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# On the asymmetric effect of real exchange rate on growth: Evidence from Africa

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**Abstract**

**Purpose —** This study investigates the asymmetric effect of real exchange rates on the economic growth of twenty African countries for the period 2005 to 2019.

**Design/Method/Approach —** A refined method of Granger and Yoon (2002) was used to decompose real exchange into appreciation and depreciation. To address the problem of endogeneity and cross-sectional dependence, a two-steps system generalized method of moments, Driscoll-Kraay estimator, and Augmented Mean group were used.

**Findings —** This study established the presence of asymmetries in the real exchange rate in the region. Further, the study found that real exchange rate appreciation inhibits economic growth while real exchange rate depreciation is beneficial to growth in the region. The results are robust to different estimation techniques.

**Practical Implications —** The outcome of this study supports the traditional view of exchange rates on macroeconomic variables. Hence, findings from this study can help investors and policymakers in the region to better understand the dynamics of the exchange rate and its effect on economic growth.

**Originality/Value —** This study enriches the literature on the relationship between exchange rate and growth, especially in Africa using a refined approach to decompose exchange rate into appreciation and depreciation.

**Keywords —** Real exchange rate appreciation, real exchange rate depreciation, growth, Africa

## Introduction

The importance of the exchange rate on macroeconomic variables has led to a subject of great debate among researchers, policymakers, and international bodies alike. Exchange rate management determined the performance and outcome of an economy since it serves as a vehicle that connects the local economy to the rest of the world (Dada, Olomola, & Adedokun, 2021; Iyke & Odhiambo, 2017; Olomola & Dada, 2017; Ozturk, 2006; Tiwari & Shahbaz, 2013). Further, a competitive exchange rate is needed especially in developing countries to achieve growth targets and desirable macro-economic objectives of government (Rapetti, Skott, & Razmi, 2012; Rodrik, 2008). In the literature, two views are broadly recognized as the effects of real exchange rates on macroeconomic variables. The traditional economists suggest that exchange rate depreciation is expansionary through an increase in net exports by substituting imports with

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home goods, thus boosting domestic production and putting the economy on a path of sustained growth (Dornbusch, 1988; Rodrik, 2008); while the reverse holds for exchange rate appreciation. On the other hand, the New Structuralists school of thought found that exchange rate depreciation could be contractionary instead of expansionary as suggested by the traditional school (Alexander, 1952; Dı´az-Alejandro, 1963; Krugman & Taylor, 1978). For instance, income could be redistributed from worker to producer as a result of the depreciation of currency thereby weakening the consumption component of aggregate demand through a reduction in marginal propensity to consume. In addition, depreciation of the exchange rate could increase the cost of imported factors of production, increase production cost and thereby reduce the effect on aggregate supply in the short run, and aggregate demand in the long run. This points to the fact that there are inherent asymmetric structures in the exchange rate (Mejıa-Reyes, Osborn, & Sensier, 2010; Parsley & Wei, 1993). That is, if depreciation improves economic growth, appreciation worsens it and its assumption does not hold in reality (Mohsen Bahmani-Oskooee & Fariditavana, 2016; Mohsen Bahmani-Oskooee, Halicioglu, & Neumann, 2018).

Scholars have identified four factors that could make the exchange rate exhibit asymmetry in its structures (Ahmad, Ahmad, & Ali, 2013; Y. Ahmad, Lo, & Staveley-O'Carroll, 2019; Cuestas, 2009; Dada et al., 2021; Juvenal & Taylor, 2008; Leon & Najarian, 2003; Sarantis, 1999; Sarno, Taylor, & Chowdhury, 2004). One, there are lots of trade barriers especially in developing countries such as transportation costs, tariffs, and other trade barriers which tend to be on the high side, thus, causing price gap among similarly traded goods (Bussiere, 2013; Dada et al., 2021; Peltzman, 2000). This price gap does not only occur in spatially separated markets but also the domestic market. Two, the intervention of monetary authority in exchange rate management and determination often leads to switching of the exchange rate from one regime to another one, usually an unstable regime (Arize, Malindretos, & Igwe, 2017; Chen & Lin, 2019; Dada, 2021). For instance, the desire of the apex bank to protect the export competitiveness of a country could force them to limit currency appreciations rather than depreciations, which has been termed the "fear of appreciation" hypothesis in literature. Three, the heterogeneous nature of market participants, their different perceptions, and imperfect information about the market could also make exchange rates exhibit asymmetry in their structures (Arize et al., 2017; Kilian & Taylor, 2003). Lastly, developing countries have witnessed a lot of structural breaks in their economies which may cause the exchange rate to adjust asymmetrically. However, earlier studies do not account for the asymmetric process in the exchange rate on macroeconomic variables (Mohsen Bahmani-Oskooee & Kandil, 2009; Christopoulos, 2004; McPherson & Rakovski, 1998).

