DEVALUATION AND CONSUMER PRICES

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Abstract

In this paper, we estimated the impact of daily and weekly exchange rate devaluations on consumer prices in Africa using 20 African nations as case studies which included Angola, Benin Burkina Faso, Cameroun, Chad, Congo Republic, Cote d'Ivoire, Egypt, Gabon, Ghana, Malawi, Mali, Namibia, Niger, Nigeria, Rwanda, South Africa, Senegal, Togo, and Tunisia. This study used a multivariate DCC-GARCH model. Over the long and short terms, it was discovered that devaluation had a detrimental impact on consumer prices. The study obtained a 100% response of consumer price level to exchange rate devaluation. In particular, the dynamic response of consumer price level to devaluation of currencies was complete as 100% variation in consumer prices was totally accounted for by devaluation of currencies. With both daily and weekly data, the study established that devaluation is a direct and significant predictor of the changes in consumer prices in Africa. We observed volatility persistence with shifting conditional correlations for both consumer prices and currency devaluation. Except for Senegal, other countries studied showed that volatility of currency devaluation and consumer prices at one time or the other (short or long run or both) had recognizable patterns of behavior that can be associated with the other whether inversely or directly. All countries examined have movements in exchange rate devaluation and consumer prices time-varying conditional correlation. Additionally, innovations in a currency devaluation and consumer prices significantly increase impulse responses in themselves during future days and weeks.

Keywords: Devaluation, consumer prices, multivariate DCC-GARCH model, Africa.

JEL Classification. C40, D24, C32

1. INTRODUCTION

Despite the significant variety in inflation performance across the economies, inflation in emerging market economies has usually been low and steady during the mid-2000s compared to the late 1990s. The achievement of the benign

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inflation environment was mostly attributable to the easing of longer-term inflation expectations, while global circumstances, notably the decline in crude oil prices, had a significant role as well (WEO, 2018). With rising interest rates in the United States and the fact that crude oil prices are no longer reasonable, many emerging market economies' currencies have significantly depreciated against the US. The Indian rupee (INR), along with the Turkish lira, Russian ruble, and Argentine peso is one of the major EME currencies whose exchange rate has significantly declined. Other emerging nations, including Brazil, Vietnam, South Africa, China, Colombia, Indonesia, and Pakistan experienced varied degrees of pressure from currency decline. Researchers and policymakers are now more interested than ever in looking into the nature and reasons for such a steep depreciation as a result of the occurrences. More significantly, the dynamics of exchange rate influence on domestic pricing is crucial to the worldwide spread of inflation and economic cycles (Aron, et al. 2014).

The law of one price is the oldest idea that connects prices and exchange rates (LOOP). According to this law, there is a complete currency rate pass-through. Since this law has been demonstrated to be unreliable, several empirical researches have been conducted. The following are the research questions derived from the topic of the research: (1) Does daily exchange rate devaluation affect commodity prices in Africa, and (2) Does weekly exchange rate devaluation affect commodity prices in Africa? Our objective is to estimate and analyze the impact of daily and weekly exchange rate devaluation on consumer prices in Africa. There are five sections in this article. The literature review is offered in section two after the introduction. The approach used to estimate the exchange rate channel is presented in Section 3. Section four presents the data discussion and the findings of the empirical study. The study is concluded in section five.

2. LITERATURE REVIEW

Theoretically, we have the expectation hypothesis. Both CPI inflation and the setting of the nominal exchange rate depend heavily on expectations. This is the expectation theory that forms the basis for analyzing asymmetric exchange rate pass-through (ERPT) has been provided by the adaptive and rational expectation hypotheses. In times of currency appreciation, businesses are less inclined to alter prices than they would be in times of depreciation (Maka, 2013). Businesses may prefer to lower prices during periods of appreciation rather than raise prices during periods of depreciation to maintain market share in a market with imperfect conditions. This is due to the possibility that a company in an oligopolistic market may believe that its rival would match its pricing if it started a price decrease rather than a rise. These cause the firm's apparent demand curve to bend as a result (Sweezy, 1939 and Hall and Hitch, 1939).

