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*Joseph Chukwudi Odionye**
*Jude Okechukwu Chukwu***

THE ASYMMETRIC EFFECTS OF CURRENCY DEVALUATION IN SELECTED SUB-SAHARAN AFRICA

ABSTRACT: *Economic activities in many sub-Saharan African (SSA) countries have weakened markedly in the last few years, with deterioration in trade balances, increasing foreign reserve depletion, and exchange rate depreciation. This situation has led to a call by the International Monetary Fund for more flexible exchange rate adjustment and even currency devaluation to reverse the economic downturn. This call for devaluation has generated controversy among economists and policymakers in these countries and has revived the need to study the effects of devaluation on economic output in SSA countries. This study therefore examines the asymmetric effects of currency devaluation as a policy shift on economic output between 1980 and 2019 in six selected SSA countries, namely Ghana, Kenya, Tanzania, Mozambique, Nigeria, and Malawi. The study employs the smooth transition regression (STR) model to determine the relative asymmetric responses of economic output to devaluation and non-devaluation regimes. The results of STR are mixed, as devaluation asymmetrically impacts positively and significantly on economic output in Ghana, Kenya, Tanzania, and Mozambique, but is insignificant in the case of Nigeria and Malawi. This mixed result suggests that the impact of currency devaluation on economic output differs across countries depending on the structure and size of the economy, the nature of goods produced, and the supportive policies in place, among other things. The policy implication of the findings is that policymakers in various countries should understand the peculiarity of core macroeconomic variables in order to design and implement robust policies.*

KEY WORDS: *asymmetric effects, currency devaluation, economic output, Africa.*

JEL CLASSIFICATION: C58, F33, N17, O47.

* Abia State University, Uturu, Nigeria, E-mail: josephodionye@yahoo.com
** University of Nigeria, Nsukka, E-mail: jude.chukwu@unn.edu.ng

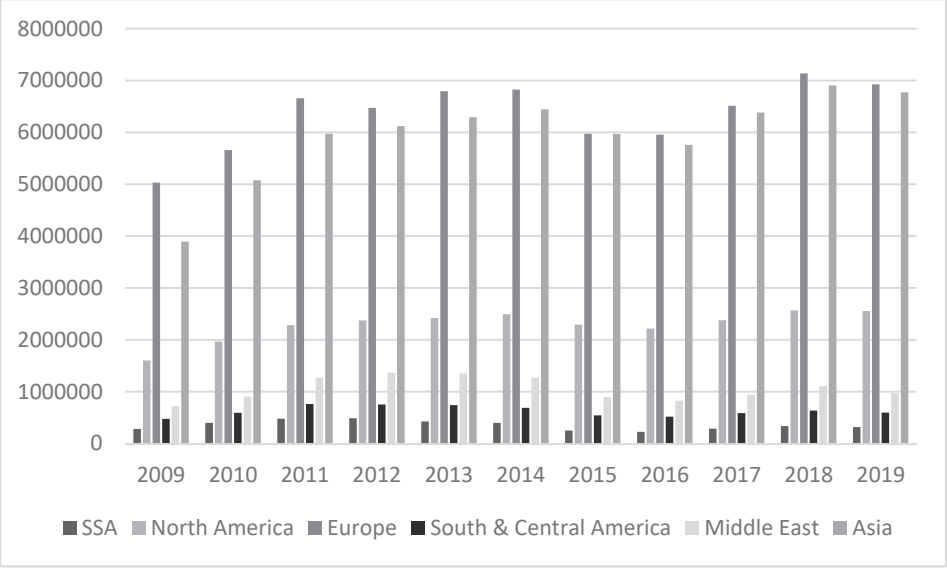
1. INTRODUCTION

Currency devaluation is often regarded as an essential policy instrument in the stabilisation of an economy's external sector. Theoretically, currency devaluation or exchange rate depreciation improves the terms of trade by raising the price of imported goods and services and lowering the price of exports, thus leading to an improvement in a country's balance of payment position. This improvement in foreign sector operations may lead to an expansion of aggregate output and employment in the macroeconomy. This has led many developing countries, including in sub-Saharan Africa (SSA), to devalue their currencies or operate a more flexible exchange rate system at one time or the other since the 1980s (Rawlin, 2011; World Economic Outlook, 2014).

