Real exchange rate misalignment and economic growth in East African least developed countries

Getaneh Mihret Ayele

College of Business and Economics, Bahir Dar University, Ethiopia

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ABSTRACT

The behavior of real exchange rate remained an important policy concern for small open economies as its poor management adversely affects their economy with substantial welfare losses. This study examined the main drivers of real effective exchange rate (REER) misalignment and its effect on the economic growth of East African least developed countries (LDCs). The study applied Pooled Mean Group (PMG) and dynamic OLS estimators for panel and ARDL Bound testing for time series data over the period 1980–2019. The panel results revealed that the REER of LDCs were significantly misaligned for the study period. The REER appreciates for an improved terms of trade and net foreign asset position, while it depreciates for an increased trade openness and broad money supply in the long-run. The panel results also confirmed that the GDP per capita would improve for an increase in real investment and human capital, while it decline for an increase in openness, net foreign inflows and REER misalignment in the long-run. The ARDL bound testing results generally support the panel estimation results. In the short-run, the REER misalignment would impede growth of Ethiopia while it promotes growth of Kenya. Thus, the central banks and policy makers of East African LDCs should initiate a consistent macroeconomic policies and regulatory frameworks focusing on the main drivers of equilibrium REER to correct currency misalignment and to support their promising economic growth.

1. Introduction

Despite the notable economic performance in some countries over the last decade, the East Africa remains the most fragile region in the world with high inflation pressure, weak external position, chronic foreign currency shortages, rising external debt, incessant public deficits and high saving gap (AfDB, 2020). Such macroeconomic uncertainties may link with currency misalignment that could arise from inconsistent macroeconomic policies (Edwards, 1989; Rodrik, 2008). The real exchange rate (RER) misalignment could result in economic inefficiency due to resource misallocation and capital flight (Edwards, 1989). Accordingly, the RER misalignment remains a major policy issue particularly for developing economies as part of their outward-oriented development strategy.

There are two common positions on the effect of RER misalignment on growth. First, according to the Washington Consensus (WC), the RER misalignment is a macroeconomic disequilibrium particularly in relative prices that induce inefficient resource allocation and depress economic growth. Neither overvaluation nor undervaluation is good for economic growth. Overvaluation implies external imbalance while undervaluation infers internal imbalance (high inflationary pressure) that hinders domestic investment and curbs the supply-side growth potential (Williamson, 1990). Second, undervaluation promotes economic growth whereas overvaluation harms it by dampening exports (Rasin and Collins, 1997; Rodrik, 2008; Elbadawi et al., 2012). Currency depreciation could alleviate economic distortion, foster structural change and spur growth (Rodrik, 2008), while a persistent currency overvaluation is an early warning of possible currency crashes (Krugman, 1979) that could severely hamper the aggregate economic growth (Fontaine, 2005). The periods of rapid growth for most developing countries were associated with undervaluation (Gala and Lucande, 2006; Berg and Miao, 2010), notably in China (Béau et al., 2009). But Taiwan and South Korea had experienced slow economic growth due to overvaluation (Rodrik, 2008). Moreover, capital control and undervaluation had been key elements of an export-oriented development strategy for Japan and Germany after World War-II, and for China and other East Asian Economies in 1980s and 1990s (Dooley et al., 2003).

Indeed, RER depreciation (appreciation) may not always result in better (poor) competitiveness (Bella et al., 2007; Ayele, 2019). Many empirical studies (Terra and Villalobos, 2010; Couharde and Sallenave, 2013; Schroder, 2013) stated that extreme undervaluation of currency beyond the threshold level could hamper economic growth. Devaluation distorts price signals and negatively affects the aggregate demand by raising the cost of imported goods and deterring both domestic and foreign direct investments. As a result, it is difficult to follow a pro-growth RER policy (Aguirre and Calderon, 2006). The relationship...
between the RER misalignment and economic growth could be either linear (Rodrik, 2008) or non-linear (Rasin and Collins, 1997; Rapetti et al., 2012).

This study, therefore, measured the RER misalignment and examined its impact on the economic growth of least developed countries (LDCs) since the existing literatures have no unequivocal answer yet. Despite the general consensus that the RER matters for economic growth, the nature of relationship and policy implications are far from settled. This study has two important contributions to the literature. First, the RER misalignment is estimated for East African LDCs, which have been overlooked in the previous studies. The issue of RER misalignment raised a policy concern for these countries as their currency have witnessed a dramatic decline in value over the last decade with an average depreciation of more than 50 percent for all sample countries. The East African economies adopted relatively pegged exchange rate regimes as part of their disinflation policies (IMF, 2021), which could be more prone to overvaluation than flexible rates (Coudert and Couharde, 2008). The study results, thus, may inform the main drivers of equilibrium REER to the Central Banks and policy makers as any deliberate action to address the misalignment must focus on the underlying fundamentals of REER. Second, this study elucidates the puzzle how REER misalignment influences economic growth. Being small open economies with less competitive external sector, this study could help the LDCs to understand whether and how the deviation of actual REER from its equilibrium level affects their promising economic growth records achieved in the recent decades.

The rest of the paper is organized as follows. The second section deals with the review of related empirical literatures followed by the presentation of econometric model and data in the third section. The fourth section presents the empirical results and discussions. The fifth section concludes the study.

2. Empirical reviews

The misalignment of RER and its effect on economic growth have been broadly discussed in the existing literature for many economies using various measures of misalignment and growth models. However, the empirical studies remained inconclusive regardless of the methodology used and the level of economic development of countries studied though the general view is that most developing economies experience a notable exchange rate misalignment that hinders their economic growth. The RER misalignment, particularly overvaluation, has a negative impact on economic growth (Edwards, 1989; Cottani et al., 1990; Gala and Lucinda, 2006; Rodrik, 2008). Misaligned currency causes poor resource allocation and economic inefficiency by distorting the price of tradables and non-tradables (Edwards, 1989). Persistently misaligned currencies tend to slow down agricultural development in African countries (Cottani et al., 1990). More devalued currency could result in a higher real per capita income while overvaluation has shortcomings for long-term growth (Gala and Lucinda, 2006). Similarly, Rodrik (2008), using a dataset on 188 countries, suggested a linear effect of RER misalignment on economic growth, implying that overvaluation hurts growth while undervaluation fosters it. Indeed, the growth impact depends heavily on the country's level of development. Undervaluation would have a sizable positive effect on the growth of developing economies that gets stronger for poorer countries, but the effect is insignificant for rich countries.