Also, an expression that is closely linked to ERPT is price-to-market (PTM) theory, which describes the pricing practices of companies exporting their goods to a destination market after an exchange rate change. The percentage variation in pricing that results from a one percent adjustment in the exchange rate is specifically specified as PTM. Therefore, the magnitude of ERPT will be smaller the more PTM

there is. If there is no PTM, import prices will alter in proportion to the fluctuation in the exchange rate, and ERPT will be finished (Gbosh&Rajan, 2006 in Berger, 2012).

The ERPT in India was also explored by Bhattacharya et al. in 2011. The study used a co-integrated VAR model with six different variables: nominal interest and exchange rates, oil price, domestic price, import price, and domestic price. The study's findings led to a partial ERPT. The analysis also demonstrates that, even if there is no correlation between production and inflation, the presence of a stronger, if partial, pass-through suggests that interest rates may have an impact on inflation through the channels of the exchange rate. They concluded that the best way for monetary policy to manage inflation is through exchange rate regulation.

The PPP theory is based on LOOP which holds that if prices are stated in terms of the same currency across nations, then the same item should be sold for the same price. The PPP when expressed in absolute terms, asserts that national pricing levels should be equal after being converted to a single currency. The relative PPP assumptions state that a currency's depreciation matches the disparity in total price inflation between the two nations in question. The main premise is that there should be a strong connection in aggregate price levels if goods market arbitrage ensures wide parity in prices over a significant range of individual items.

Empirically, Umoru & Amedu (2022) reported that fluctuations in exchange and interest rates had positive effects on commodity prices. Wimalasuriya (2005) looked at how Sri Lankan prices were affected by currency rates. The pass-through impact was estimated by the study using two different methods. According to the data, there is a 50% ERPT in import prices, which means that for every 1% decline in the exchange rate, import prices rise by around 0.5%. Second, the exchange rate pass-through into a series of prices in the "pricing chain" was calculated using a vector autoregressive (VAR) technique.

Oyinlola (2009) looked at how the exchange rate was reflected in several domestic pricing variables in Nigeria. Oyinlola uses VECM, which takes yearly data from 1980 to 2008. The findings showed that there was a long-term association between the exchange rate and domestic prices as proxied by the CPI. For the first time, between 1986Q1 and 2007Q4, Aliyu, et al. (2008) discovered little evidence of ERPT in Nigeria throughout the review period, even though it was large and consistent and somewhat greater in import costs than in consumer prices. For instance, a 1% change in the exchange rate had a four-quarter pass-through effect on import and consumer prices of 14.3% and -10.5%, respectively.

3. METHODOLOGY

The variables used for the study are daily and weekly exchange rate devaluation (exd) and weekly and daily consumer price index (cpi). The weekly cpi was generated random numbers from monthly cpi from the world Bank while the daily cpi was regenerated random statistics from generated weekly cpi using the rand. Data were analyzed using the multivariate DCC-GARCH model, ARDL model, and Panel Structural VAR models were estimated for data analysis. The impulse response and variance decomposition from the SVAR modeled responses of

variables to structural shocks. ARDL measured short and long-term relationships between specified lags of variables as well as short-term adjustments to equilibrium.

The Dynamic conditional correlation (DCC) GARCH model measures if there is interdependence in the volatility of EXD on CPI or vice-versa- for each sampled economy. Unlike the constant conditional correlation(CCC), the DCC is less restrictive and assumes time-varying provisional association. The DCC model as given in equations (1) through (5) also models the variance and covariance directly and their respective flexibility in the form of long or short-term persistence.

3.1. TITLE OF SUBCHAPTER

$$Y_t = \mu_t + \eta_t, \eta_t | F_{t-1} \sim N(0, D_t R_t D_t), \quad (1)$$

$$D_t^2 = diag\{H_t\}, H_t = V_{t-1}(\eta_t) \quad (2)$$

$$H_{i,t} = \omega_t + \alpha_i \eta_{i,t-1}^2 + \beta_i H_{i,t-1}, \quad (3)$$

where $\varepsilon_t = D_t^{-1}\eta_t$,

$$\rho_t = diag\{Q_t\}^{-1/2} Q_t \, diag\{Q_t\}^{-1/2} \quad (4)$$

$$Q_t = \Omega + \alpha \varepsilon_{t-1} \varepsilon'_{t-1} + \beta Q_{t-1}, \Omega = \rho(1 - \alpha - \beta) \quad (5)$$

Where:

$Y_t$is the multivariate process of variables; Vt-1(ηt) is the residual covariance matrix; Qt is the correlation matrix; μt is a vector of conditional means of variables; ω_i, α_i, β_i are parameters, Hi,t is a conditional variance for multi-variables; Rt is the time-varying relationship matrix, and ρ is the unconditional relationship matrix.

