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Real Exchange Rate Misalignments in Tanzania

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ABSTRACT

The study uses a real exchange rate equilibrium (REER) technique to examine real exchange rate misalignments in Tanzania, through the cointegration technique. The empirical findings reveal that the real exchange rate misalignment has decreased significantly over recent years, and the real effective exchange rate has been evolving close to the long-term equilibrium. The findings strongly suggest that the underlying monetary and exchange rate policies were crucial in bringing the real exchange rate back to equilibrium in line with medium-term fundamentals recently. As a result, it is suggested that the existing monetary and exchange rate policies be maintained. While the monetary policy will contribute to real exchange rate stability through low inflation, flexible exchange rate policy will contribute to real exchange rate stability through nominal exchange rate adjustment.

Keywords: Foreign Exchange, Foreign Exchange Policy.

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I. Introduction

The growing body of evidence about the role of exchange rates as a crucial macroeconomic adjustment mechanism has increasingly stimulated analyses of the behavior of real exchange rates in many developing countries. This evidence is strongly rooted in both theoretical and empirical studies (Rodrik, 2008; Hausmann *et al.*, 2004; Abida, 2010; Prasad, *et al.*, 2007; Levy-Yeyati & Strzenegger, 2007). One of the key implications emerging from this literature is the notion of real exchange rate misalignment or the extent real exchange rate has diverged from its benchmark or equilibrium level. Many studies acknowledge that one of the most important conditions for improving economic performance and macroeconomic stability is the correction of real exchange rate misalignment (Abida, 2010; Atasoy *et al.*, 2006). Real exchange rate misalignment may increase economic instability and distort investment decisions which result in welfare and efficiency costs. Further, real exchange rate misalignment especially overvaluation hurts exports and hinders growth. The misalignments can also encourage capital flight with substantial welfare costs (Berg & Miao, 2010; Eichengreen, 2008). In the export led growth literature, there is a common view that link depreciation in real exchange rate and economic growth with manufacturing (tradable sector) as the main operational channel (Rodrik, 2008; Hausmann *et al.*, 2004).

Knowledge about the extent real exchange rate is misaligned is thus of key interest to practitioners and researchers alike. The objective of the study is to derive (estimate) real exchange rate misalignments in Tanzania over the recent years in order to understand how real exchange rate has responded to the ongoing macroeconomic and structural policies. Investigating whether a country's exchange rate is close to its equilibrium value further helps determine future adjustment needs and possible trajectories of economic fundaments. The analysis in this study is extended to the recent years, and therefore add to the discussion about whether the concerns regarding current trends in the nominal exchange rates between Tanzania shilling and major foreign currencies are justified. The paper is organized as follows.

The next section provides a brief discussion of macroeconomic development in Tanzania, featuring in particular economic growth, current account, inflation and fiscal balance. Section 3 delves on theoretical and empirical literature on determination of equilibrium real exchange rate. Section 4 provides the analytical methodology focusing on econometric frameworks for estimating the equilibrium real exchange rate and real exchange misalignments. Section five conclude by summarizing the findings and policy implications.

II. Macroeconomic Development

Tanzania has continued to experience strong macroeconomic performance thanks to prudent macroeconomic and structural policies whose implementation has been accelerated over the recent years. The economy sustained high economic growth, recording about an annual average growth of 7 percent in real domestic product for a decade before the onset of the COVID-19 pandemic which slowed the momentum to 4.2 percent (Fig. 1).

Price stability has remained resilient, with average headline inflation being maintained within a single digit during the past 10 years. Indeed, during the past 5 years, average headline inflation has been maintained below 5 percent. Development in the real exchange rate has reflected the underlying policy regime in particular exchange rate policy which has been determined by conditions in the foreign exchange markets. The behavior of a real effective exchange rate has shown a significant degree of flexibility, with a record of some moderate depreciation over the recent years.

Fiscal performance has improved notably. For example, over the recent years, the fiscal deficit was well anchored below 5.0 percent of GDP (Fig. 2). Efficiency in tax management and rationalization of government expenditure have been enhanced; with revenue mobilization measures being dedicated to meeting county's large developmental needs including infrastructure, investment in education as well as improvement in health services as stipulated in the five-year development plan and development vision 2025 (TZA, 1999).