Recent studies that have incorporated asymmetry into exchange rate have focused mainly on export (Adaramola, 2016; Oyovwi, 2012; Rahman & Serletis, 2009; Verheyen, 2013), pass through (Bussiere, 2013), trade balance (Arize et al., 2017; Mohsen Bahmani-Oskooee et al., 2018; Buba, Garba, & Guza, 2018; Dada & Olomola, 2017; Jibrilla Aliyu & Mohammed Tijjani, 2015; Kyophilavong, Shahbaz, Rehman, Souksavath, & Chanthasene, 2018; Nathaniel, 2020), reserve (Adler & Mora, 2011; Chen & Lin, 2019; Pontines & Rajan, 2011), inflation (Wimanda, 2014), etc. with little or no known study on the asymmetric effect of exchange rate on output especially in Africa which is one of the developing region and worst hit by factors that could make exchange rate respond asymmetrically. Further, exchange rate has a significant impact on developing economies rather than developed economies (Hussain, Hussain, Khan, & Khan, 2019; Stavárek, 2013). Previous studies that have assumed symmetric effect of exchange rate on macroeconomic variables especially growth are unable to differentiate the impact of depreciation from appreciation of exchange rate, which has important policy implications. Thus, the assumption of real exchange rate appreciation having opposite and equal effects as compared to real exchange rate depreciation on macroeconomic variables might be too restrictive. Succinctly put, economic agents react differently to exchange rate appreciation and exchange rate depreciation. It has equally been observed that human being tends to react more to positive shocks than negative ones (Granger & Yoon, 2002; Hatemi-J, 2012). Based on the foregoing, it is

imperative to allow for this new dimension by separating appreciation from depreciation in the link between exchange rate and output.

This study, therefore, contributes to the body of knowledge in the following areas. First, the study examines the asymmetric effect of real exchange rate on growth in African countries by decomposing exchange rate into both appreciations (negative shock) and depreciation (positive shock) since economic growth reacts differently to shocks from real exchange rate (Bahmani-Oskooee & Fariditavana, 2016). Second, the study adopts a robust method employed by Dada (2021), Granger and Yoon (2002), Hatemi-J (2012), dan Olaniyi (2019) to decompose exchange rate into appreciation and depreciation. This method helps to separate the impacts of positive changes from the negative ones and it is unique because economic agents in international markets react differently to appreciation and depreciation (good and bad news) (Gkillas, Vortelinos, & Suleman, 2018; Salisu & Umar, 2017). In addition, the approach helps to explore whether real depreciation or real appreciations, including their magnitudes, have different effects. The approach gives a better understanding of expansionary and contractionary policies in exchange rate management and gives better and more accurate policy options to policymakers in the region. Third, the study makes use of a technique that corrects for endogeneity in exchange rate-growth literature and spatial and cross-sectional dependence among the cross-sectional unit. Globalization of the world economies in the past few decades has made countries experience ever-increasing and knitted economic and financial integration, which is largely responsible for strong interdependencies among a cross-section of units (Ajide, Osinubi, & Dada, 2021; Akinlo & Dada, 2022; De Hoyos & Sarafidis, 2006; Sarafidis & Wansbeek, 2012). African countries, as cross-sectional units, are likely to be dependent on one another, given the level of economic integration in the region, thus, the need to consider cross-sectional dependence in the analysis arises.

