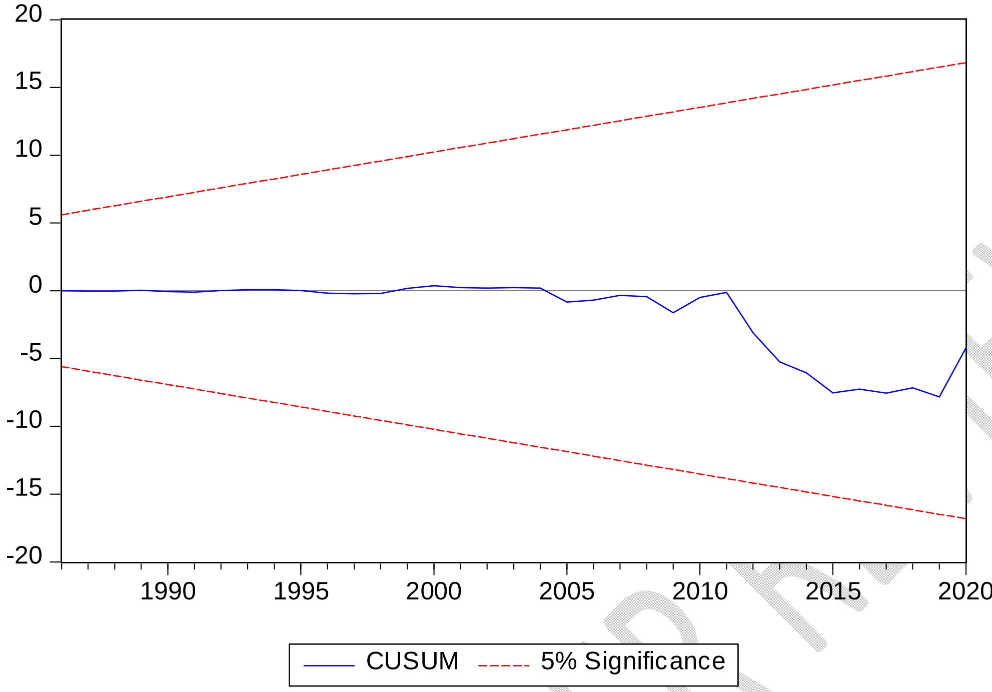
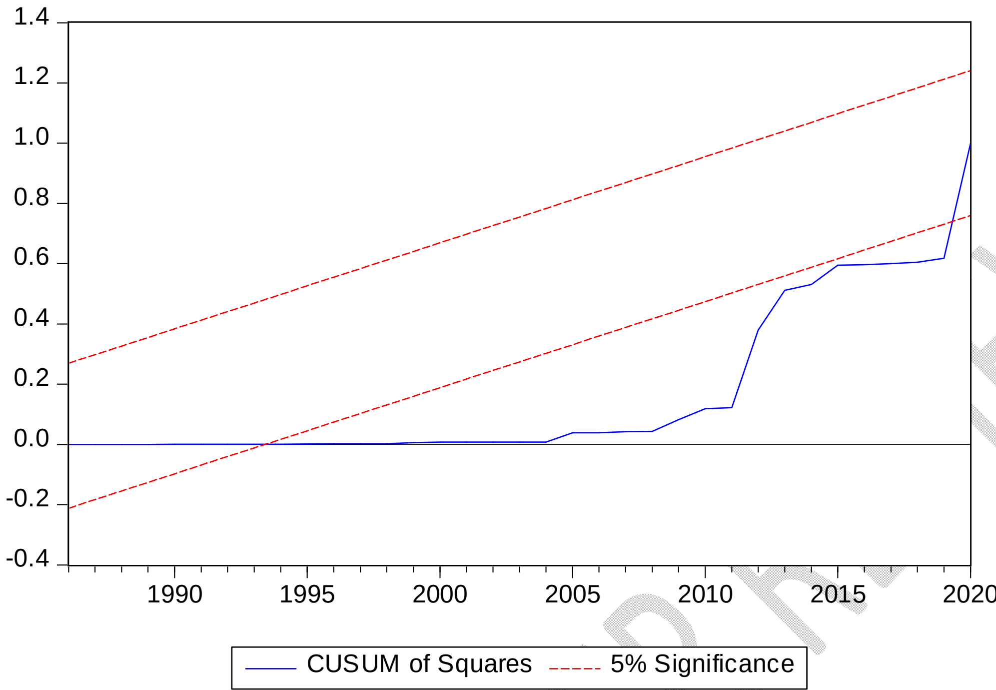


Figure 3

CUSUMQ of Squares Test



Conclusion and Policy Recommendations

The objective of this paper was to shed light on the effect of devaluation on the trade balance of Sudan over the period 1970 to 2020. The empirical model for this investigation is developed using the absorption, elasticity and monetary approaches to trade balance. Before estimating the model, each series is tested for stationarity. The estimated results indicate that devaluations do improve trade balance in the long run.

The study uses cointegration and error correction techniques to identify the variables to explain the effect of exchange rate on trade balance in Sudan. The ARDL cointegration test analysis was used to create a long run equilibrium relationship among these variables. The methodology of an ECM was applied to estimate the short- and long-run relationships. The selected cointegrated vector provided the appropriate ECT, which proved to be negative and statistically significant at a 5% level of significance during its inclusion in the short-run dynamic equation. The study considers the DY, FY, DM2, FM2 and EX variables if they explain the trade balance. All the variables indicated the correct signs and were statistically significant.

The most important policy implication of our findings is that any trade balance strategy will contribute to economic growth and vice versa. Therefore, as a recommended policy implication, we should stress on the significant effects of the determinants of trade balance. There are a few limitations of the data used in this study that must be underlined. The main problem in conducting empirical studies on developing countries is that of data availability. Many developing countries do not have adequate time series data that can be used for analysis. It is suggested that future studies on this topic should be based on high frequency data and a larger sample size so that the results are more reliable and robust.

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