Current account development continued to mirror the inter-temporal pattern whereby today's current account balance reflects future current account surpluses arising from savings and investments that are being committed today. In this sense, the current account deficit realized today should not be necessarily construed as bad for the economy if that deficit is being financed by inflows of productive/investment resources. The widening of the current account has remained notable reflecting the rising of imports especially capital goods required for investment in various sectors including manufacturing, building and construction, and mining among others. The trend in the current account has also been attributed to external factors including terms of trade, a spike in international commodity prices, and supply and demand imbalances. Over the horizon, the internal and external balance trend has also been affected by intermittent global shocks including Great Financial Crisis (GFC), European Debt Crisis (EDC), the COVID-19 pandemic, and more recently the Russia-Ukraine war.

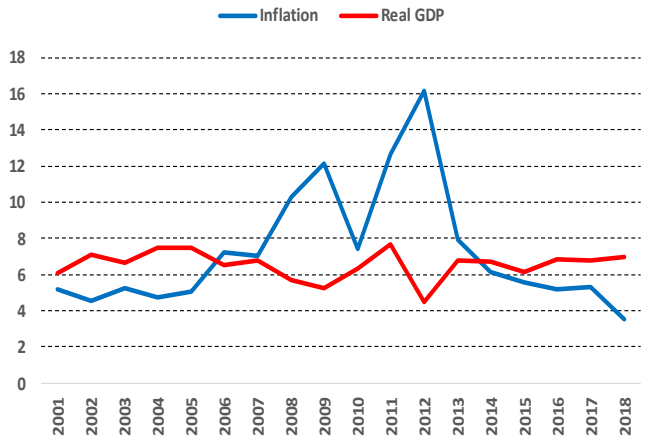

Fig. 1. Trend of inflation and GDP growth (right-hand scale).

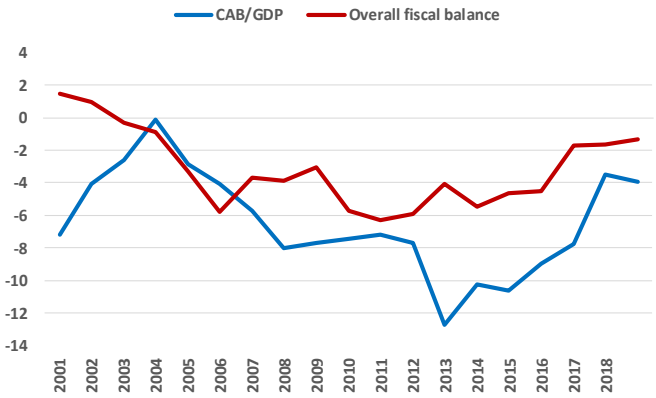

Fig. 2. Trend of current account balance and fiscal balance.

III. Literature Review

A. Theoretical Literature

Theoretical studies on the determination of real exchange rates have been flourishing over time. A study by Edward (1989) assumes the economy with three goods (exports, imports, and nontraded goods) a dual exchange rate system (fixed for trade transactions and flexible for financial transactions), and a demand for holding both domestic and foreign currency. Under the steady state, the real exchange rate is in equilibrium, and based on the solution of the model, the real exchange rate is determined by the fundamental variables including tariff rates, terms of trade, capital flows, and government consumption.

A study by Elbadawi (1994) extended Edwards (1989) and replaces tariff rates with a variable for trade openness arguing that this takes into account implicit trade restrictions such as quotas and exchange rate controls. The model predicts that the real exchange rate appreciates in face of technological progress and capital inflows. Technological progress will lead to substitution towards nontraded goods and thus lead to an increase in their price which in turn results in the appreciation of the real exchange rate. Likewise, a higher level of capital flows implies greater total assets, leading to an increase in aggregate demand which leads to pressure on the prices of non-traded goods. As noted by Atasoy and Saxena (2006) technological progress will be associated with higher productivity growth in the traded goods sector. This leads to a trade surplus and therefore appreciation in the real exchange rate.

The study by Elbadawi (1994) further predicts that a worsening of the terms of trade could lead to appreciation or depreciation of the real exchange rate depending on the relative magnitude of income and substitution effect. If deterioration of terms of trade leads to a shift in demand towards nontraded goods, it will lead to an increase in the price of nontraded goods and thus cause an exchange rate appreciation. However, deterioration in terms of trade could also reduce demand due to the income effect which could cause an exchange rate depreciation.

If the increase in government consumption is more related to non-traded goods, there will be an increase in the price of nontraded goods and lead to real exchange appreciation. Nonetheless, if government consumption is directed toward traded goods real exchange rate will depreciate.