## Methods

To examine the asymmetric effect of exchange rate on economic growth in African countries, this study relies on modified Aggregate Demand (AD) framework to drive out the model. As stated by Mohsen Bahmani-Oskooee and Mohammadian (2017), the effect of exchange rate on output can be obtained from both the Aggregate Demand and Aggregate Supply sides of the framework. To avoid the problem of complexity in the relationship between forces of aggregate demand and aggregate supply; and also, the problem of multicollinearity among the variables, this study focuses mainly on the aggregate demand side. Adopting the study of Hussain et al. (2019), the modified aggregate demand model is stated thus:

$$GDP_{it} = f(RER_{it}, GEX_{it}, BM_{it}) \quad (1)$$

Where GDP is a proxy of output, RER is the real exchange rate, GEX is government expenditure and BM is the broad money supply. All variables are expressed in logarithms except the real exchange rate. The real exchange rate captures the interaction of the domestic economy with its foreign counterpart. It is incorporated into the model through the import-export sector of the economy. A rise in the value of the real exchange rate indicates depreciation of the domestic currency while a fall in its value signifies appreciation of the domestic currency. Government expenditure and broad money supply capture the fiscal and monetary policies respectively.

In specific terms, equation 1 can be expressed as:

$$GDP_{it} = \alpha_0 + \beta_1 RER_{it} + \phi_1 GEX_{it} + \eta_1 BM_{it} + \mu_{it} \quad (2)$$

Where $\mu_{it}$ is an error term.

From equation 2, the real exchange rate is separated into both depreciation (positive shock) and appreciation (negative shock) using the method developed by Granger and Yoon (2002) but later modified and used by Bahmani-Oskooee and Gelan (2008), Chen and Lin (2019), Dada (2021), Loretta and Liu (2007), and Maurizio, Elitza, and Livio (2016). The process of separating appreciation of real exchange rate from depreciation follows a random walk as explained thus:

$$RER_{it} = RER_{it-1} + \varepsilon_t = RER_0 + \sum_{j=1}^{t} \varepsilon_j \quad (3)$$

Where; t = 1, 2, 3,……T, the constant term $RER_0$ is the starting value of the variable while ε is the error term. The positive and the negative changes are stated as:

$$\varepsilon^+ = max(\varepsilon, 0) \quad (4)$$
$$\varepsilon^- = min(\varepsilon, 0) \quad (5)$$
Therefore, $\varepsilon = \varepsilon^+ + \varepsilon^-$ (6)

Substituting equations 4 and 5 in 3, it follows that:

$$RER_{it} = RER_{it-1} + \varepsilon_t = RER_0 + \sum_{j=1}^{p} \varepsilon_j^+ + \sum_{j=1}^{p} \varepsilon_j^- \quad (7)$$

Further, depreciation and appreciation of real exchange rate are defined as a cumulative sum:

$$POS = RER_{it}^+ = \sum_{j=1}^{p} \varepsilon_j^+ \quad (8)$$

$$NEG = RER_{it}^- = \sum_{j=1}^{p} \varepsilon_j^- \quad (9)$$

Where; POS is real exchange rate depreciation and NEG is real exchange rate appreciation.
Thus, appreciation (NEG) and depreciation (POS) of the real exchange rate in equations 8 and 9 are used to replace the real exchange rate in equation 2 (Arize et al., 2017; Mohsen Bahmani-Oskooee & Fariditavana, 2016; Dada, 2021; Hussain et al., 2019; Shin, Yu, & Greenwood-Nimmo, 2014).

$$GDP_{it} = \alpha_0 + \gamma_1 POS_{it} + \chi_1 NEG_{it} + \phi_1 GEX_{it} + \eta_1 BM_{it} + \mu_{it} \quad (10)$$

The a priori expectation of the variables are as follows:
The effect of the appreciation of real exchange rate (χ) and depreciation of real exchange rate (γ) on output is ambiguous (Arize et al., 2017; Dada, 2020), its effects could be negative or positive. If the coefficient of real exchange rate depreciation (γ) is positive (negative), then exchange rate depreciation increases (reduces) output. In contrast, the positive (negative) coefficient of exchange rate appreciation (χ) indicates that appreciation of real exchange rate improves (worsens) output. The positive effect of exchange rate appreciation and depreciation on output indicates that the exchange rate is expansionary, otherwise, contractionary. Government expenditure (ϕ) and broad money supply (η) are expected to have a positive effect on output.