However, the deterioration in sub-Saharan Africa's trade balances during times of devaluation and a flexible exchange rate raises questions regarding the region's competitiveness. The region's share of world trade has been infinitesimal. As recorded by the World Trade Organization (2020), in 2000 the SSA share of world trade was 1.5%, while the developed countries accounted for 65%. By 2013, SSA accounted for about 2.3% of world trade and developed countries for 50.1%. In 2015 SSA's percentage share of world trade had declined to 1.9%, rising slightly to 2.1% in 2019, while that of developed countries was 53.7% in 2015 and increased to 56.6% in 2019. When compared with the total exports of other regions between 2009 and 2019, depicted in Figure 1, SSA's share of exports remains the lowest. This further raises the question of whether a policy of currency devaluation has ever enhanced growth through an improvement in trade.

However, many economists argue that it is wrong to generalise the effects of devaluation on output, as the state of the economy, the nature of goods produced, and other supporting economic policies can influence the effectiveness of devaluation on the economy (Mills and Pentecost, 2001; World Economic Outlook, 2015). This suggests that attributing the poor trade performance of SSA in the international markets to the effects of devaluation without a proper investigation is unscientific; hence in this study we investigate the asymmetric effects of currency devaluation on economic output in selected SSA countries using a regime switching model.

Figure 1: Total exports by region, 2009-2019



Source: World Trade Statistics 2020.

Many researchers have empirically investigated the effects of currency devaluation on output in both developed and developing economies, but their empirical findings remain mixed and controversial. Whereas some studies find devaluation effects to be expansionary (Maehle et al. (2013) for Ghana, Kenya, Malawi, Mozambique, Tanzania, Uganda, and Zambia; Brixiona and Ncube (2014) for Zimbabwe; Klau (1998) for the Communauté Financière Africaine (CFA) and non-CFA countries), others find devaluation effects to be contractionary Fouopi (2012) for CFA countries; Kamal (2015) for 33 developed and developing countries; Pal (2014) for India; Alawin et al. (2013) for Jordan; Onwuka and Obi (2015) for Nigeria, Ghana, Kenya, Malawi, Zambia, and Mali; Miteza, (2006) for Poland, Hungary, Czech Republic, Slovakia, and Romania). Studies by Ayen (2014) for Ethiopia, Alemu (2014) for 14 Asian countries, and Datta (2012) for Pakistan, to mention but a few, find mixed results. Almost all the studies reviewed except Pal (2014) for India and Cheikh (2013) for 12 European countries use real exchange rate as a proxy for devaluation without considering currency devaluation as a policy shift. Anecdotal evidence suggests that almost all SSA countries have devalued their currencies at one point or the other. These studies did not account for structural breaks in the unit root test. Perron (1989;

1997) shows that failure to allow for an existing structural break in the series leads to a bias that reduces the ability to reject a false unit root null hypothesis. This study departs from previous studies by accounting for the effects of structural breaks as well as employing a regime switching model. Against this backdrop, it investigates the asymmetric effects of currency devaluation on economic output in selected sub-Saharan African countries using the Smooth Transition Regression (STR) model.

2. LITERATURE REVIEW

Theoretically, currency devaluation or exchange rate depreciation (in a flexible exchange rate system) is expected to improve the balance of payments (BOP) and thereby enhance economic output. However, there has been serious theoretical debate as to whether devaluation is expansionary or contractionary, especially in developing countries. Viewpoints in the literature diverge and are broadly classified into two main theoretical paradigms, traditionalist and structuralist. The traditionalists are of the view that devaluation is expansionary, while the structuralists are of the view that devaluation can produce contractionary effects depending on the existing economic structure (Cooper 1971; Caves, Frankel, and Jones 1996; Krugma and Taylor (1978); van Wijnbergen 1986; Edwards 1986). The traditionalist views focus on the elasticity theory, Keynesian theory, and monetarist theory. The structuralists explain two channels through which devaluation might adversely affect macroeconomic performance, namely demand-side and supply-side channels (Acar, 2000). Studies by Cooper (1971), Caves, Frankel and Jones (1996), Krugma and Taylor (1978), van Wijnbergen (1986), and Edwards (1986), among others, explain the following channels through which devaluation may create adverse effects on aggregate demand and lead to a decrease in output and employment.