Lastly, the increase in investment could cause a rise in the aggregate demand (similar to capital flows) leading to an increase in the price of non-traded goods hence resulting in the appreciation of the real exchange rate. Nevertheless, as Atasoy and Saxen (2006) note, there could be a supply-side effect that reduces prices in the affected sectors. If those sectors include the non-traded goods sector, it will result in real exchange rate appreciation.

The study by Nassif *et al.*, (2011) develops a Keynesian theoretical approach in the determination of real exchange rates for emerging economies. Instead of macroeconomic fundamentals, the long-run real exchange rate is modeled to be determined not only by structural dynamics and long-run policies but by both short-term macroeconomic policies and their indirect effect on other short-term economic variables. In this study, the actual real exchange rate is broken down into long-term and short-term components, both of which may be responsible for the deviations of the real exchange rate from its equilibrium path.

Villavicencio and Bara (2008) explore the real exchange rate behavior in Mexico from 1960 until 2005 by developing a simple model of real exchange rate determination. The study indicates that the equilibrium real exchange rate is driven by relative GDP per capita, real interest rates, and net foreign assets.

Litsios and Pilbeam (2017) develop a model of real exchange rate determination focusing on different assets, including domestic and foreign bonds, domestic and foreign equities, and domestic and foreign real money balances. The study found that financial assets play a significant role in the determination of the real exchange rate.

B. *Empirical Literature*

Three main strands of empirical literature for measuring real exchange rate misalignments exist (IMF (2006). These are the macroeconomic balance approach, external sustainability approach and behavioral equilibrium real exchange approach.

1) *Macroeconomic balance framework*

This framework focuses on the extent to which prevailing exchange rates and policies are consistent with simultaneous internal and external equilibrium over the medium term (IMF, 2006). Basically, the macroeconomic balance methodology is based on 3 steps (Bussiere *et al.*, 2004)). The first involves estimating the equilibrium relationship between current account balances and a set of fundamentals. The second step consists in deriving the current account norm based on the estimated relationship and projected values of fundamentals in the medium term. In the third step, the required exchange rate adjustment to close the gap between the current account norm and the underlying current account balance is computed. Current account norm is typically based on an equilibrium solution to the macroeconomic model and there is a large literature on potential factors that can influence the dynamics of the current account including demographics, government fiscal policy, terms of trade, productivity, catching-up potential, trade openness, as well as institutional characteristics, among others (Bussiere *et al.*, 2004). One important point to highlight is that the current account is linked, through an accounting identity, to the difference between domestic savings and investment. This identity highlights the intertemporal nature of the current account and the role of consumption smoothing (Rogoff, 1996). One implication of this approach is that the current account deficit does not necessarily imply an imbalance. It makes sense for a country that is growing to borrow against its future income hence the current account norm should not necessarily be zero.

2) *External sustainability approach*

This approach belongs to the same thinking as in the macroeconomic balance methodology, only that the way the current account norm is derived differs (Lee *et al.*, 2008). Instead of being estimated based on an econometric model, in external sustainability, the current account norms are derived through accounting principles to ensure external debt sustainability. In addition to standard accounting identities, few assumptions are necessary for deriving current account norms using this approach. These include assumptions about the potential growth of the economy, inflation developments, and steady-state level of net foreign assets. Underlying external sustainability is an intertemporal budget constraint that requires that the present value of future primary (trade) surpluses is sufficient to pay for the country's outstanding external liabilities. In principle, to satisfy this constraint the country needs to ensure that the size of net foreign assets is stabilized relative to the size of the economy, and therefore avoiding building up of assets or liabilities without bound (Bussiere *et al.*, 2009).

3) *Behavioral equilibrium real exchange rate approach*

This approach focuses on directly estimating a reduced form equilibrium real exchange rate using its long-run determinants (IMF, 2006). The approach consists of two main stages (Chin & Prasad, 2003). The first stage estimates a reduction in the relationship between the real exchange rate and a set of economic fundamentals using the econometric technique. This stage is mostly statistical in nature although economic theory helps guide the choice of fundamentals and assess the plausibility of the results. The second stage derives the equilibrium level for the real exchange rate from this estimated relationship.