To estimate equation 10, three different approaches namely, two-step system Generalised Method of Moments (GMM), Driscoll and Kraay (1998) (D-K), and Augmented Mean Group (AMG) are used. GMM accounts for the problem of endogeneity commonly found in the exchange rate-output relationship. D-K approach produces robust standard errors which correct for heteroskedasticity and autocorrelation in the error structure (Le & Tran-Nam, 2018). Furthermore, AMG account for both cross-sectional dependence and country-specific heterogeneity. Also, this study conducts a series of tests to determine the existence or otherwise of cross-sectional dependence. Similarly, the study adopts panel unit root tests that account for cross-sectional dependence.

The study period span 2005 to 2018. Twenty countries in Africa are selected based on the availability of data (see Appendix 1). Measurement and description of variables are presented in Appendix 2. The descriptive statistics of the variables are presented in Table 1. The result shows that output (GDP), government expenditure (GEX), and broad money supply (BM) are normally distributed since the measure of central tendency (mean and median) are very close. On the other hand, asymmetric components of real exchange rate i.e appreciation (NEG) and depreciation (POS) do not exhibit normal distribution in their mean and variance. This further laid claim to the presence of asymmetric structure in the real exchange rate in Africa. Furthermore, all the variables fall within their respective minimum and maximum values. The skewness statistics show

that all the variables are negatively skewed except exchange rate depreciation (POS). The synopsis of the correlation matrix in the lower part of Table 1 reveals the absence of multicollinearity among the variables.

**Table 1.** Descriptive Statistics and Correlation Matrix

| | GDP | NEG | POS | BM | GEX |
|---|---|---|---|---|---|
| Mean | 23.595 | -18.612 | 16.176 | 36.129 | 106.002 |
| Median | 23.730 | -11.158 | 12.618 | 35.438 | 107.226 |
| Maximum | 26.874 | 0.000 | 60.508 | 119.354 | 167.266 |
| Minimum | 20.457 | -90.609 | 0.000 | 5.920 | 50.239 |
| Std. Dev. | 1.710 | 20.090 | 14.668 | 26.079 | 17.719 |
| Skewness | 0.142 | -1.437 | 1.211 | 1.582 | 0.214 |
| Kurtosis | 2.218 | 4.436 | 3.688 | 4.886 | 5.209 |
| GDP | 1 | -0.168 | -0.052 | 0.418 | -0.393 |
| NEG | | 1 | -0.340 | -0.096 | -0.116 |
| POS | | | 1 | -0.336 | 0.045 |
| BM | | | | 1 | 0.122 |
| GEX | | | | | 1 |

Where; GDP is output, NEG is an appreciation of real exchange rate, POS is exchange rate depreciation, BM is broad money supply and GEX is government expenditure.

## Results and Discussion

Before examining the asymmetric effect of the real exchange rate on output in Africa, it is imperative to test for the presence of cross-sectional dependence among the countries. Breusch-Pagan LM, Pesaran scaled LM, Bias-corrected scaled LM and Pesaran CD were used to establish the existence or otherwise of cross-sectional dependence. The null hypothesis that the residuals are cross-sectional independence is tested against the alternative hypothesis that states the errors are cross-sectional dependence. The result of the cross-sectional dependence tests in Table 2 rejects the null hypothesis of cross-sectional independence among the countries using all four criteria. This result is not surprising, owing to several commonalities African countries shared such as trade, capital mobility, integrated financial systems, and exposure to common external shocks. Since the existence of cross-sectional dependence has been confirmed, first generational unit root tests are inept of addressing cross-sectional dependence, hence, second generational unit root tests such as cross-sectionally augmented Im, Pesaran, and Shin (CIPS) and cross-sectionally augmented Dickey-Fuller (CADF) are used. CIPS and CADF panel unit root tests are used to address the problems of cross-sectional dependence and heterogeneity in the data. CIPS is based on the null hypothesis of homogeneous non-stationary (Pesaran, 2007), while cross-section augmented Dickey-Fuller (CADF) rests on the null hypothesis that all the series are non-stationary in a heterogeneous panel with cross-sectional dependence. The unit root test presented in Tables 3 and 4 reveals that the variables are a mixture of both I(0) and I(1) variables using CIPS and CADF tests statistics.

