

Full Length Research Paper

Dynamics of inflation and its impact on economic growth in selected East African Countries: Ethiopia, Sudan and Kenya

Abdelkreem Youse¹ and Sisay Debebe^{2*}

¹Institute of Agriculture and Development Studies, Department of Development Economics, St. Mary's University, Ethiopia.

²Department of Economics, College of Business and Economics, Addis Ababa University, Ethiopia.

Received 5 September, 2020; Accepted 7 January, 2021

Despite Ethiopia's, Sudan's, and Kenya's fastest-growing economies' performance over the last two decades, the overall average inflation rate remains double digits. It subsequently incorporates a detrimental impact to support economic growth in an extended period. This study aims to assess the dynamics of inflation and its impacts on economic growth Ethiopia, Kenya, and Sudan using time-series macroeconomic data collected from the African Development Bank. The research used the Autoregressive Distributed Lag (ARDL) econometrics model and investigated the presence of cointegration and long-term relationships between macroeconomic factors. The result indicates that the exchange rate and the supply of the long-run economic growth rate influence Ethiopia's money supply. Inflation rates and foreign direct investments have impacted economic growth rates in Kenya and Sudan. The economic growth rate in all counties is generally influenced by both the availability of money and the exchange rate—also, real per capita GDP affecting the economic growth rate of Sudan and Ethiopia. Policies on introducing new technologies, building capacities in public and private sectors, youth and gender parity, mobilizing domestic resources, and public participation are recommended for Ethiopia, Kenya, and Sudan.

Key words: Inflation dynamics, real GDP growth rate, ARDL model, Ethiopia, Kenya and Sudan.

INTRODUCTION

The economic growth results from fiscal, monetary, and various other economic policies recommended by policymakers. Several factors affect economic growth. Indeed, inflation and economic growth relationship are

complicated. The sophistication of the link has been explored in many studies. Earlier empirical research showed a negative relationship between inflation and economic growth. On the contrary, analyses focusing on

*Corresponding author. E-mail: sisaydebebe2000@gmail.com.

Author(s) agree that this article remain permanently open access under the terms of the [Creative Commons Attribution License 4.0 International License](https://creativecommons.org/licenses/by/4.0/)

developing countries' sample found a positive relationship between inflation and economic growth. The relationships involving inflation and economic growth have been studied substantially. Nevertheless, the specific connection is not very well defined (Stephanie, 2012).

Considering the East African countries, it is quite relevant to wisely look at the relationship over the years to ensure that inflation does not affect economic growth. During the past in Ethiopia, inflation has been maintained at a lower rate because the authorities controlled the price. The Government was providing products at a set price towards the public. Even more, the lower exchange rate also has a lower inflation rate. Likewise, the inflation level has been reduced in the earlier years of the present Government (Sisay, 2008; World Bank, 2016). However, recently, inflation continues to be high in Ethiopia. Inflation increase in Ethiopia averaged 18.69% from 2006 until 2015, reaching the highest all-time, a lot of 64.20% in 2008, and a record low of -4.10% in 2009 (CSA, 2020).

From 1999 to 2011, Sudan had a time in Sudan where it advanced from widespread natural resources discoveries via oil. Economic growth surpassed the historical average of 4.9 during the "oil economy," and 6.1% on average per year. Sudan lost nearly 75% of its returns and much of its prime economic activity due to South Sudan's secession in 2011, growth for 2014 was 3.1% and indicated some continuation of recovery; however, growth was 3.1% in 2015 (World Bank, 2015).

From 1995 to 2010, the overall economy's growth rate did not display a steady or perhaps regular Kenya pattern. In 1995 and 1996, the real GDP growth rate was 4.3 and 4.0%, respectively. Nevertheless, in 1997, the growth rate decreased considerably to a depressing level of 0.2%. The growth rate rose to 4.6 and 7.0% in 2004 and 2007, correspondingly (AfDB, 2018).