2.1 Empirical Studies

The many empirical studies have used different methods to test the conflicting theories regarding the effect of currency devaluation or depreciation on economic performance. While some studies have performed a cross-country analysis of Asian countries, others study country-specific effects, while only a very few perform a cross-country study of SSA countries.

Studies on the impact of currency devaluation on economic output abound for Asian countries and emerging economies, notably Miteza (2006), Upadhayaya et al. (2013), Christopoulos (2004), and Bussiere (2010). Miteza (2006) investigates the impact of currency devaluation on aggregate output for 5 transition economies – Poland, Hungary, Czech Republic, Slovakia, and Romania – between 1993 and 2000, using panel unit root and panel cointegration tests to establish whether there is integration and a long-run relationship between aggregate output and currency devaluation. The study uses real exchange rate as a proxy for devaluation, while industrial production is used to proxy real GDP because of non-availability of data for some of the countries. The empirical results suggest evidence of a long-run relationship between aggregate output and devaluation. The study finds that devaluation has adverse effects in the long run.

Similarly, Upadhayaya, Rainish, Kaushik, and Bhandari (2013) examine the effects of currency devaluation on total output for 4 South-East Asian countries from 1980 to 2010. The study employs panel unit root and panel cointegration tests. An empirical model that includes monetary, fiscal, and exchange rate variables is formulated and two versions of this model are used. The first model includes real exchange rate while the second includes nominal exchange rate and price ratio. The empirical results suggest that currency devaluation is contractionary in both the short and medium term; hence, the negative effect comes from changes in the nominal exchange rate.

Basirat, Nasirpour, and Alireza (2014) investigate the effect of exchange rate fluctuations on economic growth in 18 selected developing countries over the period 1986 to 2010, taking into consideration the rate of financial market development. To justify the rationale for considering the rate of financial market development the study argues that the effect of exchange rate fluctuations varies between countries, and that one of the factors that determines this variation is country-specific financial market efficiency. Employing panel data analysis for 18 countries, the results suggest that the effects of exchange rate fluctuations and financial development on economic growth are negative and significant.

Christopoulos (2004) investigates the effect of currency devaluation on output expansion in a sample of 11 Asian countries between 1968 and 1999. The study employs a panel unit root test and panel cointegration test to confirm the

existence of a long-run relationship in 5 of the 11 countries. The study finds that devaluation exerts a negative impact on output growth, while devaluation improves output growth for 3 of the countries. In related studies but for different economic regions, Kalyoncu, Artan, Tezekici, and Ozturk (2008) examine the effect of currency devaluation on output level for 23 OECD countries. The study employs the OLS estimation technique as well as unit root and cointegration tests. Their result, similar to that of Christopolus (2004), shows that in the long run, output growth is affected by currency devaluation in 9 out of the 23 countries. In 6 countries out of the 9, devaluation exerts a negative impact on output growth, while it improves output in 3 countries. Thus, their empirical results are mixed.

The few studies that investigate the impact of currency devaluation on economic output in sub-Saharan African countries include Klau (1998), who examines the role of exchange rate policies on inflation and output in the Communauté Financière Africaine (CFA) countries with a fixed exchange rate regime, and non-CFA countries in Sub-Saharan Africa with a more floating exchange rate policy. The study adopts a panel estimation technique for 22 SSA countries. It finds that devaluation impacts positively on output, and that exchange rate appreciation leads to a lower rate of inflation in the two groups. In a related study, Fouopi (2012) investigates the effects of currency devaluation on output in Communauté Financière Africaine (CFA) countries, employing panel regression estimation and using real effective exchange rate as a proxy for currency devaluation. The empirical results, which contradict Klau (1998), show that devaluation has no impact on output growth in CFA countries.

Maehle, Tefeira, and Khachatryan (2013) review different exchange rate policy reforms in selected SSA countries and their associated economic performance during and after the reforms. They perform a critical review of exchange rate regimes in 7 SSA countries – Ghana, Kenya, Malawi, Mozambique, Tanzania, Uganda, and Zambia – using descriptive statistics, and posit that before the reforms these countries shared common features of extensive foreign exchange rationing, large black-market premia, and low per capita real income. However, after liberalisation, those countries that successfully reformed were markedly different. Rationing and parallel market premia became a thing of the past and their per capita income increased tremendously.

