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**Article**

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Article

# Economic Growth, Exchange Rate and Remittance Nexus: Evidence from Africa

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**Abstract:** Abstracts This paper examined the nexus between economic growth and exchange rate, remittances, trade, and agricultural output based on data sourced from 1980 to 2018 for 10 selected African economies. We employed both the Dumitrescu and Hurlin time-domain Granger causality test and the Croux and Reusens frequency domain Granger causality test. Results from the time-domain test suggests that causality only exists between economic growth and both exchange rate and trade, with no significant relationship between economic growth and both remittances and agricultural output. When we employed frequency domain model in our analysis, the results suggested that there is a bi-directional temporary and permanent causality between economic growth and exchange rate, trade, agriculture, and remittances. Our results suggest the validity of both the J-Curve and Marshall–Lerner hypotheses in the studied economies. Our study offers some relevant policy implications.

**Keywords:** economic growth; exchange rate; remittances; agricultural output; trade; Africa

**JEL Classification:** E22; F40; F41

## 1. Introduction

Ever since the fall of the Bretton Woods agreement in 1973, economists have devoted time to researching the impact of exchange-rate fluctuation on the economy (Bahmani-Oskooee et al. 2016b; Chi 2018; Fall 2019; Qureshi and Tsangarides 2012; Romelli et al. 2018; Tunc et al. 2018). A key feature of the post-Bretton era was the adoption of a floating exchange rate regimes by many economies, inducing unpredictable instability in bilateral exchange rates (Ayopo et al. 2015; Bahmani-Oskooee et al. 2016c; Fashina et al. 2018; Lawal et al. 2018; Lawal 2014; Pradhan et al. 2017). The impact of the fluctuation in exchange rate helps in economies characterized by a low state of financial development (Bahmani-Oskooee and Gelan 2018). Africa's economies, when compared with economies in other regions such as North America, Europe, and South Asia, are largely developing frontiers,

with the majority showing signs of potential growth (Lawal et al. 2016, 2020; Salisu et al. 2020). The fluctuation in the exchange rate regime has the capacity to impede African growth. African economies are largely agrarians and serve as primary sources of raw material for developed economies, depending largely on the developed economies for importation of finished goods. This suggests that fluctuation in exchange rate regime may have severe effects on African economies by way of dampening the volume of international trade. For instance, risk-averse investors (importers and exporters) may shy away from undertaking high-risk trades (Asteriou et al. 2016; Baek 2013; Hayakawa et al. 2017; Hu and Oxley 2017). In another view, the risk-portfolio hypothesis opined that higher risk connotes higher returns, suggesting risk-induced exchange rate instability could motivate an increase in volume of trade (Nicita 2013; Santana-Gallego and Pérez-Rodríguez 2019; Sharma and Pal 2018; Sugiharti et al. 2020).

In addition to agriculture and trade, another salient factor that influences African economic behavior is remittances. (Apergis and Cooray 2018) noted that remittance receipt into developing economies over the years has increased substantially from around USD 31.05 million in 1990 to over USD 581,640 million in the year 2015. The inflow of remittance to transfer-receiving economies is said to be the second-largest foreign exchange inflow after the foreign direct investment (FDI), and higher than overseas development aid (ODA). The beauty of remittance inflow is that it is a 'bottom up' source of development finance as it is received directly by households, unlike FDI and ODA, which are institutionally received (Apergis and Cooray 2018; Fromentin 2017; Hathroubi and Aloui 2016). As noted by Hien et al. (2019), chances are high that a huge number of remittances as a means of inflow to emerging economies can induce an upward movement in a country's real exchange, with a consequent impact on economic growth and competitiveness. This condition is referred to as the Dutch disease.

The agricultural sector is a factor in the sub-Saharan Africa SSA growth basket, as the continent is largely agrarian. Agriculture contributes more than 70% in terms of labor force and over 50% of African economies GDP. In addition to natural resources such as Oil, Gold and other solid minerals, agriculture serves as the main source of foreign earnings for most African economies (Adetutu and Ajayi 2020; Djurfeldt 2013; Dorosh and Thurlow 2018; Adom and Adams 2020; Olanipekun et al. 2019).