The findings of numerous panel studies (Béreau et al., 2009; Salle- nave, 2016; Vieira and MacDonald, 2012; Couharde and Sallenave, 2013; Berg and Miao, 2010; Elbadawi et al., 2012; Mazorodze, 2021) and time series studies (Wong, 2013; Akram and Rath, 2017; Ndalea, 2012) are consistent with the Rodrik’s (2008) view. Undervaluation fosters growth by promoting the efficiency of small tradable sectors while overvaluation harms it (Berg and Miao, 2010). Undervaluation could be a powerful cyclical instrument with a clear economic leverage if it is properly employed (Couharde and Sallenave, 2013). Using an extensive panel of advanced and emerging economies, Béreau et al. (2009) also showed that undervaluation may encourage exports and promote growth. Vieira and MacDonald (2012), using GMM on a panel of 90 countries, added that a more depreciated (appreciated) real exchange rate helps (harms) long-run growth, and the effect is higher for developing and emerging countries. Sallenave (2010), using data from G-20 countries, further confirmed the negative effect of misalignment on growth.

The magnitude of misalignment and the speed of convergence towards the equilibrium are more pronounced for emerging economies than industrialized countries. Using the GMM on the data from 13 Sub-Saharan African (SSA) countries, Mazorodze (2021) also supported the negative effect of misalignment that amplifies for fragile states. The findings of Wong (2013) for Malaysia and Akram and Rath (2017) for India also suggested that undervaluation promotes efficiency of small tradable sectors while overvaluation hurts growth through inefficient resource allocation. The chronic RER overvaluation was a key fundamental behind the post-2000 economic growth contraction in Zimbabwe (Ndalea, 2012). Indeed, the negative effect of overvaluation could be ameliorated by financial development in SSA countries (Elbadawi et al., 2012) and Pakistan (Jahan and Iskand, 2020).

Moreover, many other empirical findings supported the WC view (Ghura and Grennes, 1993; Rasin and Collins, 1997; Bleaney and Greenaway, 2001; Aguirre and Calderon, 2006; Rapetti et al., 2012; Schroder, 2013), and revealed a non-linear effect of misalignment on growth. Both overvaluation and undervaluation adversely impacts growth despite the effect of overvaluation outweighs. Large undervaluation hurts growth while small to moderate undervaluation promotes it (Rasin and Collins, 1997; Aguirre and Calderon, 2006). Using a sample of 63 developing countries, Schroder (2013) also added that RER deviation in either direction from the equilibrium reduces economic growth. Indeed, the levels of misalignment could be associated with macroeconomic instability in SSA (Ghura and Grennes, 1993). Economic growth and investment in SSA can be increased when terms of trade improved and overvaluation is eliminated (Bleaney and Greenaway, 2001). The growth impact of devaluation is larger and more robust for developing countries. But the relationship between RER undervaluation and per capita GDP is non-monotonic, and it is limited to the least developed and advanced economies (Rapetti et al., 2012).

However, some recent studies supported neither Rodrik’s (2008) nor WC views. In contrary to the conventional theory, undervaluation falters economic growth of Turkey, while overvaluation promotes it (Mamun et al., 2021). The RER misalignment may have two partially conflicting goals where undervaluation helps output growth by stimulating technological progress and knowledge spillovers, but it harms growth by raising income inequality. The negative indirect effect of undervaluation is more visible on developing nations (Ribeiro et al., 2020). For SSA countries, the gain from undervaluation is almost zero regardless of their exchange rate regime (Owoundi, 2016).

In general, due to distinct characteristics of individual economies, the issue of REER misalignment and its impact on growth has no unambiguous answer and yet remains open for further research and policy discussions. In particular, the issue is not addressed yet in the existing empirical literature for the East African LDCs. Thus, it is plausible to examine the existence and extent of REER misalignment and its effect on the economic growth of these countries as their currencies have been criticized for persistent misalignment, basically overvaluation, which would potentially have a negative impact on their domestic economic performance.

3. Conceptual frameworks, econometric models and data

3.1. Conceptual framework of approaches to equilibrium REER

The measurement of RER misalignment remains a challenge in international macroeconomics as the definition of RER itself is ambiguous. There are generally two methods to measure RER misalignment: the purchasing power parity (PPP) and model-based methodologies. The PPP
The doctrine assumes that exchange rate is the relative domestic and foreign price developments suggesting a constant equilibrium RER for all periods. It overlooks the effect of changes in the fundamentals on the equilibrium RER (Baffes, Elbadawi and O’Connell, 1997), and thus, the equilibrium RER tends to be higher in developing countries (Rapetti, 2013). The model-based approaches consider the equilibrium RER as a function of economic fundamentals, and allow for a time varying equilibrium path of RER. The most commonly referred model-based approaches are the Fundamental Equilibrium Exchange Rate (FEER), Desired Equilibrium Exchange Rate (DEER), Behavioral Equilibrium Exchange Rate (BEER), Permanent Equilibrium Exchange Rate (PEER), and Natural Real Exchange Rate (NATREX).

The BEER is equilibrium RER consistent with internal balance (output level with full employment and low inflation) and external balance (sustainable current account position) (Williamson, 1994). It is a normative measure of equilibrium RER and does not specify the nature of convergence process from the short-run (actual) to the equilibrium rate (MacDonald, 2000). The DEER is very similar to FEER, except that the DEER defines the macroeconomic equilibrium in terms of desired policy objectives (Bayoumi et al., 1994). The BEER uses econometric method to establish a behavioral link between the RER and relevant economic variables. Unlike the FEER, the BEER considers the origins of cyclical and temporary movements of the RER and the given values of fundamental determinants (Clark and MacDonald, 1998). Under the PEER, the equilibrium RER is computed using the long-run sustainable level of identified economic fundamentals. Unlike the current misalignment of BEER, the total misalignment of PEER is relevant to policy makers to understand whether the misalignment has largely driven by either temporary or permanent shocks from determinant factors (Siregar, 2011). The BEER and PEER actually move together very closely implying only a small temporary component (MacDonald, 2000) though the PEER is smoother than the BEER (Maeso-Fernandez et al., 2001). Lastly, the NATREX is a moving equilibrium RER that would prevail if speculative and cyclical factors removed and unemployment is at its natural rate (Stein, 1994).

Thus, due to their varying policy implication and relevance, the choice of approaches can be done based on the question of interest for any given time horizon. The BEER and PEER are most commonly used for low income countries, while other approaches are applied to advanced and emerging economies (Bella et al., 2007). Accordingly, to estimate equilibrium RER, this study used the BEER approach as it is free from any normative element and subject to rigorous statistical testing (Egert et al., 2006).

3.2. Econometric models and estimation procedures

3.2.1. Equilibrium real exchange rate model

Based on the general framework of BEER approach (Clark and MacDonald, 1998; Siregar, 2011), the REER misalignment is derived in three steps. First, the long-run relationship between the RER and a set of relevant economic variables (both fundamentals and short-run) is estimated using a reduced-form Eq. (1) below.

\[
\ln REER_i = \alpha_i + \beta_1 \ln TOT_i + \beta_2 \ln NFA_i + \beta_3 \ln PD_i + \beta_4 \ln OP_i + \beta_5 \ln BM_i + \epsilon_i
\]

Where, \( REER \) is real effective exchange rate for country \( i \); \( TOT \) is terms of trade; \( NFA \) is net foreign asset; \( PD \) is productivity differential; \( OP \) is trade openness; \( BM \) is broad money supply; \( ln \) is natural logarithms; and \( \epsilon \) is error term.