IV. Analytical Methodology

The real exchange rate misalignments, which is the deviation of the real exchange rate from its long-run equilibrium path can either be overvaluation or undervaluation (Wong *et al.*, 2011). Overvaluation implies that the value of the currency is greater than its equilibrium and undervaluation means that the value of the currency is less than its equilibrium. Thus, to analyze the misalignments, long-run equilibrium real exchange rate needs to be estimated and then assessed the extent the actual real exchange rate has deviated from its equilibrium path overtime. Following IMF (2006) Edwards (1989), Elbadawi (1996), and Eita and Sichei (2006) among others, this study employs a behavioral equilibrium real exchange rate approach to estimate real exchange rate misalignments for Tanzania.

A. *Behavioral Equilibrium Real Exchange Rate Approach*

This approach has been widely used to estimate equilibrium real exchange rates for several countries

including IMF (2006) for member countries, Feyzio (1997) for Finland, Mkenda (2001) for Zambia, MacDonald and Ricci (2003) for South Africa, Mathisen (2003) for Malawi, Eita and Sichei (2006) for Namibia.

This focuses on a single equation model of the real effective exchange rate as a function of medium-term economic determinants identified in Edward (1989) and Elbadawi (1996). These determinants have also been used by a number of econometric studies (Feyzio, 1997; Mkenda, 2001; MacDonald & Ricci, 2003; Mathisen, 2003; Eita & Sichei, 2006). These determinants include relative productivity (PROD), commodity terms of trade (TOT), government expenditure (GOV), trade openness (OPEN), and net foreign assets (NFA). The specific role of these determinants in the model has been discussed in the theoretical section above. Given these determinants, the functional form of a real effective exchange rate is given in (1).

$$REER = F(TOT, OPEN, GOV, PROD, NFA) \qquad (1)$$

The co-integrating technique is used to investigate the relationship between the real exchange rate and its fundamentals. The advantage of this methodology is that the relationship that is found will hold in the long run. Following Johansen (1988; 1991), and Johansen and Juselius (1990) the long-run relationship between the exchange effective rate and the fundamentals is defined as (2).

$$e_t = x_t'\beta + \omega_t \qquad (2)$$

Where e_t is the real effective exchange rate, x_t is the vector of fundamentals, β is the vector of cointegrating coefficients and z_t is the error term. If the exchange rate and variables are considered to be in equilibrium, then they should not deviate from each other to much for too long. This means that the error z_t should be stationary. The exchange rate that is predicated on (2) is the long-run equilibrium rate that is defined by the fundamentals at each time period t.

The short-run dynamics consistent with the long-run equilibrium are modeled as an error correction mechanism (ECM), shown in (3).

$$\Delta e_t = \alpha z_{t-1} + \sum_{i=1}^{p} \gamma \Delta e_{t-i} + \sum_{i=0}^{q} \delta \Delta x_{t-i} + \sum_{i=0}^{s} \theta \Delta w_{t-1} + \varepsilon_t \qquad (3)$$

Here the change in the exchange rate is affected by its past changes, and by changes in the fundamentals and other short-run variables, w_t. If for instance the exchange rate in last period was overvalued relative to the fundamentals, then z_{t-1} is positive. In this period the exchange rate corrects itself by an amount dictated by α.

1) Estimation

Estimation of the long-run and the short-run relationship between real exchange rate and its determinants is undertaken in the context of the Autoregressive Distributed Lag Model (ARDL). According to Pesaran and Pesaran (1997), the ARDL method has many advantages compared to other methods of estimating cointegrating relationships. First, it can be applied for a small sample size as for the case of this study unlike other methods, secondly, it can simultaneously estimate short-run and long-run dynamics of the model, thirdly it can be used with a mixture of I(0) and I(1) data and lastly it allows a possibility that different variables to have different optimal number of lags. In the model, the long run elasticities underpin the cointegration relationship while the short run parameters are related to short-run dynamics.

Based on ARDL model of order (2, 4, 1, 3, 5, 3) as selected through the AIC, both the short run and the long run parameter estimates of the real effective exchange rate model are obtained. The long-run elasticities obtained from the ARDL model are reported in Table I. The signs of the estimated long-run coefficients appear to be in line with theoretical postulations.

In particular, coefficients related to terms of trade and degree of trade openness are negative and significant indicating that improvement of these variables tends to depreciate the real exchange rate. The coefficient pertaining to government spending is positive and significant, signifying that an increase in government expenditure appreciates the real exchange rate. This particular result confirms that much of the government expenditure was directed towards non-tradable.