Onwuka and Obi (2015) examine the relationship between the real exchange rate volatility of Nigeria and the G-3 countries, and economic growth in 6 selected sub-Saharan African countries (Nigeria, Kenya, Ghana, Mali, Malawi, and Zambia) using quarterly data from 1980Q1 to 2013Q4. They employ the Kao and Johansen-Fisher combined cointegration test and the fully modified OLS (FMOLS) of Philips and Hansen to determine the long-run relationship between variables. Their result suggests evidence of a stable long-run relationship between model variables from 1980 to 2001 but is inconclusive for the period 2002 to 2013. It further shows that exchange rate volatility seems to have depressed economic growth in both periods.

Alege and Osabuohien (2015) investigate the nexus between exchange rate variations and imports and exports in sub-Saharan African countries using the panel data analytical technique. The empirical results suggest a low degree of responsiveness in both exports and imports to exchange rate movements. The study concludes that exchange rate depreciation would worsen the trade balance in the region. The study by Memiago and Eita (2017) on the impact of exchange rate movements on trade balance supports the findings of Alege and Osabuohien (2015).

Memiago and Eita (2017) examine the impact of changes in exchange rate on imports, exports, and trade balance in SSA using panel data analysis for 39 SSA countries between 1995 and 2012. The empirical results show a direct relationship between exchange rate variation and imports. The study concludes that a policy of exchange rate depreciation may inhibit the economy and may not have the desired effect on exports.

All the studies reviewed employ panel data analysis in their analytical frameworks and use exchange rate as a proxy for currency devaluation, without taking cognisance of currency devaluation as a policy shift. This study departs from previous studies in the region and adds to the existing literature by investigating comparatively how economic output responds asymmetrically to a devaluation regime and a non-devaluation regime using the smooth transition regression model by Terasvirta (1998, 2004), in line with Cheikh (2012) and Pal (2014).

3. METHODOLOGY AND DATA

This study employs a regime switching model by Terasvirta (1998, 2004), known as Smooth Transition Regression (STR), to model the asymmetric effects of currency devaluation on economic output in 6 selected sub-Saharan African countries, namely Nigeria, Ghana, Kenya, Tanzania, Mozambique, and Malawi. Given that in the sample period the selected countries practised both flexible and fixed exchange rate regimes at different times, the study uses devaluation and depreciation interchangeably (see IMF, 2019; CBN, 2016; Maehle et al., 2013; Pauw, Dorosh and Mazunda, 2013; Kapur et al., 1991). Data for the study are from the World Development Indicator (WDI 2016, 2019) and the Penn World Table (PWT) covering the period 1980 to 2019. GDP, GEX, and MS data are from WDI (2016, 2019) and nominal exchange rate is from PWT. The selected countries cut across oil exporters, middle-income, low-income, and fragile countries, as recently classified in World Economic Outlook (2016). To determine the order of integration of the model variables the study employs the Zivot-Andrews (1992) unit root test with structural breaks and the ADF test for variables without evidence of a break point.

3.1 Smooth Transition Regression (STR) Model

The smooth transition regression (STR) models transition as a continuous process depending on the transition variable. The STR model assumes a smooth change of economic variable from one regime to another and allows the incorporation of regime-switching behaviour both when the time is unknown with certainty and when there is a short and smooth transition to a new regime, as well as capturing nonlinearity in model variables (Terasvirta, 1998, 2004; Cheikh, 2012; Pal, 2014).

The general form for the STR model is given by:

$$y_t = \beta' x_t + \phi' x_t \, \mathrm{G}\left(S_t; \gamma, c\right) + \mu_t \tag{1}$$

where $\mu_t \sim iid\left[0, \sigma^2\right], x_t = \left(w_t', x_t'\right)'$ and $\left((m+1)\times 1\right)$ is the vector of independent variables, with β representing the linear parameter and ϕ denoting the nonlinear parameter(s). *G* is the continuous transition function bounded between 0 and 1, where 0 represents one exchange rate regime (baseline point), in this case the

non-devaluation period, and 1 represents the devaluation regime and this depends on *S*, the transition variable; γ measures the speed of transition between the two regimes; and *c* measures the threshold effect. According to Terasvirta (2004), the candidate for the transition variable is one of the explanatory variables, lag of the dependent variable and trend value (t). The first step in the modelling process is to choose the transition variable, which is done by testing the null hypothesis of each of the possible transition variables. The next step is to choose the transition function, which is based on a sequence of nested hypotheses that test the order of polynomials in the auxiliary given below:

$$y_t = b_0 x_t' + b_1 \left(x_t' S_t \right) + b_2 \left(x_t' S_t^2 \right) + b_3 \left(x_t' S_t^3 \right) + \mu_t \tag{2}$$

under the null hypotheses:

$$H_{o4} : b_3 = 0 \tag{3}$$

$$H_{o3} : b_2 = 0 | \ b_3 = 0 \tag{4}$$

$$H_{o2} : b_1 = 0 | \ b_2 = b_3 = 0 \tag{5}$$

The three hypotheses above are tested with a sequence of F-tests named F_4, F_3, and F_2 respectively. If the rejection of F_3 is the strongest (has the smallest p-value), LSTR2 or the ESTR model is chosen, while LSTR1 is chosen as the appropriate model if F_4 or F_2 has the smallest p-value (Terasvirta, 2004).

3.2. Model Set-up

Following Pal (2014) and Cheikh (2012), the STR model is given by:

$$GDP_{it} = \alpha + \sum_{j=0}^{p} \theta_{ij} RER_{it-j} + \sum_{j=0}^{p} \delta_{ij} MS_{t-j} + \sum_{j=0}^{p} \eta_{ij} GEX_{it-j} + G(S_{it}; \gamma, c) \left(\sum_{j=0}^{p} \phi_{ij} RER_{it-j} \right) + \mu_{it} \tag{6}$$

where GDP at constant price is expressed in billions of the local currency, GEX is measured as gross national expenditure at constant local currency, and MS is measured as broad money supply at current local currency. Real exchange rate is measured as the product of the nominal exchange rate and countries' price ratio

(P*/P). P* is proxied by the US wholesale price index (2000=100) and p is the domestic CPI. Nominal exchange rate is the ratio of national currency to the US Dollar. In line with the theory, an increase in the real exchange rate (RER) means domestic currency depreciation in real terms and this leads to an increase in economic output through improvement in BOP (World Economic Output, 2016). Theoretically, an increase in money supply (MS) drives real money balances above the level regarded as optimal by economic agents. This leads to an increase in expenditure from a given income and thus stimulates imports, increases money demand, and leads to a BOP deficit (Anoke, Odo, and Ogbonna, 2016; Adeyemi, Oseni, and Tella, 2020). Government expenditure (GEX) is expected to influence BOP positively through increase in income or through reduction in absorption capacity (Frankel, 1999; Alexander, 1952, 1959).

4. EMPIRICAL RESULTS AND FINDINGS

The study first tested for a break point in each of the model variables using the Bai-Perron (2003) multiple break point test, given the anticipation of a structural break in the model. The result shows evidence of a break point in all model variables. Therefore, the Zivot-Andrews (1992) unit root test with structural break was employed and the result is summarised in Table 1. As expected, the unit root test results indicate that most of the variables were stationary after first difference. Also, the result shows that the variables were integrated of different orders for all selected SSA countries except Malawi and Tanzania. Thus, further tests were based on their respective order of integration to avoid spurious results.

Table 1: Summary of Zivot-Andrews unit root test

Country	Nigeria		Ghana		Kenya		Malawi		Tanzania		Mozambique	
Variables	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**	**Unit Root Stat/ (Crit)**	**I (d)**
RER	−5.43* (−4.93)	1	−5.77** (−5.57)	0	−6.20** (−5.57)	0	−6.91** (−5.57)	1	−6.51** (−5.34)	1	−8.09** (−5.34)	0
GDP	−6.47** (−5.57)	1	−7.89** (−5.57)	0	−7.82** (−5.57)	1	−8.31** (−5.34)	1	−5.09* (−4.93)	1	−5.91** (−5.57)	0
MS	−6.09** (−5.34)	0	−5.96** (−5.57)	1	−6.02** (−5.57)	0	−7.22** (−5.57)	1	−5.84** (−5.34)	1	−5.59** (−5.34)	2
GEX	−8.29** (−5.57)	1	−7.73** (−4.8)	1	−6.05** (−5.57)	0	−6.05** (−5.34)	1	−5.08* (−4.93)	1	−7.16** (−5.57)	1

Note: Figures in parenthesis are critical values. ** (*) denotes statistically significant at 1% and 5% levels of significance respectively. I(d) denote the order of integration of a variable. Source: Author's computation using E-views 9.0

4.1 Determination of Optimum Transition Variable and Function

The first step in the STR estimation is to determine the number of possible transition variables and the system automatically selected the optimum transition variable (Terasvirta 1998; 2004). The study chose exchange rate (RER) as the transition variable, while the optimum maximum lag value was selected to be 2 based on the information criteria. The result of the lag information criteria is presented in Table 2.