Motivated by Fischer's pioneering work, several studies have found proof of non-linearities inside the inflation-growth nexus using different estimation methods. Alternatively, Ahmed (2010) claims approximately that panel data approaches are superior in recording the inflation-growth relationship than country-specific investigations. Current investigation reveals blended pieces of evidence on the level of inflation restrain achieved by distinctive ponders, just like Ahmed (2010), Stephanie (2012), and Ibarra and Trupkin (2016) investigations. The variations in the calculation methods used can easily explain the inflation resistance figures. Indeed, different tests use different estimation techniques: Bick (2007) uses non-dynamic regression of the panel limit, and Ibarra and Trupkin (2016) uses regression of the smooth shift panel. Stephanie (2012) does, however, include dynamic plank threshold regression. When analyzing non-linearities in the inflation-

growth nexus, the option of an excellent estimation technique plays an important role. Ahmed (2010) and Bick (2007) all provide actual income within the growth equation among all the control variables but use tools and methods that do not question responding to the endogeneity problem. The integrated analysis that tells the inflation threshold's truth may also depend on the countries' sample. Study of developing countries in Africa, South America and Asia, as per Ahmed (2010), Bick (2007), Stephanie (2012) and Ibarra and Trupkin (2016), showed varying levels of economic development. According to Moshiri (2004), this could lead to a bias in the inflation threshold idea. Furthermore, in all developing countries, it is inappropriate" to set a single policy target.

Various researchers attempted to investigate the relationship between inflation and economic growth in Ethiopia, Kenya, and Sudan using different econometrics approaches. Still, there is a lack of comparative studies that compare the dynamics of inflation and its effect on economic growth between Ethiopia, Kenya, and Sudan, which showed the highest inflation rates in the East African Region. Conducting a comparative study helps to understand the differences and similarities, as well as share experiences and what macroeconomic policies can be used for in the three countries by assessing inflation dynamics and economic growth effects.

MATERIALS AND METHODS

Data types and sources

The analysis relies primarily on secondary time series data from the African Development Bank (AfDB) socio-economic database for Ethiopia, Kenya and Sudan. Economic growth will be used as a dependent variable, though inflation, FDI, exchange rate, growth rate of money supply growth, and real per capita GDP variables are explanatory variables. To summarize and present the data, various statistical techniques were used. In Ethiopia, Kenya, and Sudan, the econometric method of ARDL is then used to verify the relationship and impact.

Data analysis

The study used descriptive and econometric analysis. In this study, we used standard time series equation of the form:

$$RealGDP_t = \beta_0 + \beta_1 Inf_t + \beta_2 Exch_t + \beta_3 MonSup_t + \beta_4 PerCap_t + \varepsilon_t \quad (1)$$

Where real GDP is the Real GDP growth rate, Inf_t is inflation rate measured by a consumer price index, $Exch_t$ is the normal exchange rate, $MonSup_t$ is money supply growth rate, growth rate, and $PerCap$ is per capita GDP. Following Gujarati (2004), Equation 1 is written in the standard autoregressive disturbed lag form:

$$RealGDP_t = \beta_0 + \sum_{i=1}^K \beta_{1i} RealGDP_{t-i} + \sum_{i=0}^K \beta_{2i} Inf_{t-i} + \sum_{i=0}^k \beta_{3i} Exch_{t-i} + \sum_{i=0}^K \beta_{4i} MonSup_{t-i} + \sum_{i=0}^K \beta_{4i} PerCap_{t-i} + \varepsilon_t \quad (2)$$

K is the lag length capturing the adjustment process and potential simultaneity bias among the macroeconomics variables.

Unit Root test - The Augmented Dicky Fuller (ADF) test

We should be concerned whether or not the time series is stationary. Autocorrelation sometimes occurs when the underlying time series is non-stationary. The regression shows a strong correlation even when there is no substantive relationship among the variables under investigation. This concept is known as nonsense, spurious relationship with very high R squared (approximately unity) and substantial t and F-statistics. Therefore, the outcomes will be ambiguous for economic analysis. The stationary tests should be carried out before conducting any time-series analysis. If the series is stationary without any differences, it is integrated with zero [I(0)] or stationary at the level. The series is integrated by order one, or [I(1)]. If it is stationary at level two [I(2)], it becomes stationary after two differentiations (Gujarati, 2004).

The Unit Root test is a test of Stationarity that has become widely popular over the past several years (Gujarati, 2004). Suppose we have the following relationship;

$$Y_t = \rho Y_{t-1} + U_t \tag{3}$$

$$Y_t = \rho Y_{t-1} + U_t$$

Where ρ is between -1 and 1; and U_t is a white noise error term.

If the value of ρ is equal to 1, then this is a unit root cause, and the equation becomes a random walk model without drift which is a non-stationary stochastic process. Then, to check whether ρ is equal to 1 or not we regress Y_t on its one-period lagged value of Y_{t-1} . If ρ is statically equal to 1, then Y_t is non-stationary. We perform the following to see whether there is a unit root or not in the above relationship;

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + U_t \tag{4}$$

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + U_t$$

This can also be rewritten as;

$$\Delta Y_t = \delta Y_{t-1} + U_t \tag{5}$$

$$\Delta Y_t = \delta Y_{t-1} + U_t$$

Where $\delta = (\rho-1)$ and Δ , as usual, is the first difference operator. We, practically estimate the above equation and test the null hypothesis of $\delta = 0$. If $\delta = 0$, then $\rho = 1$, we have a unit root which indicates that we have time-series data that is non-stationary.