(Caruso et al. 2021; Edwards 2020; Shastri 2021) calibrated the impact of COVID-19 to the discussion of the impact of remittances on economic growth for the Central American economies, twenty-two developing economies, and India, respectively. The results offer varying degrees of outcomes. For instance, while (Shastri 2021) noted that the impact of remittance is countercyclical in relation to economic growth and that it is decoupled from macroeconomic fundamentals for India, (Caruso et al. 2021), on the other hand, noted that remittance negatively affected economic growth in the Central American economies with varying degrees; for example, El Salvador and Nicaragua were mostly affected, while the impact was mild for Panama and Guatemala. Furthermore, the impact on poverty reduction in this region is heterogeneous. (Edwards 2020), on the other hand, noted that the growth rate of the economies studied was largely influenced by remittance, tourism, and migration.

The responses of each of these variables to growth are often shaped by exchange-rate volatility. For instance, an increase in domestic currency by a way of appreciation could lead to a significant decrease in remittance received. This suggests that exchange rate fluctuation can alter remittance receipt, thereby affecting economic growth (Bayangos and Jansen 2011; Dutta and Sengupta 2018; Rabbi et al. 2013). The effect on trade and agriculture, for instance, can be seen from an overvalued currency view, which can impose adverse consequences for economic growth by discouraging export competitiveness and imposing upward pressure on the current account (Apergis and Cooray 2018).

Evidence abounds to show that African markets adopt a number of measures, including adoption of overvalued exchange regime, foreign exchange allocation and quotas, current account transactions, restrictive exchange-rate rationing resulting from a persistently

weak external account, appreciable black-market windows, exchange-rate liberalization, among others, with the intention of mitigating against the impact of exchange-rate volatility in the aggregate economy.

Given this scenario, it is important to understand the impact of exchange fluctuation on growth with a focus on remittance, agriculture, and trade, among others. The current study therefore employed panel frequency domain analysis and panel causality test that account for heterogeneous panels in the time domain estimation techniques to analyze quarterly data sourced from 1980 to 2018 on some selected SSA economies to examine the nature of the relationship between economic growth, exchange rate fluctuation, trade, agriculture, and remittance, among other things. This study contributes to literature in three folds: first, in terms of methodology by calibrating the impact of frequency domain to exchange rate, remittance, agriculture, trade and economic growth discussion; second, in terms of scope and coverage, we cover a more recent time than most of the existing studies; third, we are among the first studies that examines exchange rate-growth nexus with a focus on the impact of remittance, trade and agriculture which are the major drivers of SSA economies.

Foreshadowing our results, evidence abound to show that there is a bidirectional temporary as well as permanent causality between economic growth and exchange rate and trade, agriculture, and remittance.

The rest of the paper is structured as follows: Section 2 provides the Literature Review; Section 3 provides the Methodology, Section 4 present the Results and Policy implication, while Section 5 concludes the study.

## 2. Literature Review

This study examined the impact of exchange-rate fluctuation on African economies from two strands of existing international trade and macroeconomics literature. They are: (i) The Marshall–Lerner theory; and (ii) The J-curve theory. We briefly discussed each of these theories below.

### 2.1. The Marshall–Lerner Theory

This theory emanated from the work of Lerner, who opined that the impact of exchange rate on economic growth is best measured through the interplay of import tariffs/quotas and export subsidies (Boyd et al. 2001; Ide and Takayama 1991). The theory noted when the home economy employs tariffs and quotas to control imports and at the same time subsidize export, the value of homeland currency will appreciate as imports become dearer. A country can advance its balance of trade through the coordinated depreciation of its currency. Through this measure (depreciation of local currency), the prices of imported goods become expensive, leading to a fall in demand for imported goods. On the other hand, export becomes relatively cheap, provoking an upward shift in demand for homeland goods at the global market. Economists have since criticized this position, stressing its potential to generate undesired outcomes from the global community, as economies may react to homeland position by imposing their own tariffs and quotas against imported goods from the homeland economy. This reaction can spur upward movement in the global prices of goods and services, which could result in a fall in aggregate demand, alter economic growth, and increase unemployment. It could also promote trade wars between the homeland economy and her trading partners, as experienced in the recent US–China scenario. The Lerner (1946) proposition was modified by the Marshall–Lerner condition, which emphasized the use of exchange rate as a policy instrument to manipulate trade balances, based on the (Marshall 1923) theory of price elasticity of demand (Dong 2017; Eita 2013; Hsing 2010; Nielsen 1987; Sastre 2012). This condition emphasized employment of a strategic currency depreciation measure by the homeland economy to improve the trade balance in the long run. The M-L framework was extended by (Bahmani-Oskooee et al. 2016a), who calibrated the impact of an adjustment process preceding currency depreciation by the homeland economy.