The REER, the dependent variable, is measured as the weighted geometric average of bilateral RER against major trade partners. The exchange rate is expressed as the value trade partners’ currency per unit of domestic currency, and its increase refers appreciation. The first independent variable, \( TOT \), is measured as the ratio of export price index to import price index. The effect of \( TOT \) on \( REER \) depends on the relative strength of the income effect and substitution effect. An improvement in \( TOT \) increases real income that induces demand for tradable goods, and thus, \( REER \) appreciates. The income (pure spending) effect can be counterbalanced by substitution effect on demand and supply side leading to \( REER \) depreciation. But, the income effect dominates in most cases (Edwards, 1989; Baffes, Elbadawi and O’Connell, 1997; Obstfeld and Rogoff, 1996). The NFA is proxied as net international investment position excluding gold as a share of GDP in current U.S. dollars. Countries with net external liabilities would have more depreciated real exchange rate (Lane and Milesi-Ferretti, 2021). The PD is proxied as the total labor productivity differential between home and abroad. Productivity is measured as real GDP (in 2015 U.S. dollars) divided by the total labor force. According to Balassa-Samuelson hypothesis, high economic (productivity) growth may cause a rise in the relative price of non-tradable to tradable goods, and thus, the home currency will appreciate in real terms. It is applicable especially in rapidly growing open economies that export primary goods, but with changing export composition and industrial structure (Ito et al., 1999). The OP is proxied as the sum of exports and imports as a percentage of GDP in 2015 U.S. dollars. An increase in openness due to reduced tariff rates may lead to a fall in prices of tradable goods, which creates a higher demand for foreign currency (Dufrenot and Yeboue, 2005). The BM is monetary variable proxied as broad money as a percentage of GDP.

The equilibrium BEER for a panel of East African LDCs is estimated using the Pooled Mean Group (PMG) approach (Pesaran et al., 1999). The PMG takes the cointegration form of the simple Autoregressive Distributed Lag (ARDL) model. It confines the long-run coefficients \( \beta \) to be identical using an error correction framework, but allows the intercepts and error variances to differ across countries. The PMG/ARDL form of REER Eq. (1) above is stated as:

\[
\Delta \ln REER_i = \alpha_i + \theta_1 \ln TOT_i + \theta_2 \ln NFA_i + \theta_3 \ln PD_i + \theta_4 \ln OP_i + \theta_5 \ln BM_i + \epsilon_i
\]

Where, \( X = [\ln TOT, NFA, \ln PD, \ln OP, \ln BM] \); \( \Delta \) is the first difference; \( \alpha_i \) is country specific intercept; \( \theta_i \) is the adjustment coefficient; and \( \theta = -(\beta_i/\theta_i) \) is long-run coefficient.

The equilibrium BEER is also estimated for individual LDCs using the ARDL Bound testing approach (Pesaran et al., 2001) using a time series data to account individual country differences. The ARDL Bound testing approach has three advantages over the other long-run estimation techniques. First, the ARDL solves the uncertainty about the order of integration to test long-run relationship. Bound testing can be done for cointegration among variables of interest regardless of whether the variables are stationary, I(0) or integrated order one, I(1), but not I(2). Second, the approach allows different lag orders for both dependent and independent variables, and it is relatively more efficient for small finite samples. Third, the ARDL technique may offer unbiased estimates of the long-run model (Harris and Solls, 2003).

To perform Bound test for cointegration among the variables in the BEER model, the unrestricted ARDL model is used, which is restated as:

\[
\Delta \ln REER_i = \mu_i + \sum_{j=2}^{p} \theta_j \ln REER_{i-j-1} + \sum_{j=2}^{q} r_j X_{i-j-1} + \theta_0 \ln TOT_i + \theta_1 \ln NFA_i + \theta_2 \ln PD_i + \theta_3 \ln OP_i + \theta_4 \ln BM_i + \epsilon_i
\]

Where, \( X = [\ln TOT, NFA, \ln PD, \ln OP, \ln BM] \); \( p \) and \( q \) are lags; \( \mu_i \) is unrestricted intercept for country \( i \); and \( \epsilon \) is white noise disturbance term.

The value of long-run coefficients are computed as \( \beta_1 = -(\theta_2/\theta_1) \), \( \beta_2 = -(\theta_3/\theta_1) \), \( \beta_3 = -(\theta_4/\theta_1) \), \( \beta_4 = -(\theta_5/\theta_1) \), \( \beta_5 = -(\theta_0/\theta_1) \) for \( \ln TOT, NFA, \ln PD, \ln OP \) and \( \ln BM \), respectively. After bound testing is
done for long-run relationship, the dynamic short-run effects of all fundamental variables on the REER are examined using the restricted ARDL model, which is restated as:

$$\Delta \ln \text{REER}_{it} = \alpha_i + \sum_{j=1}^{p} \delta_j \ln \text{REER}_{it-j} + \sum_{j=0}^{q} \gamma_j \ln X_{it-j} + \theta \Delta \text{ECT}_{it-1} + \nu_{it} \quad (4)$$

Where, $\alpha_i$ is unrestricted intercept for country $i$, $\Delta \text{ECT}_{it-1} = \ln \text{REER}_{it-1} - \alpha_i - \beta_1 \ln \text{TOT}_{it-1} - \beta_2 \ln \text{PD}_{it-1} - \beta_3 \ln \text{OP}_{it-1} - \beta_4 \ln \text{BM}_{it-1}; \theta$ is the speed of adjustment coefficient towards equilibrium; $\gamma_j$ is dynamic short run effects; and $\nu_{it}$ is white noise disturbance term.

However, all explanatory variables are assumed to be exogenous in ARDL estimation, which might cause a bias against some endogenous explanatory variables. Thus, panel dynamic ordinary least squares (DOLS) is used to check the robustness of the long-run relationship. With the inclusion of leads and lags, DOLS resolves endogeneity issues and provides asymptotically better long-run test results. Although the panel DOLS provides homogenous cointegration vector across individuals, it allows individual heterogeneity by considering different short-run dynamics and individual-specific time trends and fixed effects (Mark and Sul, 2003). In addition, the group-mean DOLS based on the between-dimension offers efficient and consistent long-run results when endogeneity, serial correlation and non-stationarity problems are suspected (Pedroni, 2001). The panel DOLS is expressed as:

$$\ln \text{REER}_{it} = \alpha_i + \beta_j X_{it} + \sum_{j=1}^{K} \gamma_{jk} \Delta X_{it-k} + \epsilon_{it} \quad (5)$$

Where, $X = \{ \ln \text{TOT}; \ln \text{PD}; \ln \text{OP}; \ln \text{BM}; \}$ ($K=K_p$) is number of lags and leads; $\gamma_{jk}$ is the coefficients of lag and lead to account serial correlation and endogeneity problems.