Table 2: AR lag order selection criteria results (Transition variable = RER_t)

Information Criteria	**AIC**			**SBC**		
Lag length	**1**	**2**	**3**	**1**	**2**	**3**
Nigeria	52.457	50.982*	55.356	59.876	53.212*	57.293
Kenya	55.398	53.245*	54.209	51.095	50.217*	54.764
Malawi	36.985	36.003*	39.108	37.029	35.026*	35.982
Mozambique	28.576	23.891*	25.096	31.098	29.049*	30.034
Tanzania	36.221*	42.567	38.198	42.896	41.562*	43.987
Ghana	38.456	38.086*	38.896	37.987	36.012*	37.860

Note: * denotes lag order selection by the criterion. AIC: Akaike information criterion. SBC: Schwarz information criterion. Source: Author's computation using JMulTi 4.0

We then tested for linearity against STR in each transition variable to determine the appropriate transition function. The result of the linearity tests is presented in Table 3 below.

Table 3: Linearity tests against STR GDP model with $S_t = RER_t$

	Nigeria	**Kenya**	**Malawi**	**Mozambique**	**Tanzania**	**Ghana**
Null hypothesis	RER_t	RER_t	RER_t	RER_t	RER_t	RER_t
F	1.05E-02	1.32E-01	3.81E-01	3.97E-03	3.97E-03	2.28E-02
F4	NA	1.06E-01	7.18E-01	1.27E-01	1.27E-01	6.48E-01
F3	1.06-02	6.10E-02	7.45E-02	5.21E-01	5.22E-01	3.77E-01
F2	2.38E-07	4.74E-03	1.33E-02	6.27E-04	6.28E-04	1.66E-02
Selected model	**LSTR1**	**LSTR1**	**LSTR1**	**LSTR1**	**LSTR1**	**LSTR1**

Note: The numbers are p-values of F version of LM linearity test. Source: Author's computation using JMulTi 4.0

The decision rule for selecting the transition function is based on a sequence of nested F-tests named F4, F3, and F2. The decision rule is to select the transition function with the smallest p-value of the F-test. In the results in Table 3 above, F2 has the smallest p-value for all the countries, suggesting that logistic smooth transition regression (LSTR1) is the appropriate transition function for all the selected SSA countries.

4.2 The Comparative Impact of Currency Devaluation on Output

The smooth transition regression model was employed to estimate the asymmetric effect of currency devaluation on economic output in the selected SSA countries. The result of the model selection favoured the logistic transition function which is centred very close to zero with a steep slope. This means that the regimes dictated by the non-linear model relate to devaluation (depreciation) with G = 1, versus non-devaluation, G = 0. This implies that we have asymmetric responses of output growth to devaluation and non-devaluation regimes. The results are summarised in Table 4.

The results from the estimated logistic smooth transition regression (LSTR) function, as in Table 4, are divided into three segments: the first segment shows the coefficients of the threshold parameters (c) and the speed of transition (γ) which measures the effect of devaluation as a policy shift. The threshold levels are quite similar (positive) for all the countries except Malawi, with a negative threshold level of –0.003, and are also significant at the 5% level for all the countries except Nigeria. The positive coefficient of threshold parameters suggests that as a country's exchange rate depreciates within the range of that country's threshold level, the country's output will increase, and when it is high and above that level it will lead to a decrease in the country's output level. Kenya has the highest threshold level, followed by Nigeria and Mozambique, with Tanzania having the least. The Kenyan threshold of 3.25 implies that currency depreciation above 325% will adversely affect the economy, but depreciation within the threshold will lead to an increase in output. This high threshold level for Kenya can be attributed to the fact that the Kenyan government was one of the first SSA countries to abolish all barriers to both current account balance and capital account restrictions and accepted the IMF Articles of Agreement (Article VIII) in the early 1990s (O'Connell et al., 2010).