Having established the presence of cross-sectional dependence, this study proceeds to examine the asymmetric effect of exchange rate on output in Africa using two-step system General Method of Moment (GMM), Driscoll-Kraay (D-K), and Augmented Mean Group (AMG) techniques. The estimates of the regression result are presented in Table 5. The results in Table 5 clearly show the evidence of asymmetric effect in the relationship between real exchange rate and output in Africa. From Table 5, appreciation of real exchange rate (NEG) exerts a negative and significant effect on output in the region. The negative impact of appreciation on output in Africa indicates that it requires more foreign currency to purchase a domestic product, thus, domestic product is relatively costly compared with their foreign counterpart. Furthermore, appreciation of domestic currency makes foreign goods cheaper to consume, hence, citizens with a taste for foreign goods will easily opt for it, thereby hurting domestic output since consumption of locally produced goods has reduced. This is in tandem with the studies conducted by Bahmani-Oskooee and Mohammadian (2017), Berg, Ostry, and Zettelmeyer (2008), Gala (2008)

who found a negative effect of exchange rate appreciation on output, but contrary to the findings of Dada et al. (2020), Mejıa-Reyes et al. (2010), and Schnabl (2008) who found that appreciation of exchange rate increases productivity and economic growth.

**Table 2.** Cross-sectional Dependence Test

| | GDP | NEG | POS | BM | GEX |
|---|---|---|---|---|---|
| Breusch-Pagan LM | 2023.726*** | 1881.489*** | 1941.056*** | 1054.808*** | 603.0243*** |
| Pesaran scaled LM | 94.068*** | 86.771*** | 89.827*** | 44.363*** | 21.187*** |
| Bias-corrected scaled LM | 93.298*** | 85.938*** | 88.993*** | 43.594*** | 20.418*** |
| Pesaran CD | 39.905*** | 43.021*** | 43.899*** | 24.640*** | 13.530*** |

**Table 3.** Unit Root Test with cross-sectional (Constant)

| Variables | CIPS Test | | CADF Test | |
|---|---|---|---|---|
| | Level | 1st Difference | Level | 1st Difference |
| GDP | -1.823 | -2.687*** | -1.880 | -2.522*** |
| NEG | -1.352 | -2.659*** | -1.673 | -2.126* |
| POS | -2.113* | | -2.064 | -2.668*** |
| BM | -2.465*** | | -2.440** | |
| GEX | -2.228** | | -1.597 | -2.571*** |
| Critical values 10% | -2.11 | | -2.110 | |
| 5% | -2.22 | | -2.220 | |
| 1% | -2.45 | | -2.450 | |

Where *, ** and *** indicates 10%, 5% and 1% level of significant respectively

**Table 4.** Unit Root Test with cross-sectional (Constant and Trend)

| Variables | CIPS Test | | CADF Test | |
|---|---|---|---|---|
| | Level | 1st Difference | Level | 1st Difference |
| GDP | -1.982 | -2.707* | -2.359 | -2.685* |
| NEG | -1.729 | -2.731* | -1.719 | -2.631* |
| POS | -2.565 | -3.280*** | -2.565 | -3.280*** |
| BM | -2.792** | | -2.792** | |
| GEX | -2.553 | -4.296*** | -2.553 | -4.296*** |
| Critical Values 10% | -2.65 | | -2.640 | |
| 5% | -2.77 | | -2.760 | |
| 1% | -3 | | -2.980 | |