Although the coefficients of productivityand net foreign assets appear to have the expected signs, they are statically insignificant. The coefficient of adjustment (see Appendix C) of -0.39 indicates that approximately 39 percent of the misalignment of the previous year adjusts back to the long-run equilibrium in the current year. Following the estimations, the behavioral real effective exchange rates (BEER) are derived using the estimated long-run elasticities and the economic fundamentals specified in the model.

Following MacDonald and Ricci (2003) we use Hodrick-Prescott (HP) (Hodrick *et al.*,1997) filter, to capture the permanent components of this series which give us the equilibrium real exchange rate. Both BEER and PEER are reported in Fig. 3.

TABLE I: LONG-RUN ELASTICITIES

Levels Equation				
Case 5: Unrestricted Constant and Unrestricted Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LTOT	-1.173454	0.316257	-3.710445	0.0015
LPROD	0.339306	0.277798	1.221414	0.2369
LOPEN	-0.916447	0.111043	-8.253107	0.0000
LGOV	1.521733	0.339267	4.485357	0.0003
LNFA	0.073837	0.155893	0.473637	0.6412

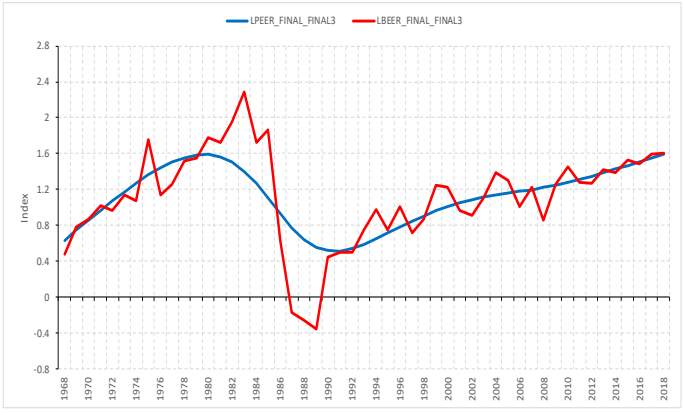

Fig. 3. Behavioural and Permanent Real Effective Exchange Rate.

2) Real exchange rate and misalignments

The real exchange rate misalignments are derived by comparing the behavioral and permanent real effective exchange rates using (4).

$$RER\ misalignment = ((BEER - PEER)/PEER) * 100 \quad (4)$$

Basing on the analysis, the currency is overvalued if the value of the misalignment is positive and undervalued if the value of the misalignment is negative. The results of misalignment are depicted by Fig. 4.

The estimations offered chequered results reflecting a mixture of overvaluation and undervaluation. Overall, the real effective exchange rate has evolved towards stability and over the recent years (2015-18) it has been broadly in line with its long-run equilibrium. This development broadly reflects the increasing pace in the implementation of prudent macroeconomic and structural policies that are currently in place.

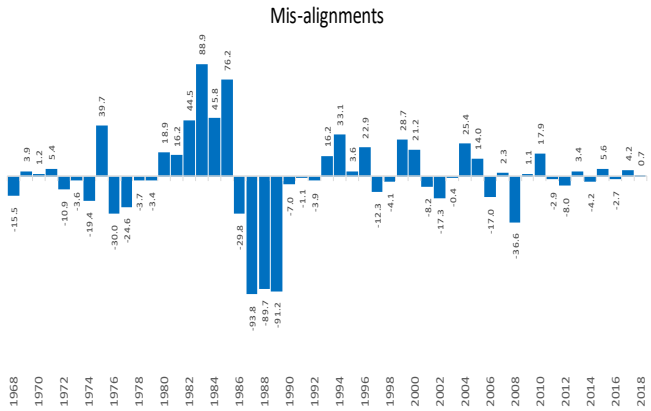

Fig. 4. Real Exchange Rate Misalignments.

V. Conclusion and Policy Implication

This study has conducted the assessment of real exchange rate misalignments in Tanzania using the real exchange rate equilibrium (REER) approach and focusing on cointegration empirical analysis. In this approach, the equilibrium real exchange rate is estimated as a function of medium-term fundamentals that includes commodity terms of trade, relative factor productivity, government spending, degree of trade openness, and net foreign assets. The misalignments were then obtained as deviations of the equilibrium real exchange rate from its current value.

The empirical results show that over recent years the real exchange rate misalignment has declined substantially, and the real effective exchange rate has remained almost in line with the long-run equilibrium.