The second step under BEER approach is calculation of the equilibrium REER, which is obtained by substituting the long-term values of fundamentals into the estimated relationship, while short-term variables are set to zero. The long-run values of fundamentals are isolated from fundamentals into the estimated relationship, while short-term variables are unrestricted intercept for country $i$.

**Table 1. Johansen cointegration test results for the REER model.**

| Hypothesized No. of CE(s) | Trace test | Max-Eigen test |
|---------------------------|------------|----------------|
|                           | Fisher Stat. | Prob.          |
|                           | Fisher Stat. | Prob.          |
| None                      | 81.8000     | 0.0000         | 44.14          | 0.0000         |
| At most 1                 | 44.8200     | 0.0000         | 22.41          | 0.0332         |
| At most 2                 | 27.7500     | 0.0060         | 14.28          | 0.2834         |

Note: Trend assumption (linear deterministic trend), lags interval (in first difference, 1:1).

Source: Author’s estimation using EViews 10.

the REER misalignment is computed as the deviations of the actual REER from the estimated equilibrium REER. Thus, the index of REER misalignment (Clark and MacDonald, 1998) is measured as:

$$\text{MIS}_i = \ln \left( \frac{\text{REER}_{i}}{\text{REER}_{\text{eq}}} \right) = \ln \text{REER}_t - \ln \text{REER}_{\text{eq}} \quad (6)$$

Where, $\text{MIS}_i$ is misalignment for country $i$ at time $t$; $\text{REER}_{\text{eq}}$ is real effective exchange rate; and $\text{REER}_{i}$ refers to equilibrium REER estimated based on Eq. (1).

### 3.2.2 Economic growth estimation model

Once the REER misalignment is measured, its impact on economic growth is examined using the Barro Growth model employed by Rasin and Collins (1997) and Couharde and Sallenave (2013), for instance, which is extended and presented as:

$$\ln Y_{it} = \alpha_i + \alpha_2 \ln \text{INV}_{it} + \alpha_3 \ln \text{HC}_{it} + \alpha_4 \ln \text{OP}_{it} + \alpha_5 \ln \text{ODA}_{it} + \alpha_6 \text{MIS}_i + \tau_i$$

Where, $Y$ is the real GDP per capita, $\text{INV}$ is real investment, $\text{HC}$ is human capital, $\text{OP}$ is trade openness, $\text{ODA}$ is official development assistance, $\text{MIS}$ is misalignment, and $\tau$ is error term.

The dependent variable, real GDP per capita, is measured as the ratio of real GDP (in 2015 U.S. dollars) to total population. The growth determinants are selected based on the previous empirical works of Barro.
Table 3. The PMG/ARDL estimation results for the REER model.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------|-------------|------------|-------------|-------|
| lnTOT    | 0.1978      | 0.0653     | 3.0278      | 0.0028|
| NPA      | 0.0096      | 0.0015     | 6.2986      | 0.0000|
| lnPD     | 0.3905      | 0.2075     | 1.8815      | 0.0615|
| lnOP     | -0.3623     | 0.1601     | -2.2630     | 0.0248|
| lnBM     | -0.2235     | 0.1087     | -2.0559     | 0.0412|

Note: Dependent variable: lnBM. Source: Author’s estimation using EViews 10.

Table 4. Group-mean panel DOLS estimation results for the REER model.

|                  | DOLS without time trend | DOLS with time trend |
|------------------|-------------------------|----------------------|
|                  | Coefficient | Std. Error | Prob. | Coefficient | Std. Error | Prob. |
| lnTOT            | 0.2133       | 0.0891      | 0.0182 | 0.2200      | 0.0864      | 0.0122 |
| NPA              | 0.0021       | 0.0010      | 0.0467 | 0.0019      | 0.0012      | 0.1273 |
| lnPD             | -0.4163      | 0.1792      | 0.4094 | 0.3056      | 0.4426      | 0.4912 |
| lnOP             | -0.4309      | 0.1063      | 0.0001 | -0.2899     | 0.1286      | 0.0239 |
| lnBM             | -0.4205      | 0.1402      | -0.0033 | -0.3516     | 0.1662      | 0.0366 |
| SE of Regr.      | 2.4126       | 2.7053      |        |             |             |       |
| Long-run var.    | 0.0089       | 0.0075      |        |             |             |       |

Note: Grouped estimation; Fixed leads and lags specification (lead = 1, lag = 1); Prewithlisting with lags = 1, Bartlett kernel, Newey-West fixed bandwidth. Source: Author’s estimation using EViews 10.

and Lee (1994), Aguirre and Calderon (2006), Béreau et al. (2009) and Schroder (2013).

The coefficient of misalignment is expected to be negative based on the WC view (Williamson, 1990). But it would be negative for overvaluation and positive for undervaluation (Rodrik, 2008). Human capital could nurture growth (Romer, 1990). Investment is proxied by fixed capital formation as a percentage of GDP, and higher investment can have a positive effect on growth (Barro and Lee, 1994). Trade openness may enhance economic growth with efficient resource allocation and improved total factor productivity with technology diffusion and knowledge dissemination (Rivera-Batiz and Romer, 1993). The trade-led growth hypothesis is usually valid (Brueckner and Lederman, 2015; Kebo, 2017). Official development assistance is measured as foreign aid as a share of GDP, and may have a positive effect on growth, conditional to the stable macroeconomic policy environment. A very high aid inflow could slower growth (Durbarry et al., 1998).

To estimate the growth model, Eq. (7) above, the same econometric estimation strategies as for REER model are followed. The equations for the PMG/ARDL, unrestricted ARDL and DOLS estimators are presented as below in Eqs. (8), (9), and (10), respectively.

The PMG/ARDL form of economic growth equation is presented as:

\[
\Delta \ln Y_t = \alpha_i + \varnothing_i \Delta \ln Y_{t-1} + \beta_i \ln Z_{i,t-1} + \sum_{j=1}^{p-1} \delta_{ij} \Delta \ln Y_{t-j} + \sum_{j=0}^{q-1} \phi_{ij} \Delta \ln Z_{j,t-j} + \tau_u
\]

(8)

Where, \( Z = [\ln INV, \ln HC, \ln OP, \ln ODA, MIS] \); \( \Delta \) is the first difference; \( \alpha_i \) is country specific intercept; \( \varnothing_i \) is the adjustment coefficient; and \( \theta = (\beta_i / \varnothing_i) \) is long-run coefficient that is assumed to be the same across countries.