It confirmed that the Augmented Dicky Fuller (ADF) test could be used to test for Stationarity. In the case of ADF test, Gujarati (2004) specified using the following equation:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^m \alpha_i \Delta Y_t + U_i \tag{6}$$

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^m \alpha_i \Delta Y_{t-i} + U_i$$

Where U_i is a pure white noise error term and where $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$; $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, etc. The number of lagged difference

terms is often determined empirically, and the idea is to include enough lagged terms to make the error term in the equation serially uncorrelated. In ADF, we still test whether $\delta = 0$ and the ADF test follows the same asymptotic distribution as the DF statistic, so that same critical values can be used (Gujarati, 2004).

Lag length selection criterion

The ARDL technique researchers estimate $(p+1)k$ as the number of regressions to achieve an optimal length of lag by each variable, p is the maximum number of lags that can be used, and k is the equation's number of variables. The model can be made based on model selection criteria such as Schwartz-Bayesian Criteria (SBC) and Akaike's Information Criteria (AIC). SBC is known as the parsimonious model: selecting the lowest possible lag length, while AIC is known for choosing the maximum relevant lag length (Gujarati, 2004). To apply these criteria, we calculate the following system statistics for each lag.

$$AIC = \log | \Sigma | + 2g/n \tag{7}$$

$$SBC = \log | \Sigma | + g \log(n) \tag{8}$$

Where $| \Sigma |$ is the cause of the variance-covariance matrix of the system's residuals, g is the total number of parameters estimated in all equations and n is the number of observations.

Test for cointegration (bounds test)

Co-integration is an econometric principle that simulates long stability between the associated economic time series that converges over time. Therefore, cointegration provides a better statistical and economic basis for the quantitative error correction model, which combines short-term and long-term data in modeling variables. Cointegration testing is an essential step toward establishing whether a model has useful long-term relationships scientifically. In this investigation, a bound testing technique is being used to assess the presence of long-term relationships between the real Gross Domestic Product and the repressors and is focused primarily on the F-test. The F-test is a test of the hypothesis which reveals that there is no cointegration between different factors against Cointegration's existence or appearance between variables (Gujarati, 2004; Johansen and Juselius, 1990). It also includes determining the mentioned unrestricted error correction model (UECM) using OLS.

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^q \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^q \alpha_{2i} \Delta X_{t-i} + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + U_t \tag{9}$$

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^q \alpha_{1i} \Delta Y_{t-i} + \sum_{i=1}^q \alpha_{2i} \Delta X_{t-i} + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + U_t$$

The F-test hypothesis is denoted as:

H0: $\beta_1 = \beta_2 = 0$ (null, that is, the long run relationship does not exist).
 H1: $\beta_1 \neq \beta_2 \neq 0$ (Alternative, that is, the long-run relationship exists).

This is tested in each of the models as specified by the number of variables.

The ARDL bound testing is performed on the Wald test (F-statistic). The Wald-Test's asymptotic distribution is non-standard under the null hypothesis that there is no cointegration between the variables. The smaller value bound implies that all variables are I(0), indicating no cointegration relationship between the variables studied. The upper bound implies that all variables are I(1), which means cointegration between variables. If the calculated F-statistic is higher than the critical value, the H0 is rejected (the variables are cointegrated). When the F-statistic test is less than the lower bound