These results strongly confirm that the underlying monetary and exchange rate policies have played a critical role in the recent adjustment of the real exchange rate to the equilibrium level in line with the medium-term fundamentals. Accordingly, it is recommended to sustain the strengthening of the current monetary and exchange rate policies. Whilst monetary policy will enhance stability in the real exchange rate through a low inflation mechanism, the flexible exchange rate policy will contribute to the stability of the real exchange rate through adjustment of the nominal exchange rate.

In addition, it is imperative to continue with the current efforts of improving structural conditions which include among others liberalization of the capital account, enhancing trade liberalization through engagements in regional integrations, and deepening industrialization in order to create value addition of exports. This latter measure is critical in order to mitigate the shocks arising in the global markets.

Appendix

A. Data Source and Definition

The dependent variable is the CPI-based multilateral real effective exchange rate (REER). The real effective exchange rate is constructed as the trade-weighted average of the real exchange rate. Data for the real exchange rate are from countries' central banks and the IMF. The commodity terms of trade are defined as the export price index to the import price index. Data on this variable are drawn from the World Bank database. Relative productivity is computed as a ratio of GNP per worker for Tanzania relative to the average GNP per worker for the OECD countries. In particular, using data on the labor force from Global Development Finance and GNP from the IMF, the ratio of GNP to the labor force is computed to get data on GNP per worker for Tanzania. The same method is applied to obtain GNP per worker for the OECD countries. The government spending variable is measured as the ratio of government spending to nominal GDP and is drawn from the IMF's International Financial Statistics (IFS) database. The degree of openness is computed as the ratio of the sum of exports and imports to the nominal gross domestic product (GDP). Data on exports, imports, and GDP are from the IMF's International Financial Statistics database. The variable net foreign assets are defined as total foreign assets (less official gold holding) minus total liabilities to foreigners and are drawn from the IMF's International Financial Statics (IFS) database. The variable net foreign assets are scaled by the nominal values of the GDP. In order to take into account developments that may generate structural breaks, dummy variables were included in the model. All variables are in logs.

B. Stationarity

Co-integration analysis requires a non-stationary time series of the same order of integration. We use several unit root tests including Philip and Perron (PP) Augmented Dickey-Fuller (ADF). The results of this test are reported in Table II. The PP test shows that all variables have unit roots in levels with the exception of net foreign assets. However, the variables become stationary after the first difference, indicating that the variables are integrated of order one (I(1)). The PP test was complimented by Augmented Dickey-Fuller (ADF) test. The findings of this test are reported in Table IV. Findings of this test also indicate that the variables are I(1). These variations in the order of integration among variables provide support for the use of the ARDL model (Pesaran & Pesaran, 1997).

TABLE II: SUMMARY STATISTICS

	REER	TOT	PROD	OPEN	GOV	NFA
Mean	176.3885	0.970871	0.341530	32.47205	18.49966	6.749475
Median	139.9559	0.972041	0.330852	32.92230	17.79770	8.035171
Maximum	483.8679	1.602216	0.501630	51.26297	31.53437	15.62027
Minimum	93.64725	0.672467	0.182332	15.79967	8.973275	-8.891348
Std. Dev.	88.13992	0.237052	0.084153	10.22524	5.948622	5.707841
Skewness	1.587536	0.498162	0.256377	-0.077681	0.327242	-0.928947
Kurtosis	5.266375	2.488897	2.011008	1.790751	2.209316	3.678913
Jarque-Bera	32.33727	2.664509	2.637169	3.158644	2.238753	8.314469
Probability	0.000000	0.263882	0.267514	0.206115	0.326483	0.015651
Sum	8995.812	49.51443	17.41802	1656.074	943.4827	344.2232
Sum Sq. Dev.	388432.3	2.809682	0.354088	5227.781	1769.305	1628.973
Observations	51	51	51	51	51	51

TABLE III: UNIT ROOT TEST (PHILLIPS PERON)