The unrestricted ARDL form of economic growth equation:

\[
\Delta \ln Y_t = \mu_j + \sum_{j=1}^{p} \delta_j \ln Y_{t-j} + \sum_{j=0}^{q} \gamma_j \ln Z_{t-j} + \theta_1 \ln Y_{t-1} + \theta_2 \ln INV_{t-1} + \theta_3 \ln HC_{t-1} + \theta_4 \ln OP_{t-1} + \theta_5 \ln ODA_{t-1} + \theta_6 \ln MIS_{t-1} + \tau_{tj}
\]

(9)

Where, \( Z = [\ln INV, \ln HC, \ln OP, \ln ODA, MIS] \); \( p \) and \( q \) are lags; \( \mu_j \) is unrestricted country specific intercept; and \( \tau_{tj} \) is the disturbance term. The value of long-run coefficients are computed as \( \beta_1 = - (\theta_2 / \varnothing_1), \beta_2 = - (\theta_3 / \theta_1), \beta_3 = - (\theta_4 / \theta_1), \beta_4 = - (\theta_5 / \theta_1), \beta_5 = - (\theta_6 / \theta_1) \) for \( \ln INV, \ln HC, \ln OP, \ln ODA \) and MIS, respectively.

The DOLS form of economic growth equation is:

\[
\ln Y_t = \alpha_i + \beta_i \ln Z_i + \sum_{j=K_1}^{K_2} \gamma_j \Delta Z_{i,t-k} + \tau_u
\]

(10)

Where, \( Z = [\ln INV, \ln HC, \ln OP, \ln ODA, MIS] \); \( (K_1, K_2) \) is number of lags and leads; \( \gamma_j \) is the coefficients of lag and lead that account to serial correlation and endogeneity problems.

3.3. Data sources and testing tools

The study used panel data from six East African LDCs. The sample countries are Burundi, Ethiopia, Kenya, Rwanda, Tanzania, and Uganda. Data are annual and spans from 1980 – 2019. The study period, data frequency and sample countries are chosen based on data availability. The required data were retrieved and organized from different databases. The consumer price index based REER data was obtained from Bruegel datasets, which is a weighted average of bilateral RER against each trade partner. Data for net foreign asset was accessed from Lane and Milesi-Ferretti (2021) database. Data for trade openness, productivity differential, official development assistance, real GDP, real GDP per capita, total population, total labor force and broad money were retrieved from World Bank’s World Development Indicators (WDI) database. The terms of trade and gross capital formation data were obtained from IMF’s commodity terms of trade (PCTOT) database (Gruss and Kebhaj, 2021) and IMF’s World Economic Outlook (WEO) database, respectively. Data for average total years of schooling was retrieved from the United Nations Development Program (UNDP) database.

For panel and time series data analysis, stationarity tests should be conducted as non-stationary data series could provide spurious regressions. The unit root tests are performed using the Levin-Lin-Chu (LLC), Im, Pesaran & Shin (IPS) and ADF-Fisher Chi-square tests for panel while Augmented Dickey-Fuller (ADF) with intercept for time series data. The unit root results, presented in Table 1, showed that all data series are integrated order one, (I(1)), but neither of the variables is I(2), and thus cointegration test can be performed.
Table 5. Bound F-test results for the REER Model.

| Country    | ARDL Model Without Deterministic Trend | ARDL Model With Unrestricted Trend |
|------------|---------------------------------------|------------------------------------|
|            | F-test | t-test | LM(2) | F-test | t-test | LM(2) |
| Burundi    | 330200 | 10.4396 | -4.5237 | 0.2715 | 330200 | 9.9702 | -4.5746 | 0.3360 |
| Ethiopia   | 100103 | 8.0692  | -3.4985 | 0.8002 | 100103 | 10.6349 | -4.8465 | 0.1039 |
| Kenya      | 300013 | 10.0383 | -1.8073 | 0.3110 | 300213 | 5.8624  | -0.1611 | 0.1096 |
| Rwanda     | 400114 | 5.3608  | -3.3895 | 0.1507 | 233020 | 11.9646 | -7.7976 | 0.1381 |
| Tanzania   | 200330 | 6.0722  | -2.9592 | 0.5557 | 221221 | 5.2842  | -1.0155 | 0.7849 |
| Uganda     | 302200 | 5.6645  | -2.476  | 0.3206 | 303030 | 4.5613  | -1.8949 | 0.1862 |

Note: Pesaran et al. (2001) bound testing critical values for the F-statistic with k (=5) are [3.41, 4.68], [2.62, 3.79] and [2.26, 3.35] for 1%, 5% and 10% significance level, respectively. Asymptotic critical value bounds of the t-statistic are [-3.43, -4.79], [-2.86, -4.19], and [-2.57, -3.86] for 1%, 5% and 10% significance levels. LM is the Lagrange Multiplier test for serial correlation.

Source: Author’s estimation using EViews 10.

Table 6. Coefficients of ARDL estimation for the REER model.

| Country   | Burundi | Ethiopia | Kenya | Rwanda | Tanzania | Uganda |
|-----------|---------|----------|-------|--------|----------|--------|
| Long-run Estimates: |         |          |       |        |          |        |
| lnTOT_t-1 | 0.266**  | -0.013   | -0.190| 0.437***| -0.486   | 0.354**|
| lnBM_t    | 0.008*** | 0.004**  | -0.032**| 0.003* | 0.001    | 0.009***|
| lnPD_t    | -0.659***| 0.801*** | 0.472 | -0.085 | -0.442   | 1.553***|
| lnOP_t    | -0.277   | -0.297   | 2.764 | -0.201 | -0.637***| -0.682**|
| lnNFA_t   | -0.861***| -0.505** | 3.352 | 0.422   | 0.302    | -0.584**|

Short-run Estimates:

| Country   | Burundi | Ethiopia | Kenya | Rwanda | Tanzania | Uganda |
|-----------|---------|----------|-------|--------|----------|--------|
| lnREER_t-1 | -0.351***| -0.507***| -0.117**| -0.463***| -0.344***| -0.645***|
| lnTOT_t-1  | -0.215***| -0.624***| 0.401***| 0.404***| -0.206****|
| lnBM_t     | 0.230**  | -0.364***| -0.559***| -0.341***|          |        |
| lnPD_t     | -0.133***|          |        |        |          |        |
| lnOP_t     |          |          |        |        |          |        |
| lnNFA_t    | -0.351***|          |        |        |          |        |
| lnBM_t     | -0.133***|          |        |        |          |        |
| lnPD_t     | -1.061***| -0.797***| -0.672***| -0.961| 0.329    |        |
| lnBM_t     | -1.559***|          |        |        | -2.181***| -1.887***|
| lnBM_t     |          | -1.840** |        |        |          |        |
| lnBM_t     |          | -0.335***| -0.340***| -0.599***|          |        |
| lnBM_t     |          |          | -0.261** |        |          |        |
| lnBM_t     |          |          |        | -0.208**|          |        |
| lnBM_t     |          |          |        |        |          |        |
| lnBM_t     |          |          |        |        |          |        |
| C          | 1.959*** | 5.250*** | 0.999***| 2.714***| 7.380***|        |

Residual Diagnostics and Model Stability:

| Country    | Burundi | Ethiopia | Kenya | Rwanda | Tanzania | Uganda |
|------------|---------|----------|-------|--------|----------|--------|
| Residuals  | Pass    | Pass     | Pass  | Pass   | Pass     | Pass   |
| Residuals  | Pass    | Pass     | Pass  | Pass   | Pass     | Pass   |

Note: The figures in parenthesis are standard errors, and ***, **, * are significant at 1%, 5% and 10% significance level, respectively.