## 2.2. The J-Curve Theory

The J-curve theory centers on both the long- and short-term impact of devaluation of currency on trade balance. The theory suggests that initially, a currency depreciation is succeeded by an increase in spending on import, given that homeland consumers pay more in their local currency for imported goods as prices had been determined at a higher price/rate in foreign currency before the homeland devalued her currency. On the other hand, the prices of exports become less expensive right after the homeland devalues her currency, since homeland firms are paid relatively less at the initial set prices. These seemingly contrary situations only exist in the short run, as the balance of trade—based on the fact that homeland demand for imported products—will decline, while demand for export of the homeland product will increase; see (Badinger 2019; Bahmani-Oskooee and Aftab 2018; Bahmani-Oskooee et al. 2018; Dogru et al. 2019; Hurley and Papanikolaou 2018; Ivanovski et al. 2020; Sensoy and Tabak 2016).

The validity of these two theories has been tested empirically using datasets from a few economies with mixed results.

(Dogru et al. 2019) examined the impact of the fluctuation in exchange rate on tourism trade balance between the US and Canada, Mexico, and the UK, based on monthly data sourced from January 1996 to June 2017. The study employed a combination of linear and nonlinear autoregressive distributed lag (ARDL) cointegration, as well as error-correction models, to examine the validity of the M-L hypothesis and the J-curve model in the studied economies, and observed that depreciation of the USD positively exerts on US trade balance with balance with each of the studied trading economies. The study further subjects the test to examination of sectorial impact, with a focus on the tourism subsector and observed that when the USD appreciates, it exerts a negative consequence on the US bilateral tourism basket with Canada and the UK, though it has little or no impact on the US-Mexico tourism trade balance. Theoretically, the results tilts in support of the validity of the M-L condition and rejects the possibility of the J-curve hypothesis for the studied economies.

For some selected African economies, (Senadza and Diaba 2017) employed the pooled mean-group estimator of dynamic heterogeneous parcels technique to analyze data sourced from eleven sub-Saharan African markets, comprised of Ghana, Gambia, Kenya, Madagascar, Mauritius, Mozambique, Nigeria, Sierra Leone, Tanzania, Uganda, and Zambia from 1993 to 2014. The study noted that exchange-rate fluctuation has no significant impact on imports, though a significant negative relationship exists on exports, at least in the short run.

In a related development, (Bahmani-Oskooee and Gelan 2018) examined the impact of real exchange-rate volatility on trade balance of twelve African economies based on quarterly data sourced from 1971 (Q1) to 2015 (Q4). The authors divided their work into different parts by measuring the distinct impact of real exchange-rate volatility on import and export, focusing on short-run and long-run analysis. The study employed the ARDL bound testing approach and observed that exchange-rate volatility affects trade flows of many of the studied economies in the short run, while the impact was reduced to only five out of the twelve studied economies in the long run. A major flaw of the study is that it adopts only aggregate trade flows as it fails to account for each country's major trading partners.

(Kodongo and Ojah 2011) investigated the link between fluctuation of the real exchange rate and the international portfolio flows of the four largest African economies, Egypt, Morocco, Nigeria, and South Africa, based on monthly data sourced from 1997 (M1) to 2009 (M12). The study divided the work into two distinct periods—a full sample period, and two subperiods based on volume and volatility of portfolio flows. The study employed Granger causality techniques as well as a vector auto regressions model, and observed that the relationship between portfolio flows and fluctuation on foreign exchange rate is essentially country dependent and varies depending on time.