Null Hypothesis: The variable has a unit root							
At Level							
		LTOT	LPROD	LREER	LOPEN	LGOV	LNFA
With Constant	t-Statistic	-1.9951	-1.5071	-1.6292	-2.1710	-1.7970	-5.1450
	Prob.	0.2880	0.5219	0.4605	0.2191	0.3778	0.0001
		No	No	No	No	No	***
With Constant & Trend	t-Statistic	-2.9502	-1.7693	-2.2506	-2.2676	-2.0507	-5.4276
	Prob.	0.1563	0.7046	0.4521	0.4431	0.5598	0.0002
		No	No	No	No	No	***
Without Constant & Trend	t-Statistic	-1.8494	0.3360	-0.4697	-0.7090	-0.2405	-0.5251
	Prob.	0.0618	0.7785	0.5070	0.4046	0.5946	0.4843
		*	No	No	No	No	No
At First Difference							
		d(LTOT)	d(LPROD)	d(LREER)	d(LOPEN)	d(LGOV)	d(LNFA)
With Constant	t-Statistic	-7.1097	-5.7688	-4.1182	-5.2456	-6.1125	-18.6433
	Prob.	0.0000	0.0000	0.0021	0.0001	0.0000	0.0000
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.0334	-5.7021	-4.0747	-5.1876	-6.0443	-18.6105
	Prob.	0.0000	0.0001	0.0124	0.0005	0.0000	0.0000
		***	***	**	***	***	***
Without Constant & Trend	t-Statistic	-7.1136	-5.7841	-4.1368	-5.2729	-6.1743	-18.8460
	Prob.	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
		***	***	***	***	***	***
Notes							
a: Lag Length based on SIC							
b: Probability based on MacKinnon (1996) one-sided p-values.							

Source: Author's calculations from EViews

TABLE IV: UNIT ROOT TEST RESULTS, ADF

Null Hypothesis: the variable has a unit root							
At Level							
		LTOT	LPROD	LREER	LOPEN	LGOV	LNFA
With Constant	t-Statistic	-1.9680	-1.5071	-2.1571	-2.3394	-1.8551	-1.9319
	Prob.	0.2996	0.5219	0.2242	0.1641	0.3503	0.3154
		no	no	no	no	no	no
With Constant & Trend	t-Statistic	-2.7827	-1.6276	-2.8100	-2.4428	-1.9856	-2.2320
	Prob.	0.2103	0.7677	0.2008	0.3540	0.5944	0.4619
		no	no	no	no	no	no
Without Constant & Trend	t-Statistic	-1.7677	0.4121	-0.5747	-0.7847	-0.4135	-0.3714
	Prob.	0.0733	0.7984	0.4633	0.3712	0.5292	0.5456
		*	no	no	no	no	no
At First Difference							
		d(LTOT)	d(LPROD)	d(LREER)	d(LOPEN)	d(LGOV)	d(LNFA)
With Constant	t-Statistic	-7.1091	-6.0515	-4.1182	-5.2660	-6.1166	-17.1819
	Prob.	0.0000	0.0000	0.0021	0.0001	0.0000	0.0000
		***	***	***	***	***	***
With Constant & Trend	t-Statistic	-7.0331	-6.0004	-4.0747	-5.2089	-6.0493	-17.0417
	Prob.	0.0000	0.0000	0.0124	0.0005	0.0000	0.0000
		***	***	**	***	***	***
Without Constant & Trend	t-Statistic	-7.1136	-5.9923	-4.1368	-5.2923	-6.1778	-17.3638
	Prob.	0.0000	0.0000	0.0001	0.0000	0.0000	0.0000
		***	***	***	***	***	***
Notes							
Lag Length based on SIC							

Note: (*) Significant at the 10%; (**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant
Source: Author's calculations from EViews

C. Determination of Lag Length

To determine the lag length, the analysis focused on a number of competing estimators including the Schwarz Bayesian Criterion (SC), Hanna-Quin Criterion (HQ), Akaike Information Criterion (AIC), Log-Likelihood Ratio (LR) as well as Final Prediction Error (FPE) (Schwarx, 1978; Hannan & Quinn, 1979). All the estimators (AIC, LR, HQ, SC and FPE) provide different optimal lag lengths. These variations in optimal lag length provide further support for the use of ARDL which has the flexibility of choosing the appropriate lag length for each variable (Pesaran & Pesaran, 1997). The results of these estimators are reported in Table V.

D. Co-Integration Test

The study applies the Johansen cointegration test to establish the long-run relationship among the variables. According to trace statistics, the test indicates 6 cointegrating relations and 1 cointegration relation according to the Max-Eigen value statistic. The findings of this test are reported in Table VI.