Table 4: STR results of asymmetric impact of currency devaluation on output

Country						
Variable	**Nigeria**	**Ghana**	**Kenya**	**Malawi**	**Tanzania**	**Mozambique**
Threshold (c)	0.431 (0.932)	0.3728* (0.051)	3.254** (0.000)	–0.003* (0.042)	0.341** (0.001)	0.407** (0.008)
Speed of Transition γ	82.261 (0.693)	12.382* (0.031)	236.19** (0.025)	6.391 (0.845)	0.731** (0.0000)	4.781** (0.0001)
G = 0 Non-devaluation Regime						
Constant	–0.016 (0.104)	14.02** (0.0000)	–0.07** (0.001)	–0.042 (0.386)	50.25* (0.043)	65.11** (0.001)
$lnGEX_t$	0.036 (0.188)	–9.661* (0.034)	0.023 (0.17)	0.081 (0.78)	1.03* (0.051)	2.37** (0.000)
$lnMS_t$	0.067* (0.045)	–16.41** (0.002)	–0.712 (0.662)	0.861 (0.189)	1.301** (0.0000)	0.087 (0.134)
$lnRER_t$	0.009 (0.73)	0.051** (0.008)	–0.009* (0.051)	–0.201 (0.561)	2.732** (0.001)	–10.542** (0.000)
G = 1 Devaluation regime						
Constant	26.31 (0.831)	0.104 (0.01)	23.11 (0.67)	0.76 (0.72)	–66.21 (0.09)	–8.99** (0.000)
$lnGEX_t$	0.69* (0.05)	5.19 (0.485)	–0.002 (0.079)	–0.341 (0.931)	9.34** (0.000)	1.713** (0.001)
$lnMS_t$	–63.15 (0.87)	19.32 (0.176)	0.076 (0.44)	–0.871 (0.74)	4.54* (0.05)	0.008** (0.000)
$lnRER_t$	10.34 (0.17)	0.761** (0.0001)	0.008** (0.009)	–0.639 (0.17)	2.020* (0.03)	19.532** (0.001)
R^2	0.876	0.788	0.598	0.602	0.986	0.808
Adj. R^2	0.845	0.767	0.581	0.597	0.953	0.802
ARCH Test	(0.33)	(0.08)	(0.12)	(0.67)	(0.19)	(0.29)
J.B Test	(0.54)	(0.19)	(0.81)	(0.003)	(0.051)	(0.764)
A/C	(0.67)	(0.13)	(0.02)	(0.07)	(0.51)	(0.23)
PC	(0.09)	(0.08)	(0.87)	(0.06)	(0.08)	(0.19)

Note: Figures in parenthesis are p-values of t-statistics. ** (*) denotes statistically significant at 1% and 5% levels of significance respectively. A/C represents LM test for no autocorrelation. PC denotes LM test for parameter constancy. Variables are based on their order of integration. Source: Author's computation using JMulTi 4.0

The threshold coefficient of 0.431 for Nigeria suggests that an exchange rate depreciation above 43.1% will affect the economy negatively. Evidence of this was seen in October 2015 when the exchange rate depreciated above 100% following the 8% devaluation of the naira from N155 to N168. Nigerian GDP grew by –0.36% (year-on-year) in real terms in the first quarter of 2016, the lowest in more

than a decade. The year-on-year inflation rate in Nigeria jumped from 9.3% in October 2015 to 17.6% in August 2016. This was the highest since 2005, as the cost of housing, food and non-alcoholic beverages, and transport surged, mostly due to rising import costs occasioned by a weak naira after devaluation (NBS, 2016; CBN, 2016).

The results further suggest that the transition between two extreme regimes (G = 0 and G = 1) is smooth for Malawi, Tanzania, and Mozambique, while the high gamma coefficient for Nigeria, Ghana, and Kenya indicates a rather abrupt transition (policy change). This result supports the finding of Cheikh (2012), who found Belgium to have a high gamma coefficient compared to 5 other European countries. The gamma coefficient measures the effects of devaluation on output. The gamma coefficients are significant for Ghana, Kenya, Tanzania, and Mozambique since their p-values are less than 0.05, and insignificant for only Nigeria and Malawi. This implies that devaluation as a policy shift has a significant impact on output for Ghana, Kenya, Tanzania, and Mozambique, whereas for Nigeria and Malawi devaluation as a policy shift is insignificant. This mixed result supports the findings of Maehle et al. (2013), who found that some SSA countries that successfully reformed their economies experienced improvements, but some (for example, Malawi) did not.