Where *, ** and *** indicates 10%, 5% and 1% level of significant respectively

In contrast, depreciation of the exchange rate has a significant positive effect on output. This result reveals that the region will benefit from the depreciation of the real exchange rate since it increases output. Therefore, depreciation of the exchange rate is expansionary in Africa. This supports the Marshal-Learner condition. For African countries to fully benefit from the Marshal-Learner condition, the exchange rate must depreciate significantly so that the elasticity of export is more than import. In addition, depreciation of the exchange rate favors the tradeable sector through reallocation of resources, thereby increasing learning by doing and technological spillover in the economy (Eichengreen, 2008; Rodrik, 2008). The positive impact of the depreciation of the real exchange rate is confirmed by the theoretical work of Rodrik (2008). Rodrik (2008) postulates that real exchange rate depreciation is growth-enhancing in developing countries than developed countries. The outcome of this study conforms to the traditional school of thought. Other studies that found a positive effect of exchange rate depreciation on growth include Christopoulos (2004), Hausmann, Pritchett, and Rodrik (2005), and Rapetti et al. (2012), among others, but contrary to the studies of Ahmed (2003), Edwards (1986, 1989), Mejıa-Reyes et al. (2010), and Schnabl (2008).

**Table 5.** Estimation Results

| Dependent Variable: GDP | Model 1<br>Two-Step GMM | Model 2<br>D-K | Model 3<br>AMG |
|---|---|---|---|
| GDP(-1) | 0.031** | | |
| | [-2.43] | | |
| NEG | -0.012*** | -0.008*** | -0.010*** |
| | [-6.94] | [-9.86] | [-5.12] |
| POS | 0. 007 | 0.006*** | 0.004** |
| | [0.99] | [3.89] | [2.43] |
| GEX | 3.812*** | 0.113** | 0.034*** |
| | [4.23] | [2.25] | [3.98] |
| BM | 0.135*** | 0.023*** | 0.035* |
| | [5.21] | [10.29] | [1.683] |
| C | 1.552*** | 2.786*** | 0.342*** |
| | [3.41] | [4.03] | [4.49] |
| Observations | 260 | 260 | 260 |
| Number of groups | 20 | 20 | 20 |
| Wald Test | 12.20*** | 19.67*** | 21.23*** |
| Sagan Test | 0.621 | | |
| AR(1) | 0.002*** | | |
| AR(2) | 0.274 | | |
| RMSE | | | 0.0272 |

Where *, ** and *** indicates 10%, 5% and 1% level of significant respectively
[ ] are t-value
Wald Test is based on the null hypothesis of NEG=POS

The significant effect of exchange rate depreciation reveals that monetary authority in the region should not fear real exchange rate depreciation since it is beneficial to growth; on the other side monetary authority needs to fear exchange rate appreciation since its effect is significant and negative. This result further reveals that there will not be currency mismatch risk if the monetary authority in the region depreciates their currency. Comparing the magnitude of appreciation and depreciation of the exchange rate, the result shows that output responds more to appreciation than depreciation. This tallies with the studies conducted by Aguirre and Calderón (2005), Dhasmana (2015), Rahman and Serletis (2009), Razin and Collins (1999) that the response of output to exchange rate appreciation is more than that of exchange rate depreciation. Specifically, Razin and Collins (1999) found that the negative effect of overvaluation on growth is stronger than the positive effect of undervaluation, which suggests the existence of asymmetries in 93 countries (developed and developing countries). Contrarily, Arize et al. (2017) found that trade balance reacts more strongly to depreciations than to appreciations.

Besides, the nature of participants in the foreign exchange market could make depreciation and appreciation of the real exchange rate have a different effect on economic growth. For a risk-averse agent, depreciation of the real exchange rate will have much more effect on growth than appreciation of the real exchange rate. However, if economic agent in the foreign exchange market is risk-neutral, appreciation of the real exchange rate will be more felt than the depreciation of the real exchange rate. The outcome from this study reveals the importance of incorporating the asymmetric effect of the real exchange rate (appreciation/depreciation) into the exchange rate- output relationship since they have different magnitudes. Hence, previous studies on the relationship between output growth and exchange rate that was premised on a symmetric assumption, and the absence of cross-sectional dependence might have led to wrong policy prescription, especially in Africa. The fact that the null hypothesis of the coefficients of the asymmetric variables equals zero ($\chi_i = \gamma_i$) is rejected using the Wald test in all the regressions suggests that the difference between these two magnitudes is statistically significant, thus, establishing the need to incorporate asymmetric into the relationship.