TABLE V: LAG LENGTH TEST

VAR Lag Order Selection Criteria
Endogenous variables: LREER LTOT LPROD LOPEN LGOV LNFA
Exogenous variables: C
Sample: 1972 2018
Included observations: 44

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-29.10920	NA	1.79e-07	1.494008	1.730197	1.582888
1	188.6582	370.6679	7.95e-11	-6.240774	-4.587451*	-5.618618
2	239.1855	73.10339	4.62e-11	-6.858959	-3.788501	-5.703525*
3	286.9332	56.89085*	3.44e-11*	-7.358860	-2.871268	-5.670149
4	323.1485	33.90366	5.28e-11	-7.368021*	-1.463295	-5.146033

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author's calculations from EViews

TABLE VI: JOHANSEN SYSTEM COINTEGRATION TEST

Sample (adjusted): 1972 2015
Included observations: 44 after adjustments
Trend assumption: Linear deterministic trend
Series: LREER LTOT LPROD LOPEN LGOV LNFA
Lags interval (in first differences): 1 to 3
Unrestricted Cointegration Rank Test (Trace)

	Trace Test				Maximum Eigen Value Test		
Hypothesized No. of CE(s) No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.657525	140.2243	95.75366	0.0000	50.36319	40.07757	0.0025
At most 1 *	0.464769	89.86110	69.81889	0.0006	29.37766	33.87687	0.1569
At most 2 *	0.449449	60.48345	47.85613	0.0021	28.05127	27.58434	0.0436
At most 3 *	0.261015	32.43217	29.79707	0.0243	14.21642	21.13162	0.3475
At most 4 *	0.237198	18.21575	15.49471	0.0190	12.72558	14.26460	0.0863
At most 5 *	0.110248	5.490170	3.841465	0.0191	5.490170	3.841465	0.0191

Trace test indicates 6 cointegrating eqn (s) at the 0.05 level
Max-Eigen value test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Source: Author's calculations from EViews

TABLE VII: ESTIMATION RESULTS

ARDL Error Correction Regression
Dependent Variable: D(LREER)
Selected Model: ARDL (2, 4, 1, 3, 5, 3)
Case 5: Unrestricted Constant and Unrestricted Trend
Included observations: 46
ECM Regression
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.321353	0.435393	7.628394	0.0000
@TREND	-0.022805	0.003847	-5.927932	0.0000
D(LREER(-1))	0.330218	0.100929	3.271771	0.0040
D(LTOT)	-0.230825	0.088376	-2.611836	0.0171
D(LTOT(-1))	0.263061	0.119576	2.199944	0.0404

Cont. of Table VII

D(LTOT(-1))	0.263061	0.119576	2.199944	0.0404
D(LTOT(-2))	-0.156448	0.091270	-1.714132	0.1028
D(LTOT(-3))	-0.151931	0.083781	-1.813438	0.0856
D(LPROD)	0.579606	0.132001	4.390905	0.0003
D(LOPEN)	-0.379744	0.068657	-5.531011	0.0000
D(LOPEN(-1))	0.368037	0.097815	3.762594	0.0013
D(LOPEN(-2))	0.275694	0.088459	3.116629	0.0057
D(LGOV)	0.335041	0.079546	4.211910	0.0005
D(LGOV(-1))	-0.793057	0.134052	-5.916061	0.0000
D(LGOV(-2))	-0.657569	0.111944	-5.874078	0.0000
D(LGOV(-3))	-0.375562	0.103356	-3.633669	0.0018
D(LGOV(-4))	-0.158863	0.072415	-2.193776	0.0409
D(LNFA)	0.106933	0.025873	4.132941	0.0006
D(LNFA(-1))	0.134902	0.036911	3.654843	0.0017
D(LNFA(-2))	0.099938	0.027591	3.622113	0.0018
D1984	0.263670	0.062786	4.199480	0.0005
D2009	-0.002981	0.044340	-0.067235	0.9471
CointEq(-1)*	-0.380427	0.096143	-7.701276	0.0000
R-squared	0.925863	Mean dependent var		-0.012244
Adjusted R-squared	0.860994	S.D. dependent var		0.150097
S.E. of regression	0.055961	Akaike info criterion		-2.622377
Sum squared resid	0.075160	Schwarz criterion		-1.747809
Log likelihood	82.31467	Hannan-Quinn criter.		-2.294759
F-statistic	14.27268	Durbin-Watson stat		2.050417
Prob(F-statistic)	0.000000	-		-

Source: Author's calculations from EViews

CONFLICT OF INTEREST

The views expressed in this paper are solely those of the author(s) and do not necessarily represent the opinion of the Bank of Tanzania.

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