ARDL model: the estimated ARDL equation is of the form in equation (6).

$$Y_t = \Upsilon_{0i} + \sum_{i=1}^{p} \delta_i Y_{t-1} + \sum_{i=0}^{q} \beta'_i X_{t-1} + \varepsilon_t \quad (6)$$

Where: Y=vector and X= variables co-integrated; Υ= constant; *p,q*= lag order δ, β=coefficients; $\varepsilon_t = error\ term$

SVAR model. The SVAR model is given in equation (7)

$$\begin{bmatrix} EXD_t \\ CPI_t \end{bmatrix} \begin{bmatrix} 1 & b12 \\ b21 & 1 \end{bmatrix} = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} EXD_{t-1} \\ CPI_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{MDt} \\ \varepsilon_{CPIt} \end{bmatrix} \quad (7)$$

Where $\varepsilon_{EXDt}, \varepsilon_{CPIt}$are uncorrelated structural shocks or innovations.

4. RESULTS

Figure 1 reveals that **v**olatility of daily consumer prices in the countries exhibited significant clustering between 2020 and 2021 years revealing high instability in commodity prices within these most recent years.

Figure 2 shows plots that reveal that currency devaluation is a daily occurrence in most African countries. Furthermore, the highest currency devaluation

volatility exists in countries such as Ghana, Burkina Faso, Benin Republic, and Cote d'Ivoire.

Figure 3 shows weekly exchange rate devaluation charts for the twenty countries. The chart shows high volatility in Benin Republic, Burkina Faso, Cote d'Ivoire, and Ghana. Mali, Namibia, Niger, Senegal, South Africa, Togo, and Tunisia. Other countries of focus- Cameroun, Chad, Congo, Gabon, Egypt, and Rwanda were fairly stable with a few spikes. Charts with breaks or gaps represent periods where currency exchange rates were unchanged during the period. Angola, Congo, Gabon, and Rwanda had the most stable devaluation rates in the period examined. Overall, currencies of African countries experience devaluation as part of the economy but these occur at varied magnitudes.

Figure 4 reveals weekly CPI, which is a standard measure of inflation in specific countries was observed to have large variations every week in all African countries. Overall, price stability as a macroeconomic objective is far from being reached on the continent as depicted by high and largely volatile inflation charts. Trends are similar to daily trends and volatility clustering was found to be higher in the last two years of study- 2020 and 2021.

With how exchange rate devaluation was calculated, Table 1 shows that positive values imply that the units of local currencies used to purchase a unit of the US dollar increased compared to the previous day. Angola had the highest currency devaluation within the period of study, followed by Rwanda, Ghana, Malawi, and Nigeria. The Central African currency had the third highest devaluation in a period after Angola and Rwanda. All positive mean values imply that devaluation of currency is regular in African countries while minimum values taking negative forms reveal that periods exist where the values of local currencies rise above obtainable at a particular period.

Table 1. *Daily and weekly devaluation statistics*

Country	**Mean**		**Maximum**		**Minimum**	
	Daily	***Weekly***	***Daily***	***Weekly***	***Daily***	***Weekly***
Angola	0.009	0.011	32.50	6.500	-0.997	-0.248
Benin	0.000	0.000	0.037	0.012	-0.040	-0.011
Burkina Faso	0.000	0.000	0.037	0.012	-0.040	-0.011
Cameroun	0.000	0.000	0.953	0.317	-0.068	-0.052
Chad	0.000	0.000	0.953	0.317	-0.068	-0.052
Congo rep	0.000	0.000	0.953	0.317	-0.068	-0.052
Cote D'Ivoire	0.000	0.000	0.037	0.012	-0.040	-0.011
Egypt	0.000	0.000	0.717	0.123	-0.054	-0.018
Gabon	0.000	0.000	0.953	0.317	-0.068	-0.052
Ghana	0.001	0.001	0.130	0.029	-0.112	-0.029
Malawi	0.001	0.001	0.503	0.101	-0.091	-0.024
Mali	0.000	0.000	0.037	0.012	-0.040	-0.011