(Gkillas et al. 2018) calibrated the impact of changes in stock market behavior to the study of exchange-rate fluctuations in the African economies with a focus on Botswana,



Egypt, Kenya, Mauritius, and South Africa. The study employed a combination of an asymmetric threshold approach, error correction, and structure VAR to analyze daily data sourced from 1 January 2001 to 20 January 2018. The study noted that African foreign exchanges respond significantly to large-scale news, and that these markets react speedily to short-term positive/negative stock market news, especially after the global financial crisis.

In another strand, (Hien et al. 2019) examined the nexus between real exchange-rate, remittances, and economic growth for 32 selected Asian economies. The study attempted to uncover the existence of Dutch disease on the studied economies resulting from the remittances–exchange rate relationship. The authors employed the system Generalized Methods of Moments (S-GMM) and the linear dynamic panel data (DPD) model to analyze data sourced from the year 2006 to 2016. The authors noted that a positive and significant relationship exists between remittance and exchange rate, such that a 1% increase in remittance inflows will lead to 0.103% appreciation of the exchange rate. The author noted that this relationship undermines the studied economies' competitiveness, suggesting the existence of the Dutch disease. The study further noted that economies with a high remittance ratio to GDP are not affected by the Dutch disease, and that floating exchange rate dampens real exchange appreciation occasioned by capital flows.

For the Philippines, (Mandelman 2013) estimated the impact of the interactions between monetary policy, exchange rate, and remittance on economic growth. The study employed a heterogeneous agent model that calibrated a rule-of-thumb household without access to financial markets to examine the possibility of remittances serving as counter-cyclical and insurance mechanisms against macroeconomic shocks. The study noted a pure deterministic framework, nominal fixed-exchange-rate regime impedes aggressive real exchange-rate appreciation and performs effectively for recipient households faced with upward trends for remittances. The author concluded that a flexible floating regime suitably mitigates against unanticipated shocks in a business cycle.

(Sobiech 2019) calibrated the impact of financial development into a remittance-growth nexus by employing a newly created index of overall financial development, a dynamic factor model, and a battery of panel data estimates to analyze data sourced from 1970 to 2010 from 61 selected developing economies. The study noted that an inverse relationship exists between financial development and the impact of remittances on economic growth, such that the more an economy is financially developed, the smaller the effect of remittances on growth. The study further revealed that a positive relationship is noted between remittances and growth with economies with a low level of financial development. The study concluded that remittances is a pro-growth model, at least in the short run, but for growth to be sustained, economies should pursue financial development. This finding is in line with an early study of (Nguyen 2017) for Vietnam, who noted that the impact of remittances on growth through exchange-rate regime is only positive and significant in the short run. The author pointed out that a 10% increase in remittance will induce a 3% fall in the exchange rate, suggesting the appreciation of domestic currency, with a consequential implication on exports competitiveness.

For Moldova, (Nikas and Blouchoutzi 2014) employed fixed-effect ordinary least square (OLS) and a Granger causality test to analysis data sourced from 1995 to 2010 on remittance inflows, exchange rate, and economic growth. The study noted that remittances either depreciate or have no significant impact on real exchange-rate.

Taguchi 2017 opined that the ability of Bangladesh to channel remittance inflows to investment, which results into capital accumulation given that the shares of gross fixed capital formation to GDP and that of exports of goods and services increases overtime. The study also noted that remittance inflows were supported by the adoption of a supporting environment for the manufacturing industry, massive investment in infrastructures, establishment of industrial zones, and export-processing areas, all of which aid the impact of remittance on growth.

### 3. Data and Methodology

This study employed quarterly data sourced from 1980 to 2018 on economic growth proxy by the real gross domestic product, trade openness, agricultural output, and remittances for 10 of the largest African economies. All the data, except that of agricultural output, were extracted from the World Development Indicators of the World Bank. The data on agricultural output were sourced from the Economic Research service of the US Department of Agriculture (USDA).