Source: Author’s estimation using EViews 10.

4. Empirical results and analysis

4.1. Estimation of real exchange rate misalignment

To examine the long-run and short-run determinates of REER, the data series should be check for cointegration among the REER and its fundamentals, namely the terms of trade, net foreign asset, productivity differential, trade openness and broad money. The Johansen cointegration test results presented in Table 2 confirmed the existence of long-run relationship among variables in the REER equation. Thus, long run estimation can be done using proper panel estimation techniques.

The panel long-run and dynamic short-run effects of economic fundamentals on the REER are estimated using the PMG approach. Table 3 presents the PMG/ARDL estimation results. The adjustment coefficient
(error correction term) is negative and statistically significant, which supported the existence of cointegrating relationship between REER and its fundamentals in the long-run. The short-run deviations of the actual REER from its equilibrium level could be dissolved at a rate of 28.16 percent in each period. The PMG results showed that the REER is determined by all fundamentals and short-run (monetary) variable with their expected signs in the long-run. The REER is found to appreciate for an increase in terms of trade, net foreign asset and relative productivity, while it depreciates for more trade openness and higher broad money supply as a percentage of GDP in the long-run.

The positive coefficient of terms of trade confirmed the dominance of the income effect over the substitution effect, implying that improved terms of trade may help to increase real income that may induce demand for tradable goods. The coefficient of net foreign asset position is not sizable though it is statistically significant. The coefficient of relative domestic productivity is statistically significant at least at 10% significance level with the expected positive sign, which supports the Balassa-Samuelson hypothesis. The negative effect of trade openness may be due to the fact that trade liberalization in LDCs could reduce the relative price of non-tradables to tradable goods. Trade openness may actually cause loss of net welfare gains for highly indebted countries. These results are generally consistent with the existing theories and recent empirical findings of Kamenik and Kumhof (2014) and Gantman and Dabos (2018). Moreover, the REER of sample LDCs are found to depreciate for an increased relative productivity and trade openness in the short-run. This is because increasing domestic productivity requires LDCs to import more raw materials for their infant industries and capital goods for rapidly growing infrastructural development needs, which in turn increase demand for foreign currency.

To check the robustness of the PMG results, the REER model is also estimated using panel DOLS with and without time trends. The panel DOLS results are presented in Table 4, and as expected, the results generally suggest comparable findings with the PMG results. All fundamental variables, except productivity differential, have the expected signs and are statistically significant to determine the REER of sample LDCs. Under panel DOLS estimation, the coefficient of productivity differential is found to be negative though it is statistically insignificant.

The Bound testing results based on the critical values of F-statistic (Pesaran et al., 2001) are presented in Table 5. The F-test results showed that the REER has a long-run relationship with its fundamentals for all sample LDCs. Indeed, the bound testing t-statistic results are found insignificant for Kenya and Uganda. Nevertheless, the error correction term, ECT (−1), presented in Table 6, is negative and statistically significant for all sample LDCs even at 1% significance level under restricted ARDL estimation. This supported the existence of long-run association among variables in the REER model. The ECT (−1) term depicted that the speed of adjustment of the REER to its equilibrium value is fairly low especially for Kenya, Tanzania and Burundi. Moreover, the Bound testing procedure offered nearly similar results under both without deterministic trend (unrestricted intercept and no trend) and with deterministic trend (unrestricted intercept and trend). Accordingly, the trend is fairly insignificant, and the ARDL is estimated without deterministic trend.

As the cointegration exists, both the long-run and short-run coefficients for the determinants of REER are estimated using the ARDL approach. The long-run results of the ARDL estimation, presented in Table 6, suggested relatively similar findings with panel results. The exception is that the REER depreciates for an increased relative productivity and improved net foreign asset position for Burundi and Kenya, respectively. In line with the conventional theories, the REER of Burundi and Uganda are found to appreciate for an improvement in terms of trade and net foreign asset position, while depreciate for a higher trade openness and broad money supply. In the long-run, the REER also appreciates for an increased productivity differential in Ethiopia supporting the Balassa-Samuelson hypothesis, while it depreciates for higher trade openness in Tanzania.

Likewise, in the short-run, REER of Burundi and Uganda could appreciate for an improved terms of trade and net foreign asset, respectively. Higher trade openness also result in depreciation of the REER for Kenya, Rwanda and Tanzania. The REER of Ethiopia, Kenya and Rwanda also depreciates for an increased broad money supply. But, in contrary to the existing theories, a better relative productivity would lead to a depreciation of REER in the case of all sample LDCs except Kenya. These results are consistent with the recent empirical findings of Berk et al. (2018), which stated that total factor productivity in non-traded goods may lead to real depreciation of exchange rates.

The empirical results generally suggest that the terms of trade, net foreign assets, relative productivity, trade openness and broad money supply could significantly determine the value of the REER of East African LDCs both in the long-run and short-run. Thus, the value of REER misalignment is determined for a panel of LDCs and individual economics using the long-run coefficients and sustainable values of economic fundamentals. The long-run values of REER fundamentals are filtered using the CF asymmetric filtering method.

The yearly average REER misalignments for panel and individual countries are plotted in Figures 1 and 2, respectively. The results showed

![Figure 1](image-url)  
*Figure 1.* The plots of REER misalignments for a panel of LDCs. Note: Country code 1, 2, 3, 4, 5 and 6 denotes Burundi, Ethiopia, Kenya, Rwanda, Tanzania and Uganda, respectively. Source: Author’s estimation results using EViews 10.
that the REER of all LDCs remained significantly misaligned with large variation of overvaluation and undervaluation episodes for the sample period. Indeed, the variations of REER misalignments have been declining for Ethiopia and Uganda over the last two decades. But the REER of Burundi, Kenya, Rwanda and Tanzania remained highly volatile with significant deviation from its equilibrium level.