Other control variables included in the model have a positive and significant effect on output in the region. Real activity responds positively to both fiscal and monetary policies. This result shows that government/monetary authority expansionary policies are beneficial to growth in Africa. This is in tandem with existing studies (Bahmani-Oskooee & Kandil, 2009; Hussain et al., 2019) that increase in government expenditure and money supply boost economic activities. Furthermore, the diagnostic indicators of the models are in the right magnitude. For instance, the Sargan test of over-identifying restrictions shows that the instruments used for the two-step GMM are valid and the model is free from second-order serial autocorrelation (AR(2)). Similarly, the root mean square error (RMSE) suggests that the error of the AMG model is minimized.

## Conclusion

In this paper, one of the most important questions in monetary and international economics is being revisited; that is the effect of exchange rate on output, and whether output response to exchange rate asymmetrically in developing countries. Since it has been established in the literature that the impact of exchange rate is mostly felt by developing countries, this study focuses on twenty countries in Africa between 2005 and 2019. The real exchange rate was decomposed into appreciation (negative shocks) and depreciation (positive shocks) using a refined method of Granger and Yoon (2002). The objectives of the study are achieved using three estimation techniques, namely; two-step system General Method of Moment (GMM), Driscoll-Kraay (D-K), and Augmented Mean Group (AMG) which account for the problem of endogeneity and cross-sectional dependence.

The outcome of this study provides an interesting yet surprising result. The result reveals that the response of output to the depreciation of the real exchange rate differs significantly from the appreciation of the exchange rate in the region, thus confirming the presence of asymmetric structure in the real exchange rate in the region. Specifically, real exchange rate appreciation has a negative and significant effect on output, while on the other hand real exchange rate depreciation has a significant positive effect. This result shows that output in the region benefits from the depreciation of the exchange rate while appreciation hinders it. Further, the result shows that the region should not fear real exchange rate depreciation, rather real exchange rate appreciation should be dread in the region. The results are robust to different estimation techniques.

These results have some policy implications. First, the region needs to be fully liberalized and open to international trade to benefit from the depreciation of the real exchange rate. This will lead to an increase in the tradeable sector of the economy in the medium run, while in the long run, it will have a positive outcome on aggregate output. Similarly, overvaluation of the real exchange rate should be avoided, since it makes the region less competitive in terms of trade, thus, a decline in economic growth. However, caution needs to be taken in depreciating the real exchange rate beyond the threshold level, since most developing countries finance their project, and import most of their materials (raw and finished products) in foreign currency mainly US dollar which might likely have a recessionary impact on the economy. Lastly, policymakers should maintain competitive exchange rate policies that will stabilize the real exchange rate around its equilibrium level.

Also, it is imperative to note that this study has contributed significantly to the debate on the asymmetric effect of real exchange rate on output in African countries, however, non-availability of data on essential variables such as real exchange rate for some countries reduces the scope of study to twenty countries. Further, subsequent studies can extend this work to other developing countries and account for the cross-sectional dependence that is inherent in panel data.

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**Appendix 1.** List of Countries

| | | | |
|---|---|---|---|
| Algeria | Burundi | Cameroon | Central African Republic |
| Congo | Cote d'Ivoire | Equatorial Guinea | Gabon |
| The Gambia | Ghana | Lesotho | Malawi |
| Morocco | Nigeria | Sierra Leone | South Africa |
| Togo | Tunisia | Uganda | Zambia |

**Appendix 2.** Measurement and Description of Data

| Variables Definition | Measurement | Source |
|---|---|---|
| Real Gross Domestic Product (GDP) | Constant 2005 in foreign currency unit ($) | World Development Indicator (WDI), 2018 edition |
| Real Effective Exchange Rate (RER) | Price of a US Dollar in terms of domestic currency (2010=100). | World Development Indicator (WDI), 2018 edition |
| Broad Money (BM) | Broad Money in terms of Domestic Currency as a percentage of GDP | World Development Indicator (WDI), 2018 edition |
| Government Expenditure (GEX) | Gross national expenditures as Percent of GDP | World Development Indicator (WDI), 2018 edition |