#### 3.1. Methodology

The current study followed (Aydin and Esen 2018; Aydin 2019; Cowan et al. 2014; Nasreen et al. 2020; Lawal et al. 2019; Ozcan and Ozturk 2019; Lawal et al. 2017, 2018; Salisu et al. 2020; Zhang et al. 2016) to employ the (Dumitrescu and Hurlin 2012) panel causality test, as well as that of (Croux and Reusens 2013) frequency-based panel-frequency domain test to examine the nature of the relationship between economic growth and each exchange-rate fluctuation, trade remittance, and agriculture in the economies considered in the empirical analysis. Our choice of the DH test was informed based on three advantages it offers compared with existing methods; (i) it considers cross-section dependency, (ii) the time dimension as well as the size of the cross-section relativity is inconsequential, (iii) it achieves effective results in an unbalanced panel. We first tested the cross-sectional dependence of the variable by employing the (Pesaran 2004) LM test. Thereafter, we employed the panel unit root test using the cross-sectional augment version developed by (Pesaran and Yamagata 2008). This test accounts for the cross-section dependence of the series, and the Slope homogeneity across regions. Furthermore, we examined the causal relationship between the variable by employing our main techniques (Dumitrescu and Hurlin 2012) panel causality test, which does not require pretesting for panel unit root and cointegration analysis (Aydin 2019; Cowan et al. 2014); and the (Croux and Reusens 2013) panel frequency domain test. Our (Dumitrescu and Hurlin 2012) panel unit test can account for heterogeneity in the variables used.

##### 3.1.1. Cross-Sectional Dependence Test

SSA economies shared almost the same characteristics: (1) they are all developing economies, serve as sources of raw material to the developed world, are majorly agrarian, mainly low-income economies (except for South Africa), and remittance serves as a major contributor to foreign inflows of capital. There is a need to first conduct a cross-sectional dependence test. Thus, we employed the Pesaran (2004) LM test, expressed as follows:

$$CD_{LM} = \sqrt{\frac{1}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \left( T \frac{\rho_{ij}}{2} - 1 \right)} \quad (1)$$

As established in the literature, when the cross-sectional size (N) is larger than time dimension (T), we employed the test as expressed in (2), such that

$$CD_{LM} = \sqrt{\frac{2T}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^N \dot{\rho}_{ij}} \quad (2)$$

Here,  $\dot{\rho}_{ij}$  is the correlation between the errors, and the null hypothesis is as follows:

$H_0 : COV(U_{it}, U_{Ij}) = 0$ , no cross-sectional dependence

$H_0 : COV(U_{it}, U_{Ij}) \neq 0$ , cross-sectional dependence

As a rule, if the p-values are smaller than the significance value, we reject the null hypothesis; if otherwise, we cannot reject the null hypothesis.

### 3.1.2. Panel Unit Root Test

To account for cross-sectional dependence in the data-generating set, we employed the CIPS panel Unit root test developed by (Pesaran and Yamagata 2008). The DF(CADF) (which is the cross-sectional augmented Dickey–Fuller Static model) is expressed as follows:

$$\Delta Y_{i,t} = \alpha_i + \beta_i Y_{i,t-1} + c_i \bar{Y}_t + \varepsilon_{i,t} \quad (3)$$

Here,  $\bar{Y}_t = \frac{1}{N} \sum_{i=1}^N Y_{i,t}$ ,  $\Delta \bar{Y}_t = \frac{1}{N} \sum_{i=1}^N \Delta Y_{i,t}$  and  $\varepsilon_{i,t}$  represent the error term. The CIPS is as follows:

$$CIPS = \frac{1}{N} \sum_{i=1}^N CADF_i \quad (4)$$

We test the null hypothesis against the alternative, the rule say we reject the null hypothesis if the critical values in smaller than the test statistics, if otherwise, we cannot reject the null hypothesis.