As shown in Figure 2, all sample countries exhibit significant overvaluation of REER during the periods of fixed exchange rate regime mainly before mid-1990s. The undervaluation episodes have been observed in the recent decades following the adoption of relatively managed floating exchange rate regimes in the 1990s. These countries had also experienced significant and repetitive episodes of nominal devaluations since mid-1990s to support their weak external sector. Furthermore, the REER misalignment (basically undervaluation) for Uganda is relatively lower than other LDCs over the last two decades, which may be due to the adoption of flexible exchange rate policy in 1997 along with capital liberalization (Okello et al., 2019). These results are consistent with the empirical findings of Caputo (2015), which stated that fixed exchange rate regime increases the average rate of appreciation and reduces the speed of convergence to equilibrium level for developing countries. The choice of exchange rate regime matters for developing countries.
Table 8. The PMG/ARDL estimation results for the growth model.

| Variable  | Coefficient | Std. Error | t-Statistic | Prob.* |
|-----------|-------------|------------|-------------|--------|
| Long Run Equation: | | | | |
| LnINV     | 1.0147      | 0.2667     | 3.8048      | 0.0002 |
| LnHC      | 1.0422      | 0.3514     | 2.9661      | 0.0034 |
| LnOP      | 0.2089      | 0.2772     | 0.7536      | 0.4520 |
| LnODA     | -0.3291     | 0.1552     | -2.1265     | 0.0352 |
| MIS       | -0.5867     | 0.2685     | -2.1825     | 0.0301 |
| Short Run Equation: | | | | |
| ECTt-1    | -0.0398     | 0.0093     | -4.2819     | 0.0000 |
| ΔlnINV    | 0.0247      | 0.0224     | 1.0992      | 0.2730 |
| ΔlnHC     | 0.1250      | 0.0908     | 1.3886      | 0.1666 |
| ΔlnOP     | -0.0123     | 0.0304     | -0.4057     | 0.6854 |
| ΔlnODA    | -0.0324     | 0.0221     | -1.4650     | 0.1445 |
| ΔMIS      | -0.0398     | 0.0218     | -1.8274     | 0.0692 |
| C         | 0.2545      | 0.0553     | 4.6028      | 0.0000 |
| Mean dependent var | 0.0161 | S.D. dependent var | 0.0613 |
| S.E. of regression | 0.0303 | Akaikes info criterion | -4.0407 |
| Sum squared resid | 0.1774 | Schwarz criterion | -3.3591 |
| Log likelihood | 531.89 | Hannan-Quinn criter. | -3.7661 |

Note: Dependent variable: ΔlnY. Method: PMG/ARDL. Sample: 1980–2019. Maximum dependent lags: 4 (automatic selection). Dynamic regressors: 4 lags automatic; lnINV, lnHC, lnOP, lnODA, MIS. Model selection method: Schwarz Criterion (SIC). Selected Model: ARDL (1, 1, 1, 1, 1, 1). Source: Author's estimation using EViews 10.

4.2. The effect of REER misalignment on economic growth

The Johansen panel cointegration test is performed again for the economic growth model. The results, presented in Table 7, confirmed the existence of long-run relationships between the real GDP Per capita and its regressors. Thus, the PMG/ARDL and DOLS models are estimated again to examine the effect of REER misalignment on the growth of East African LDCs. The error correction term (speed of adjustment) under the PMG estimation is also negative and statistically significant, implying that the variables of the growth model in Eq. (7) have a long-run relationship.

The results of PMG and DOLS are presented in Tables 8 and 9, respectively, and both estimators have offered comparable findings. The results, as expected, showed that economic growth of LDCs improve for an increase in real investment (gross fixed capital formation) and higher human capital development, but decline for an increase in official development assistance and REER misalignment. The negative growth effects of REER misalignment, basically overevaluation, both in the long-run (significant at 5%) and short-run (significant at 10%) are consistent with the Rodrik (2008) view. It can be marked that REER misalignment is a major concern for the growth of East African LDCs. This negative growth effect of REER misalignment is consistent with the recent empirical findings of Schroder (2013) and Ramos-Herrera (2022), which concluded that the REER should be kept closer to its equilibrium value to avoid the negative effect of REER misalignment on economic growth of developing and emerging countries in the long-run.

The positive effect of real investment on economic growth supported the existing theories of investment and recent empirical findings (Upreti, 2015). The growth effect of human capital is in line with the existing growth theories (Barro and Lee, 1994) and recent empirical findings of Pelisescu (2015) and Sarwar et al. (2021), which stated that growth of GDP per capita would have a positive and significant association with innovative capacity of human capital and qualification of employees through secondary and tertiary education. Nevertheless, the negative effect of foreign aid on economic growth in LDCs may be due to their unstable domestic macroeconomic policies and weak institutional arrangements and legal frameworks to properly manage foreign aid inflows. This result is consistent with the findings of Abate (2022), which revealed that foreign aid negatively affects the economic growth of developing countries with lower index of institutional quality and economic freedom. The growth effect of foreign aid in developing countries is conditional to good domestic policy with amenable economic, social and political institutions (Babalola and Shittu, 2020).

The Bound testing results are also done and presented in Table 10 for individual LDCs. Based on the F-test statistic critical values of Pesaran et al. (2001), there is a long-run association between real GDP per capita and its regressors for all countries except Burundi. The Bound test results are supported by the negative and statistically significant coefficients of the error correction terms under the restricted ARDL model, shown in Table 11, for all respective LDCs. Thus, the unrestricted ARDL model can be estimated for all sample LDCs to examine the long-run and dynamic short-run effects of the RER misalignment on their economic growth.

Table 10. Bound testing results for the growth model.

| Country   | ARDL Model | Without Deterministic Trend | ARDL Model | With Unrestricted Trend |
|-----------|------------|------------------------------|------------|-------------------------|
|           | F-test     | t-test | LM(2) | F-test | t-test | LM(2) |
| Burundi   | 101200     | 1.6689 | -0.6034 | 0.9459 | 102002 | 2.6288 | 0.3051 | 0.8103 |
| Ethiopia  | 100001     | 7.5803 | -0.5927 | 0.8936 | 100001 | 5.3016 | -0.2095 | 0.1269 |
| Kenya     | 200111     | 4.0603 | -3.6377 | 0.6025 | 202222 | 5.7354 | -5.5480 | 0.1825 |
| Rwanda    | 110110     | 5.5036 | -1.8227 | 0.6866 | 110110 | 2.2862 | -1.3389 | 0.6574 |
| Tanzania  | 210211     | 7.7704 | -0.9753 | 0.2785 | 110200 | 2.6156 | -2.0351 | 0.1724 |
| Uganda    | 220022     | 4.0918 | -3.2660 | 0.1189 | 220022 | 3.9764 | -2.3873 | 0.1721 |

Note: SIC used for Lag selection. Pesaran et al. (2001) bound testing critical values are used (see Table 5 for reference). LM is the Lagrange Multiplier test for serial correlation. Source: Author's estimation using EViews 10.
The ARDL bound testing results, presented in Table 11, generally support the panel results. The results showed that human capital development has a positive and statistically significant impact on the growth of Kenya and Uganda in the long-run, and on growth of Burundi in the short-run. The real investment has also a positive and significant effect for Rwanda at least in the short-run. The official development assistance has a negative and significant effect on the growth of Rwanda and Uganda both in the long-run and short-run. But foreign aid is found to have a positive and statistically significant impact the growth of Kenya both in the long-run and short-run, which may be due to her relatively stable domestic macroeconomic environment to manage the foreign capital inflows. Trade openness has also a negative effect on the growth of Kenya both in the long-run and short-run, but statistically insignificant for other sample LDCs in the long-run. The effect of REER misalignment is statistically insignificant for all countries in the long-run. This may be due unstable exchange rate policy in the LDCs with repetitive devaluations as a response to their inflationary economy. In the short-run, a REER misalignment has a positive and significant effect on the growth of Kenya, while it has a negative and significant effect on the growth of Ethiopia.