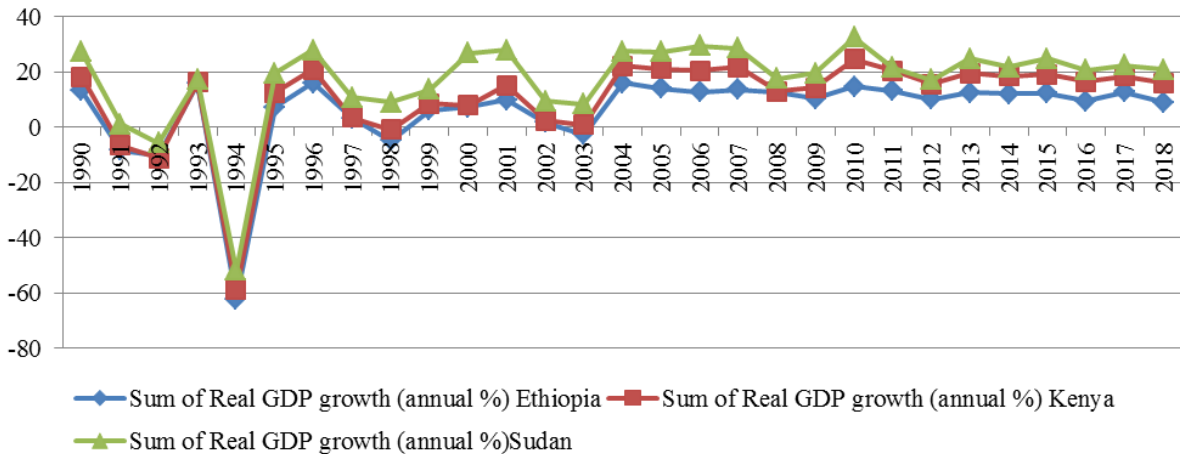


Figure 1. Trends of real GDP in Ethiopia, Kenya, and Sudan from 1991-2018. Source: AFDB Socio-Economic Database (2020).

critical value, the H0 cannot be rejected (no cointegration among the variables). Suppose the computed F-statistics falls between both the minimum and maximum values, in that case, the results are unsatisfactory, and we need to verify the stationarity error term. Depending on the outcomes of the ARDL bounds test, we use either the Error Correction Model (ECM) in the event of a long-term relationship or the short-term ARDL model in the event of no cointegration.

Long run representation of the ARDL model

The long-run representation of the ARDL model specified using Gujarati (2004) and Johansen and Juselius (1990). OLS will help estimate this long-run model if the F-statistic exceeds the upper bound critical value, and the long-run relationship is confirmed.

$$\begin{aligned} \Delta \ln(\text{Real GDP}_t) &= \alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta \ln(\text{RealGDP}_{t-i}) + \sum_{i=1}^k \alpha_{2i} \Delta \text{CVT}_{t-i} + \sum_{i=1}^k \alpha_{3i} \Delta \text{CVR}_{t-i} \\ &+ \sum_{i=1}^k \alpha_{4i} \Delta (\text{LD}_{t-i}) + \sum_{i=1}^k \alpha_{5i} \Delta \ln(\text{FA}_{t-i}) + \sum_{i=1}^k \alpha_{6i} \Delta (\text{IS}_{t-i}) + \sum_{i=1}^k \alpha_{7i} \Delta \ln(\text{LF}_{t-i}) + \delta \text{ECM}_{t-1} + e_t \end{aligned} \tag{10}$$

$$\begin{aligned} \Delta \ln(\text{Real GDP}_t) &= \\ &\alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta \ln(\text{RealGDP}_{t-i}) + \sum_{i=1}^k \alpha_{2i} \Delta \text{CVT}_{t-i} + \sum_{i=1}^k \alpha_{3i} \Delta \text{CVR}_{t-i} + \sum_{i=1}^k \alpha_{4i} \Delta (\text{LD}_{t-i}) + \sum_{i=1}^k \alpha_{5i} \Delta \ln(\text{FA}_{t-i}) + \\ &\sum_{i=1}^k \alpha_{6i} \Delta (\text{IS}_{t-i}) + \sum_{i=1}^k \alpha_{7i} \Delta \ln(\text{LF}_{t-i}) + \delta \text{ecm}_{t-1} + e_t \end{aligned}$$

Where; δ is the speed of adjustment parameter with a negative sign which shows convergence over time and ECM is the error correction term.

Short run representation of the ARDL model

The short-run interactions of the ARDL model specified as follows:

$$\begin{aligned} \Delta \ln(\text{Real GDP}_t) &= \alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta \ln(\text{RealGDP}_{t-i}) + \sum_{i=1}^k \alpha_{2i} \Delta + \sum_{i=1}^k \alpha_{3i} \Delta \text{CVR}_{t-i} + \sum_{i=1}^k \alpha_{4i} \Delta (\text{LD}_{t-i}) + \sum_{i=1}^k \alpha_{5i} \Delta \ln(\text{FA}_{t-i}) + \\ &\sum_{i=1}^k \alpha_{6i} \Delta (\text{IS}_{t-i}) + \sum_{i=1}^k \alpha_{7i} \Delta \ln(\text{LF}_{t-i}) + e_t \end{aligned} \tag{11}$$

$$\begin{aligned} \Delta \ln(\text{Real GDP}_t) &= \alpha_0 + \sum_{i=1}^k \alpha_{1i} \Delta \ln(\text{RealGDP}_{t-i}) + \sum_{i=1}^k \alpha_{2i} \Delta + \sum_{i=1}^k \alpha_{3i} \Delta \text{CVR}_{t-i} + \sum_{i=1}^k \alpha_{4i} \Delta (\text{LD}_{t-i}) + \sum_{i=1}^k \alpha_{5i} \Delta \ln(\text{FA}_{t-i}) + \\ &\sum_{i=1}^k \alpha_{6i} \Delta (\text{IS}_{t-i}) + \sum_{i=1}^k \alpha_{7i} \Delta \ln(\text{LF}_{t-i}) + e_t \end{aligned}$$