### 3.1.3. Dumitrescu–Hurlin Causality Test

This test is expressed as follows:

$$Y_{i,t} = \alpha_i + \sum_{k=1}^k \gamma_{i,t-k} + \sum_{k=1}^k \beta_i^{(k)} X_{i,t-k} + \varepsilon_{i,t} \quad (5)$$

Here, the individual effect is represented by  $\beta_i = (\beta_i^{(1)}, \beta_i^{(2)}, \dots, \beta_i^{(k)})$ ,  $\alpha_i$  is the individual fixed effects,  $\gamma_i^{(k)}$  is the lag parameter,  $K$  represents lag length, and  $\beta_i^{(k)}$  are the slope parameters.

The hypothesis is as follows:

$$\begin{aligned} H_0 : \beta_i &= 0, \forall i = 1, \dots, N \\ H_1 : \beta_i &\neq 0, \forall i = 1, \dots, N \\ \beta_{ii} &\neq 0, \forall i = N_1 + 1, N_1 + 2, \dots, N \end{aligned} \quad (6)$$

Under the DH mechanism, the null hypothesis states that no causal relationship exists in at least one cross-section unit. The null hypothesis is a homogeneous phenomenon, while the alternative hypothesis is a heterogeneous output. Under the DH, we reject the null hypothesis if the calculated probability values are smaller than the significance value; if otherwise, the null hypothesis cannot be rejected.

To calculate the test statistics (Dumitrescu and Hurlin 2012) first estimated the individual Wald statistics for each of the cross-section units and used the average of estimated individual statistics to calculate the Wald test statistics for the panel.

The Panel statistics are expressed as follows:

$$W_{N.T}^{Hnc} = \frac{1}{N} \sum_{i=1}^N W_{iT} \quad (7)$$

Beyond employing time-dimension-based estimates, we employed a frequency-based technique. This was premised on the fact that, while time-domain estimation techniques evaluate the time series as a function of time, frequency-domain-based techniques focus on frequency divided into various frequency components, which allows the spectral density function to be investigated in the frequency-domain framework, thus revealing the periodic fluctuation in the series. Unlike time-domain models, which estimate a single test statistic over time, frequency-domain estimation techniques can examine the causal relationship at different frequencies, and thus offer a robust result across a different domain of the data-generating set. Moreso, in a situation where the relationship between variables occurs in more than one frequency, the time-domain-estimating techniques will be insufficient to effectively maximize the information in the original dataset (Lawal et al. 2017, 2019).



### 3.1.4. Frequency Domain Panel Causality Test

The study followed (Aydin 2019; Ozcan and Ozturk; Ozcan and Ozturk 2019) to employ the (Croux and Reusens 2013) frequency-domain panel causality test. The SUR model is as follows:

$$X_{i,t} = \sum_{j=1}^p \beta_{i,j} X_{i,t-j} + \sum_{j=1}^p \gamma_{i,t-j} + \varepsilon_{i,t} \quad i = 1, 2, 3, \dots, M \quad (8)$$

Here, the variables of country  $i$  at time  $t$  are represented by  $X_{i,t}$  and  $Y_{i,t}$ , respectively.  $\varepsilon_{i,t}$  represents the error terms at time  $t$  of the country  $i$ ;  $p$  represents the lag length, while  $M$  represents the number of countries.

The constraints on the null hypothesis are stated as follows:

$$\sum_{j=1}^p \gamma_{i,j} \cos(jw) = 0, \quad i = 1, 2, \dots, M \quad (9)$$

s.t.

$$\sum_{j=1}^p \gamma_{i,j} \sin(jw) = 0 \quad i = 1, 2, \dots, M \quad (10)$$

To test these constraints, we employed the incremental  $R^2$  measured test as follows:

$$R_1^2 = R^2 - R_*^2 \quad (11)$$

where  $R^2$  is the unrestricted and  $R_*^2$  is the restricted McElroy  $R^2$  value.

$$R_1^2 > F_{(2M, M(T-2p), 1-\alpha) \frac{2M}{M(T-2p)} (1-R^2)} \quad (12)$$

Here,  $F_{(2M, M(T-2p), 1-\alpha)}$  represents the  $\alpha$  critical value of the F-distribution with  $2M$  and  $M(T-2p)$  degrees of freedom. We reject the null hypothesis if the incremental  $R^2$  value is larger than the F-statistic value; if otherwise, we cannot reject the null hypothesis.