In general, the economic growth of LDCs could improve for higher real investment and human capital development, while it decline for an increase in REER misalignment, trade liberalization and foreign aid inflows. The REER of LDCs remained largely misaligned that should be corrected through proper exchange rate management and consistent macroeconomic policies to strengthen external competitiveness and then improve economic performance. In fact, mere currency devaluation to correct REER misalignment may not help African low income countries to boost export growth and improve balance of payment deficits due to their poorly diversified export structure (Ayele, 2019). In addition, the LDCs remained the prime destinations of the official development assistance from industrialized economies, which essentially requires stable macroeconomic policy environment and strong legal frameworks in the recipient countries. For countries with overvalued or noncompetitive currency, the impact of aid on growth would become weaker (Elbadawi et al., 2012) and trade openness would trigger a rise in imports while the export response remain weaker that ultimately create balance of payment difficulties (Hallaert, 2010). The positive effect of trade liberalization could be visible for countries which have well-diversified external sector with more value-added export goods. But it may harm growth in countries with less diversification of export structure (Ayele, 2019). In addition, the LDCs could experience the advantages of trade openness and rising saving gap but with more value-added export goods. But it may harm growth in countries such as large African sample countries which are highly concentrated on exports of primary agricultural commodities along with behind border trade barriers such as poor trade logistics performance and weak custom administration.

5. Conclusion

The exchange rate continues to be a major policy instrument for open economies since poor currency management causes severe economic burden and substantial welfare losses. The chronic foreign currency shortage along with persistent current account and fiscal deficits, rising external debt service burden, excessive inflation and rising saving gap remained a significant policy concern for African LDCs. Accordingly, this study examined the REER misalignment and its effect on the economic growth of East African LDCs. The empirical estimation results generally showed that the REER of sample LDCs appreciate for an improved terms of trade and net foreign asset position, while depreciate for high trade openness and broad money supply. The REER misalignment in turn could have a negative and significant impact on the economic growth of LDCs both in the short-run and long-run. The results also indicated that the

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Table 11. Coefficients of ARDL estimation for the growth model.

| Country   | Burundi | Ethiopia | Kenya | Rwanda | Tanzania | Uganda |
|-----------|---------|----------|-------|--------|----------|--------|
| **Long-run Estimates:** |         |          |       |        |          |        |
| lnINV,t-1 | 0.336 (0.488) | 2.613 (3.476) | 0.005 (0.025) | 0.343 (0.428) | -1.594 (1.978) | 0.085 (0.099) |
| lnHCT,t-1 | -0.406 (0.816) | 0.408 (1.349) | 0.539*** (0.055) | 0.633 (0.674) | 8.148 (6.628) | 0.746*** (0.199) |
| lnODAt,t-1 | -2.559 (5.334) | 2.437 (4.955) | -0.354*** (0.073) | -0.066 (0.492) | -1.131 (0.925) | 0.122 (0.102) |
| lnODAt,t-1 | 0.343 (0.804) | -1.209 (1.819) | 0.209*** (0.037) | -0.617** (0.236) | 1.529 (1.448) | -0.194** (0.081) |
| lnMSt,t-1 | -1.839 (3.192) | 1.495 (3.802) | 0.015 (0.033) | -0.801 (0.786) | -1.065 (1.151) | 0.104 (0.104) |
| **Short-run Estimates:** |         |          |       |        |          |        |
| ECT,t | -0.057*** | -0.031*** | -0.433*** | -0.135*** | -0.038*** | -0.276*** |
| lnY,t | 0.417*** |         |         |         |         |         |
| lnINV,t |         |         |         |         |         |         |
| lnINV,t-1 |         |         |         |         |         |         |
| lnHCT | 0.536*** |         |         |         |         |         |
| lnOP,t | 0.025 |         |         |         |         |         |
| lnOP,t-1 | -0.078** |         |         |         |         |         |
| lnODAt | 0.085** |         |         |         |         |         |
| lnODAt-1 | 0.049*** |         |         |         |         |         |
| lnMSt | -0.155*** |         |         |         |         |         |
| lnMSt-1 | 0.064*** |         |         |         |         |         |
| lnMSt | -0.005 |         |         |         |         |         |
| lnMSt-1 | 0.074*** |         |         |         |         |         |
| lnMSt | -0.027** |         |         |         |         |         |
| lnMSt-1 | 0.0561*** |         |         |         |         |         |
| C | 1.057*** |         |         |         |         |         |
| Residual Diagnostics and Model Stability: |         |          |       |        |          |        |
| Adj. R² | 0.3254 | 0.6345 | 0.5749 | 0.9203 | 0.8012 | 0.7018 |
| F-Stat. (Prob.) | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 | 0.0000 |
| LM test (prob.) | 0.9454 | 0.8936 | 0.6025 | 0.6866 | 0.2785 | 0.1189 |
| Jarque-Bera (Prob.) | 0.6669 | 0.0996 | 0.1125 | 0.1682 | 0.5967 | 0.9823 |
| BGP (Prob.) | 0.5352 | 0.8053 | 0.6858 | 0.9774 | 0.3428 | 0.9268 |
| CUSUM | Pass | Pass | Pass | Pass | Pass | Pass |
| CUSUM Sq. | Pass | Pass | Pass | Pass | Pass | Pass |

Note: The figures in parenthesis are standard errors, and *** , ** , * are significant at 1%, 5% and 10% significance level, respectively. Source: Author’s estimation using EViews 10.
GDP per capita could improve for a higher fixed capital formation and human capital development, but it declines for an increase in trade openness and net official aid inflows.

Thus, the currencies of East African LDCs generally require proper exchange rate regime adoption with consistent macroeconomic policies to correct the persistent deviation of their REER from its equilibrium level and to lessen its negative impact on economic growth. The East African LDCs may further devalue their currency to make their exports more competitive in the external sector. But this in turn could bring severe burden on their domestic economy due to a potential increase in the cost of essential raw materials and capital goods imports for their local infant industries and infrastructural developments. As a result, the persistently misaligned currency and associated macroeconomic instabilities require appropriate macroeconomic policies and regulatory frameworks beyond nominal currency devaluation. The exchange rate regimes may not be fully responsible for REER misalignments or even for their potential growth repercussions in SSA (Owoundi, 2017). The sustainability of exchange rate policy depends on the suitable policy responses to the shocks to the economy and on the soundness of the domestic economic, financial, legal and political system (Fontaine, 2005). The espousal of macroeconomic policies should aim at reducing the REER fluctuations and stabilizing the domestic economy. Finally, this study can be extended with a large panel of SSA countries in comparison with other regions.

Declaration

Author contribution statement

Getaneh Mihret Ayele: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data will be made available on request.

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