RESULTS AND DISCUSSION

Macroeconomic development

Comparison of trends of economic growth rate in Ethiopia, Sudan, and Kenya

The Ethiopian Government committed to improving the country's economic well-being and work towards

eradicating poverty. In the current Five-Year Growth and Transformation Plan (GTP I) of Ethiopia, the primary objective was to sustain at least decent real GDP growth rate of 11% per year and attain the Millennium Development Goals (MDGs) by 2014/15. The Government has committed itself to mobilizing the required resources, including the efficiency to achieve the GTP II Plan, to fulfill Ethiopia's vision of becoming a low-middle-income country by 2025 and sustaining growth.

In Sudan, Figure 1, real GDP growth was estimated to

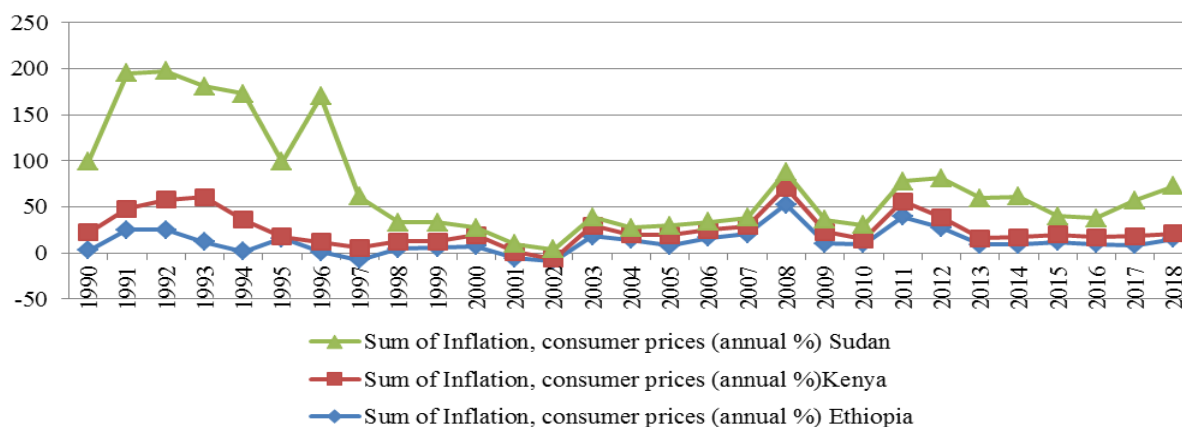


Figure 2. Trends of inflation in Ethiopia, Kenya, and Sudan from 1991-2018.
Source: AFDB Socio-Economic Database (2020).

be 4.1% in 2018 and 3.3% in 2017. The main drivers of growth were supply mining (growth of 6.3%), agriculture (3.7%) and manufacturing (1.5%). On the demand side, private consumption was the primary contributor to growth, while the current account deficit, estimated at 2.4% of GDP in 2018, declined from growth. Higher inflation, as well as the phase-out of energy tax assistance, worsened growth. Although unemployment rose to 18% due to rapid exchange rate depreciation and chronic inflation, poverty and inequality dropped significantly between 2010 and 2015. Growth is expected to rise due to ongoing macroeconomic policy and structural reforms, elimination of tax privileges, a reduction in government spending, incentives to boost exports, a rebound in the industrial sector, and reducing the impact of the previous government through peace dialogue to end the civil war.

Moreover, the shutdown in South Sudanese oil production strictly affected Sudan's economic indicators. Further worsening matters, economic sanctions remain in place on Sudan, while aid and external economic activity are inadequate. The structural economic shift caused by South Sudan's secession has adversely affected virtually all of the country's economic growth prospects.

In Kenya, GDP increased by about 5.9% in Figure 1 in 2018; supported by demand-side household consumption and investment and supply-side public administration facilities, IT, finance and insurance, and transport and storage). GDP fell from 6.5% in 2018, mainly due to unfavourable conditions and lowered government investment.