Namibia	0.000	0.000	0.092	0.026	-0.070	-0.026
Niger	0.000	0.000	0.037	0.012	-0.040	-0.011
Nigeria	0.000	0.000	0.419	0.083	-0.143	-0.021
Rwanda	0.003	0.003	9.336	1.687	-0.905	-0.014
S/Africa	0.000	0.000	0.174	0.023	-0.106	-0.026
Senegal	0.000	0.000	0.037	0.012	-0.040	-0.011
Togo	0.000	0.000	0.037	0.012	-0.040	-0.011
Tunisia	0.000	0.000	0.045	0.018	-0.091	-0.007
All	0.001	0.001	32.500	6.500	-0.997	-0.248

Country	**Standard Deviation**		**Kurtosis**	
	Daily	*Weekly*	*Daily*	*Weekly*
Angola	0.433	0.216	4794.5	691.0
Benin	0.007	0.003	5.5	4.0
Burkina Faso	0.007	0.003	5.5	4.0
Cameroun	0.013	0.009	3741.6	1092.4
Chad	0.013	0.009	3741.6	1092.4
Congo rep	0.013	0.009	3741.6	1092.4
Cote D'Ivoire	0.007	0.003	5.5	4.0
Egypt	0.009	0.004	5171.4	927.8
Gabon	0.013	0.009	3741.6	1092.4
Ghana	0.013	0.004	23.1	18.1
Malawi	0.012	0.004	500.3	214.9
Mali	0.007	0.003	5.5	4.0
Namibia	0.010	0.004	8.8	8.4
Niger	0.007	0.003	5.5	4.0
Nigeria	0.011	0.004	326.7	193.2
Rwanda	0.172	0.069	2909.8	595.0
S/Africa	0.010	0.004	20.3	6.2
Senegal	0.007	0.003	5.5	4.0
Togo	0.007	0.003	5.5	4.0
Tunisia	0.006	0.002	18.5	7.4
All	0.104	0.052	72700.3	10855.1

Source: Author's Compilations

The country-based descriptive statistics as reported in Table 2 below for daily CPI reveal that Egypt had the least average rise in prices (CPI=43.4) compared to other African nations studied although Burkina Faso has the lowest peak (maximum) in commodity prices of 110 CPI points. South Africa, Tunisia, and Namibia take the second, third, and fourth places in least mean values on the table. On the largest values, Malawi tops the table of means with 146.52 CPI points. Malawi thus has the largest inflationary trends on average. Malawi is followed by Angola, Nigeria, Ghana, and Rwanda using the mean indicator. Angola was found to have the highest peak in changing commodity prices with 679 CPI points. Weekly

comparison is slightly different with Namibia being the second-least average in CPI, followed by South Africa before Tunisia. Malawi and Angola maintain their top positions as in the daily description.