## 4. Results and Discussions

In Table 1, we present the results of the cross-section dependence and unit root test. The first panel presents the result of the cross-sectional dependence based on the (Pesaran 2004) LM test. From the result, it can be deduced that cross-sectional dependence exists in the studied economies. It can also be deduced that the impact of shock from any of the economies studied exerts on others. The panel unit root test result shows that all the variables are stationary (1) in the first differences.

In Table 2, we represent the result of the (Dumitrescu and Hurlin 2012) panel causality test. From the result, it can be deduced that bi-directional causality exists between economic growth and exchange rate and trade. The result on the relationship between exchange rate and remittance and agriculture shows that no causality exists, not even at any of the three lag-lengths. Our results are in line with the findings of (Badinger 2019; Eita 2013; Hsing 2010) who documented the existence of a significant relationship between exchange rate and trade. This suggests that economic growth can be spurred up through deliberate manipulation of domestic currency. Our results tilt towards supporting the existence of J-curve in Africa, as evidenced in the existence of the bi-directional relationship between economic growth and exchange rate and trade. Our results contradict the finding of (Bahmani-Oskooee and Halicioglu 2017; Bahmani-Oskooee et al. 2016a; Dong 2017) who noted that J-curve theory does not hold between United States and her trading partners, Turkey and Mexico.

**Table 1.** Cross-sectional dependence and unit root test results.

Variables	Statistics	p-Value	abs
InRGDP	28.87 ***	0.001	0.512
InEXC	87.54 ***	0.000	0.614
InREM	78.55 ***	0.000	0.673
InTRD	67.09 ***	0.000	0.433
InAGRIC	88.13 ***	0.003	0.513
CIPS Panel Unit Root Test Results			
Test Statisticss			
Variables	Levels	First Differences	
InRGDP	−2.021	−3.476 ***	
InEXC	−2.063	−3.872 ***	
InREM	−2.118	−4.021 ***	
inTRD	−2.401	−4.182 ***	
InAGRIC	−2.207	−4.311 ***	

Note: \*\*\* implies the rejection of the null hypothesis at 1% significance level; average absolute values (abs) suggesting correlation coefficient.

**Table 2.** Results of the Dumitrescu–Hurlin panel causality test.

The Null Hypothesis	k = 1	k = 2	k = 3
InRGDP $\rightarrow$ InExc	0.423 (0.043) **	0.401 (0.000) ***	1.051 (0.000) ***
InEXC $\rightarrow$ InRGDP	1.152 (0.046) *	3.543 (0.000) ***	4.212 (0.000) ***
InRGDP $\rightarrow$ InTRD	0.344 (0.366) **	1.322 (0.000) ***	5.944 (0.000) ***
InTRD $\rightarrow$ InRGDP	0.412 (0.049) **	1.024 (0.000) ***	4.916 (0.000) ***
InRGDP $\rightarrow$ InREM	0.567 (0.322)	2.871 (0.342)	4.087 (0.766)
InREM $\rightarrow$ InRGDP	0.654 (0.659)	1.805 (0.453)	4.781 (0.563)
InRGDP $\rightarrow$ InAGRIC	2.981 (0.897)	1.566 (0.662)	6.911 (0.769)
InAGRIC $\rightarrow$ InRGDP	6.992 (0.876)	4.908 (0.543)	4.066 (0.819)

Note: p-value are in parentheses. \*\*\*, \*\*, \* represents the rejection of null hypothesis at 1%, 5%, and 10% significance levels, respectively; k represents the lag length.

In Table 3, we present the results of the frequency-domain causality test employed to examine the causal relationship at different frequency domains. The study focuses on three frequency horizons: short (2.5); intermediate (1.5); and long (0.5).