Comparison of trends of inflation in Ethiopia, Sudan, and Kenya

Oil prices tend to be pushing inflation in Kenya,

accounting for 20%. Money growth has, however, contributed significantly to rapid inflation rises. Disparities in the strength of expansionary monetary policies may explain the discrepancy in massive inflation. Inflationary pressures express the monetisation of the fiscal deficit in Ethiopia. Simultaneously, private sector credit growth could be the primary means of achieving extensive cash growth in Kenya, resulting in aggregate monetary expansion.

As shown in Figure 2, inflation in Ethiopia began to grow steadily in 2004, with gross inflation rising to 17.7% in 2008, with a maximum inflation rate of 39.5%. High inflation causes may be attributed to monetary policy intervention, the disruption of agricultural supply and inflation due to higher international prices.

The trend of inflation is fluctuating in the three countries, but is very inconsistent in Sudan due to the instability and war issues. Although promising recorded macroeconomic performance starting from 2003 compared to the previous years in three studied countries, inflation in Sudan spiraled out of control right from 2016 onwards. The unprecedented increase in inflation leads to reduced economic growth and exacerbates the cost of living in Sudan's urban areas, leading to a government regime change.

Econometrics model results

Unit root test using Augmented Dickey-Fuller test

The ADF outcome for Ethiopia presented in Table 1 that all the variables examined in this research are integrated either in level or first order. The findings show that GDP growth, inflation, the growth rate of money supply and GDP per capita are stationary at the level I(0). Simultaneously, the FDI and exchange rate variables are

Table 1. ADF Unit Root Test Result.

Variable	Ethiopia			Kenya			Sudan		
	t stat	5%	Stationary	t stat	5%	Stationary	t stat	5%	Stationary
Real GDP growth	4.620	3.596	Level	4.717	3.595	Level	3.563	2.976	Level
Inflation	3.716	3.596	Level	7.857	3.603	1 st Level	7.696	3.595	1 st Level
FDI	5.453	3.600	1 st Level	9.314	3.603	1 st Level	4.654	2.981	1 st Level
Exchange rate	3.929	3.600	1 st Level	3.697	3.595	1 st Level	4.398	2.981	1 st Level
Money supply rate	9.688	3.596	Level	4.790	3.595	Level	7.783	2.981	Level
Per capita GDP	4.551	3.596	Level	4.790	3.595	Level	3.443	2.976	Level

Source: Model result.

Table 2. Bounds test for cointegration for Ethiopia using estimate error correction model (ECM).

Variable	Ethiopia			Kenya			Sudan		
	F stat	[I_1] L_05	Cointegration	F stat	[I_1] L_05	Cointegration	F stat	[I_1] L_05	Cointegration
Real GDP growth	5.439	3.79	Yes	7.18	3.79	Yes	23.81	3.79	Yes
Inflation	7.019	3.79	Yes	13.44	3.79	Yes	15.20	3.79	Yes
FDI	8.237	3.79	Yes	5.02	3.79	Yes	4.90	3.79	Yes
Exchange rate	12.021	3.79	Yes	4.89	3.79	Yes	20.26	3.79	Yes
Money supply growth rate	24.185	3.79	Yes	7.15	3.79	Yes	18.93	3.79	Yes
Per Capita GDP	5.431	3.79	Yes	7.20	3.79	Yes	23.77	3.79	Yes

Source: Model result.

stationary at the first level I(1). The outcome of stationary tests for Kenya show that GDP growth, money supply growth rate, and GDP per capita are stationary at the level I (0). In contrast, inflation, FDI, and exchange rate variables are stationary at the level I(0) and at the first level I(1). Similarly, GDP growth, money supply growth, rate growth, and per capita GDP are stationary I(0) at the level for Sudan, and inflation, FDI, and exchange rate variables at the first level I are stationary.

Bounds test for co-integration result

The short data cycle is driven by the use of the ARDL Bounds method. As each variable is treated as a dependent variable, the computed F-statistics are listed in Table 2. For the conditional ARDL vector error correction model, we select a maximum lag order of 2 using the Akaike knowledge criterion (AIC).

Table 2 shows that the F-calculated for real GDP, inflation, FDI, exchange rate, money supply rate, and real per capita GDP is greater than the F test's standard bound at a 5% significant level. They are suggesting that there is a long-run relationship between variables when the Error Correction Model (ECM) was used. It thus emerged that the dependent and independent variables

are significant in long-run relationship.