The results from the second and third segments (devaluation and non-devaluation regimes) show that the coefficients of real exchange rate are positive in both regimes for Nigeria, Ghana, and Tanzania, but are negative for Malawi. In the case of Kenya and Mozambique the coefficients of real exchange rate are negative in the non-devaluation period but positive and significant in the devaluation period. The implication of the result for Kenya and Mozambique, as expected, is that the real exchange rate has a negative but significant impact on the economy before devaluation but a positive and significant impact during the devaluation period. This result supports the conventional wisdom that devaluation is expansionary. In the case of Nigeria, the coefficient of real exchange rate is 0.009% in the non-devaluation period, implying that a 1% depreciation in the exchange rate will increase output by 0.009%, but with the introduction of a new exchange rate policy the coefficient of real exchange rate increased from 0.009% to 10.34%, suggesting that 1% depreciation will increase output by 10.3%. The Ghanaian exchange rate coefficient increased from 0.051%

in the non-devaluation regime to 0.761%, while the Tanzanian exchange rate coefficient declined slightly from 2.73% in the non-devaluation era to 2.02% in the devaluation era with all being significant. The Malawian evidence supports the structuralists' viewpoint which posits that devaluation is contractionary, as the coefficient of real exchange rate remained negative and insignificant in both regimes.

The coefficients of government expenditure (GEX) are insignificant for Nigeria, Kenya, and Malawi, but significant for Ghana, Tanzania, and Mozambique in the non-devaluation segment. While the coefficients of Tanzania and Mozambique are positive and significant, the Ghana coefficient is negative but significant. In the devaluation segment the coefficients of GEX are positive and significant for Nigeria, Tanzania, and Mozambique. This supports the theoretical viewpoint that increase in government expenditure leads to increase in economic output through the multiplier.

The estimated coefficients of money supply (MS) are positive and significant for Nigeria and Tanzania and negative but significant for Ghana is in the non-devaluation era, whereas in the devaluation period only those of Tanzania and Mozambique are significant, which contradicts the theory's postulates. It is worth noting that the results are mixed.

The coefficient of multiple determination (R^2) and its adjusted version (adjusted R^2) show that variation in the regressors significantly account for the variation in the dependent variable, given the high R squared (above 70%) in all countries except Kenya and Malawi, with an R squared of 59.8% and 60.2% respectively.

The quality of the estimated LSTR model was examined by conducting several misspecification tests: the ARCH-LM test, Jarque-Bera (J-B) test, autocorrelation test, and parameter constancy test. The model passed the main diagnostic tests for most countries. In Table 4 the p-value of the ARCH-LM test is greater than 0.05 for all the countries, suggesting no ARCH effect in the model. In the case of the Jarque-Bera test, the p-value shows evidence of normal distribution of the model residual for all the countries except Malawi and Tanzania, whose p-value of the J-B test is less than 0.05. The results further indicate no evidence of serial autocorrelation in the model for all the countries except Kenya, as their p-values

are greater than 0.05. Finally, the result for all countries shows evidence of parameter constancy since the p-value is greater than 0.05.

5. CONCLUSION AND POLICY IMPLICATIONS

This paper has demonstrated an asymmetric effect of devaluation on output growth in Sub-Saharan Africa. The empirical results indicate an asymmetric response of output growth to devaluation and non-devaluation regimes. The threshold levels are positive for all the countries except Malawi, with a negative threshold level of –0.003. This implies that as a country's exchange rate depreciates within the range of the individual country's threshold level the country's output will increase, but above that level it will lead to a decrease in the country's output.

The results further show that currency devaluation has a significant impact on output for Ghana, Kenya, Tanzania, and Mozambique; but has insignificant impact in the case of Nigeria and Malawi. These mixed results suggest that the impact of currency devaluation on output is country-specific, depending on the state and size of the economy, the nature of goods produced, and the supportive policies in place.

Thus, economic policymakers should understand the peculiarities of core macroeconomic indicators in order to design and implement a robust and effective exchange rate policy. For example, devaluation has no significant impact on output in Nigeria and Malawi. The finding of an insignificant impact of currency devaluation on output in Nigeria and Malawi support the structuralists' viewpoint that devaluation can produce contractionary effects in some circumstances.

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