**Table 3.** Results of the panel frequency causality.

The Null Hypothesis	Frequency			Critical Value
	W = 0.5	W = 1.5	W = 2.5	10%
InRGDP $\rightarrow$ InEXC	0.007 *	0.004 *	0.005 *	0.000
InEXC $\rightarrow$ InRGDP	0.004 *	0.003 *	0.003 *	0.000
InRGDP $\rightarrow$ InTRD	0.002 *	0.006 *	0.004 *	0.000
InTRD $\rightarrow$ InRGDP	0.007 *	0.008 *	0.003 *	0.001
InRGDP $\rightarrow$ InREM	0.005 *	0.006 *	0.003 *	0.001
InREM $\rightarrow$ InRGDP	0.007 *	0.007 *	0.002 *	0.003
InRGDP $\rightarrow$ InAGRIC	0.003 *	0.006 *	0.001 *	0.010
InAGRIC $\rightarrow$ InRGDP	0.004 *	0.007 *	0.002 *	0.010

Note: \* represents the rejection of null hypothesis at 10% significance level.

We define W at 0.5 and 2.5 as permanent and temporary causality, respectively. Unlike the results of the (Dumitrescu and Hurlin 2012) model, our (Croux and Reusens 2013) panel frequency test revealed that bi-directional temporary and permanent causality exist

between exchange rate and agriculture and remittance. This suggests that exchange rate fluctuation will impact agriculture output and remittance in the studied economies. This suggests that SSA economies can boost their agricultural export through export subsidizing with stringent control on importation and strategic control of export.

## 5. Conclusions and Policy Implications

The study examines the relationship between economic growth and exchange rate, trade, agriculture, and remittance inflow from selected African economies based on data sourced from 1980 and 2018. We began our analysis by employing a cross-sectional dependence test to access suitable unit root and causality tests. Results from this analysis show that cross-sectional dependence exists in the study. We then proceeded to apply unit root tests to examine the stationarity levels of the series. The findings reveal that the variables studied are stationary at first differences. Having established stationarity at first differences, we proceeded to conduct causality analyses. In the first leg of our causality test, we employed a time-domain-based test using a DH panel causality test. Our results reveal that a bi-directional causality exists between economic growth and exchange rate and trade. Furthermore, the result stated that no significant relationship exists between economic growth and remittance and agriculture. Theoretically, these results emphasized the relevance of devalued exchange rate in driving economic growth through trade and explained by both the M-L and J-Curve hypotheses.

To accommodate the inability of time-domain models to capture the impact of higher-frequency phenomena on the data-generating set, we further subjected our analysis to a frequency-domain horizon by employing the CR (2013) panel frequency causality test. Our results reveal that there is a bi-directional temporary and permanent causality between economic growth and exchange rate, agriculture, trade, and remittance. Our results further support the evidence of both J-Curve and M-L hypotheses for the studied economies. This again justifies the use of a frequency-domain model, as the results obtained could not be presented under a time-domain framework.

Our results offer some policy implications. First, since our findings suggest a bi-directional relationship exists between economic growth and exchange rate, remittances, trade and agricultural output, it suffices to say that (i) remittances lead to an increase in exchange rate, which could imply an overvalued currency, resulting from an increase in consumption and spending; thus, if the exchange rate is higher, it suggests that there is higher global demand for the currency. This could be detrimental to growth, as it could spur demand for import domestically because import becomes cheaper. This could also have negative consequence on export, as it becomes relatively expensive when compared with competing economies. Channeling remittances to investment will lead to reduction in real exchange rate, which will in turn lead to an increase in export and a fall in import. This suggests an increase in trade, which will also lead to an increase in economic growth.

The study therefore suggests that given the fact that exchange rate, remittance, trade, and agricultural output help to explain the behavior of economic growth for the studied African economies, market regulators should pay keen attention to the directions of each of these variables, promoting policies that will expand the remittance regime mirroring other macroeconomic variables.

The study therefore recommends that policy makers should ensure that remittance inflows are channeled towards the productive sector by creating a conducive investment atmosphere, or else remittance inflows (which could provoke an upward shift in exchange rate) will be spent on consumption. Providing a conducive investment atmosphere to support agriculture, small and medium-scale enterprises, for instance, will lead to an increase in economic growth.

To further advance the course of future research on this subject, we recommend that researchers reexamine this relationship focusing on different economies, employ other macroeconomic variables, use a different methodology, differentiate between skilled workers and unskilled workers, and compare the results with those obtained in this study.

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