Long-run ARDL result

The long-term dynamics among real GDP, inflation, FDI, exchange rate, growth rate of money supply growth, and real per capita GDP are shown in the results in Table 3. The predicted long-term outcomes show a negative and statistically significant long-term relationship between real GDP and inflation and the exchange rate. The long-run relationship between the variables shows that at minimum one direction, there is Granger-causality. Therefore, at a 5% level of significance, the null hypothesis that inflation has no major impact on actual GDP was dismissed. This suggested that keeping all factors stable indicated a 1% rise in inflation lowered the real GDP by 0.0027%.

Similarly, the projected long-term outcome showed a positive and significant relationship between real GDP growth, real per capita GDP, and money supply. Thus, at a 5% significance level, the null hypothesis was dismissed, which implies that a 1% change in the real per capita GDP rate contributes to an increase in real GDP of 1.034%. The FDI was linked to the real GDP in a positive yet negligible way. Therefore, the null hypothesis that

Table 3. Long-run ARDL result.

Variable	Ethiopia			Kenya			Sudan		
	Coefficient	Standard Error	t-stat	Coefficient	Standard Error	t-stat.	Coefficient	Standard Error	t-stat.
Real GDP growth	-0.003 **	0.0010	-2.47	0.0003	0.0002	1.71	0.001***	0.0001	5.32
Inflation	0.001	0.0006	1.20	0.001***	0.0001	5.01	0.001***	0.0002	5.07
FDI	-0.005	0.0042	-1.12	-0.001***	0.0003	-3.76	0.004 ***	0.0011	3.33
Exchange rate	1.11***	0.0261	42.48	0.933***	0.0241	38.71	0.983***	0.0056	175.91
Money supply	1.034 ***	0.000	1750.54	1.03 ***	0.0004	2561.99	1.026***	0.0005	2008.26
Per Capita GDP	-0.003 **	0.0010	-2.47	0.0003	0.0002	1.71	0.001***	0.0001	5.32

*, **, *** is significant at 10, 5 and 1% significance levels, respectively.

Source: Model result.

foreign direct investment has no meaningful effect on real GDP has not been dismissed.

The previous result on the evidence of a robust long-run relationship between our variables of interest indicates the need to investigate further the nature and type of causal relationship between them. The presence of a long-run relationship does not say anything about the directions and of causation between the variables. The demands for further tests for Granger causality determine the direction of the association is needed. The long-run estimated model for Ethiopia is presented as follows:

$$\text{GDP Growth} = -0.5785933 - 0.0027 \text{ Inflation} + 0.00007 \text{ FDI} - 0.0047 \text{ Exchange rate} + 1.111 \text{ Money supply growth rate} + 1.043 \text{ per capita GDP}$$

The results of the long negative relationship between inflation and economic growth are consistent with Fisher's theories and his study "role of a macroeconomic factor in growth." The data obtained in his analysis consists of some macroeconomic parameters, including 93 countries' inflation. Research has shown that the channel by which inflation adversely affects economic growth is by reducing investment and limiting productivity growth. Fisher also claims that price mechanisms are skewed by inflation, reducing resource distribution quality, thereby adversely impacting economic growth. Due to strict monetary policy, inflation in Ethiopia was lower, and the Government supplied goods to the public at a fixed price.

Inflation has a positive, negligible, long-term association with real GDP for Kenya in Table 3. FDI, the growth rate of money supply growth, and real per capita GDP, on the other hand, have a major effect on real GDP. The calculated long-run results show a negative and statistically significant long-run exchange rate for the real GDP. The long-run relationship between the variables shows that at minimum one direction there is Granger-causality. Therefore, at a 5% level of significance, the null hypothesis that inflation has no substantial impact on real GDP has not been dismissed. This means that keeping

all unchanged factors means that a 1% rise in inflation raises the real GDP by 0.00033%.

Similarly, a negative and significant relationship between real GDP and the exchange rate was reported by the projected long-run result. The null hypothesis was dismissed at a degree of 5%. This indicates that a 1% rise in the exchange rate would result in a drop in the real GDP of -0.0012431%.

The long-run estimated model for Kenya is presented as follows:

$$\text{GDP Growth} = 0.3543642 + 0.003334 \text{ inflation} + 0.0006847 \text{ FDI} - 0.0012431 \text{ exchange rate} + 0.9334988 \text{ money supply growth rate} + 1.029353 \text{ per Capita GDP}$$

For Sudan in Table 3, the long-run showed a significant positive relationship between all the variables of interest (real GDP, inflation, FDI, Exchange rate, Money supply growth, rate growth, and real per capita GDP). The positive relation between real GDP and inflation was not as expected. Still, some studies mentioned that inflation impacts economic growth in terms of certain thresholds (World Bank, 2015).

The long-run estimated model for Sudan is presented as follows:

$$\text{GDP Growth} = 0.0166985 + 0.0004612 \text{ Inflation} + 0.0009646 \text{ FDI} + 0.0035141 \text{ Exchange rate} + 0.9830015 \text{ Money supply growth rate} + 1.025894 \text{ per Capita GDP}$$

Sudan has gained from the vast oil-based exploration. Economic growth surpassed the historical average of 4.9 during the "oil economy," and recorded 6.1% as the highest rate. Sudan lost about 75% of its revenues and much of its prominent economic performance due to South Sudan's separation in 2011: crude oil production. However, growth was 3.1% for 2014 and demonstrated a stabilization progression that began in 2013. The growth was recorded at 3.5% in 2015.

Diagnostic test and model stability test result

The model was tested for serial correlation using the Post-estimation Diagnostic Tests, and Durbin-Watson d-statistics shows no serial correlation tested. The result indicated that the Durbin-Watson d-statistic test of 2.19, 2.23 and 2.28, and Breusch-Godfrey LM test for autocorrelation of 0.22, 0.017 and 0.36 for Ethiopia, Kenya and Sudan respectively are higher than 5% failing to reject the null hypothesis (H0: no serial correlation), implying that the model was not serially correlated. In addition, the model was also tested using the model stability by estimating CUSOM and the figure, which shows that the entire model is stable within the 5% boundary.

Conclusions

In this study, despite promising macroeconomic performance in Ethiopia, Kenya, and Sudan countries, inflation in Sudan spiraled out of control starting from 2016 onwards while there is slow growth rate in Kenya and Sudan. The main driver of long-run economic growth in Ethiopia is the exchange rate and money supply. In Kenya and Sudan, inflation, FDI, exchange rate, money supply growth rate commonly affected the economic growth rate. In addition, real per capita GDP affected the economic growth rate of Sudan. Based on the findings, the study recommended the following policy responses. First, the central banks must apply an appropriate macro-economic policy instrument to maintain low and stable inflation and exchange rate. Second, the Government should continue the strictly fiscal management to enable the monetary policy instrument to sustain economic growth and strengthen poverty reduction programs. Third, promoting and sustaining FDI inflow via creating and providing adequate policy subsidies. Finally, money supply and growth rate is dramatically improving and is adversely influenced by the performance of macro-economic variables. Hence, there is a need to take into account nature and the effects. In addition, the three countries need to develop policies that benefit from the regional, continental and international commitments such as the Global Agenda for the sustainable development goals and the African Union Agenda 2063 that will help them explore the means and ways of mobilizing the domestic resources to contribute to the economy.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

REFERENCES

- African Development Bank (AfDB) (2018). African Economic Outlook. African Development Bank.
- African Development Bank (AfDB) (2020). Socio-Economic Database <https://dataportal.opendataforafrica.org/nbyenxf/afdb-socio-economic-database-1960-2021>
- Ahmed Md S (2010). An Empirical Study on Inflation and Economic Growth in Bangladesh (2010). OIDA International Journal of Sustainable Development 2(3):41-48.
- Bick A (2007). Pitfalls in panel threshold models: The role of regime dependent intercepts, Working Paper Goethe University Frankfurt.
- Central Statistics Authority (CSA) (2020). www.csa.gov.et.
- Gujarati DN (2004). Basic Econometrics. 4th Edition, McGraw-Hill Companies.
- Ibarra R, Trupkin DR (2016). "Reexamining the relationship between inflation and growth: Do institutions matter in developing countries?," Economic Modelling, Elsevier 52(PB):332-351.
- Johansen S, Juselius K (1990). Maximum Likelihood estimation and inference on Cointegration with applications to the demand for money. Oxford Bulletin of Economics and Statistics 52:2. <https://doi.org/10.1111/j.1468-0084.1990.mp52002003.x>
- Moshiri S (2004). Inflation-Growth Profiles Across Countries: Evidence from Developing and Developed Countries. International Review of Applied Economics 18(2):191-207.
- Sisay M (2008). Determinants of Recent Inflation in Ethiopia. Unpublished MA thesis, Unity University, Addis Ababa, Ethiopia.
- Stephanie K (2012). Inflation and Growth: New Evidence from a Dynamic Panel Threshold Analysis Article in Empirical Economics. DOI:10.1007/s00181-012-0553-9
- World Bank (2015). Sudan Country Economic Memorandum Realising the Potential for Diversified Development. World Bank, Washington, D.C.
- World Bank (2016). Ethiopia's Great Run: The Growth Acceleration and How to Pace it. World Bank, Washington, D.C.