Table 2. *Daily and weekly price index (cpi) statistics*

Country	Mean		Maximum			
	Daily	*Weekly*	*Daily*	*Weekly*		
Angola	138.5816	134.5081	679.00	658.80		
Benin	93.94059	93.78781	113.00	113.00		
B/Faso	91.07417	90.99381	110.00	110.00		
Cameroun	95.99099	95.91027	126.00	125.40		
Chad	93.90570	93.81331	122.00	121.80		
Congo rep	90.52718	90.41329	127.00	126.20		
Cote d'Ivoire	99.76271	99.67479	121.00	120.40		
Egypt	43.44950	43.10043	121.00	117.20		
Gabon	95.33000	95.27384	125.00	124.80		
Ghana	108.2732	108.2251	342.00	332.60		
Malawi	146.5280	146.3126	495.00	479.00		
Mali	96.51732	96.46952	118.00	116.60		
Namibia	82.27942	55.53124	170.00	124.80		
Niger	97.29581	97.22517	117.00	116.40		
Nigeria	122.5335	122.1733	411.00	402.40		
Rwanda	99.22848	99.21234	167.00	165.60		
S/Africa	74.66283	74.63272	165.00	164.20		
Senegal	95.51032	95.45932	113.00	112.60		
Togo	97.48196	97.40318	123.00	122.40		
Tunisia	81.51750	81.46429	143.00	142.00		
All	96.53832	96.08143	679.00	658.80		
Country	Minimum		Standard deviation			Kurtosis
	Daily	*Weekly*	*Daily*	*Weekly*	*Daily*	*Weekly*
Angola	1.0000	1.000	159.46	158.613	4.643	4.716
Benin	0.0000	15.400	17.969	16.848	7.099	4.132
B/Faso	65.000	65.250	14.552	14.574	1.506	1.501
Cameroun	67.000	67.200	17.007	17.026	1.694	1.689
Chad	61.000	61.000	19.442	19.441	1.467	1.462
Congo rep	0.0000	0.0000	28.532	28.306	5.306	5.055
Cote d'Ivoire	73.000	73.000	13.407	13.456	1.953	1.941
Egypt	13.000	13.000	32.294	33.638	2.848	2.722
Gabon	0.0000	28.400	16.588	15.496	6.134	2.900
Ghana	6.0000	6.0000	94.323	94.338	2.489	2.475
Malawi	0.0000	8.2000	140.80	138.38	2.741	2.757
Mali	74.000	74.500	12.969	12.981	1.511	1.488
Namibia	0.0000	0.0000	56.647	44.572	1.821	1.454
Niger	76.000	76.000	12.105	12.105	1.744	1.738
Nigeria	15.000	15.333	102.22	102.10	3.187	3.162
Rwanda	45.000	45.000	39.229	39.193	1.699	1.695

S/Africa	33.000	33.000	29.627	29.588	2.006	1.978
Senegal	0.0000	25.000	14.823	13.607	13.72	6.947
Togo	73.000	74.000	14.835	14.855	1.563	1.548
Tunisia	49.000	49.200	25.640	25.616	2.443	2.437
All	0.0000	0.0000	66.600	66.472	18.84	18.987

Source: Author's Compilations

The panel dataset for the study variables had unit roots presented in Table 3. CPI was found to be stationary at level for three of the tests and non-stationary in the other two as depicted by p values lower than 0.05. After first differencing, the Levin's & Breitung tests still showed insignificance of the unit root as depicted by the p values above 0.05 (1.00 and 0.98 respectively) Nevertheless, since the other tests employed for the study revealed stationarity, the study assumes that all variables are stationary.

Table 3. *Stationarity statistics*

Variable	I(I)	Levin, Lin & Chu t*	Breitung t-stat	Im, Pesaran& Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square
CPI	I(0)	16.9648 (1.00)	0.64805 (0.74)	-3.49825 (0.00)	330.272 (0.00)	3159.94 (0.00)
	I(1)	720.116 (1.00)	2.14453 (0.98)	-106.038 (0.00)	4601.56 (0.00)	368.414 (0.00)
EXD	I(0)	-739.159 (0.00)	-5.99389 (0.00)	-534.498 (0.00)	1442.45 (0.00)	569.208 (0.00)

Note: * *0.05 level of Significance*

Source: Author's Compilations

From Table 4, all panel cointegration tests on daily and weekly data had the null hypotheses rejected revealing a long run relationship between daily CPI and daily EXD in sampled African countries as well as weekly frequencies of the same variables.

Table 4: *Pedroni residual co-integration results*

	Daily		Weekly	
Tests	*Statistic*	*Weighted Stat.*	*Statistic*	*Weighted Stat.*
Panel v-Statistic	3245.0*(.00)	448.7*(.00)	40.452*(.00)	21.66*(.00)
Panel rho	-4832.8*(.00)	-6315.3*(.00)	-1023.79*(.00)	-1478.76*(.00)
Panel PP-	-823.9*(.00)	-494.9*(.00)	-222.66*(.00)	-211.47*(.00)
Panel ADF-	-923.3*(.00)	-244.9*(.00)	-32.30*(.00)	-7.14*(.00)
rho-Statistic	-4458.2*(.00)		-1008.5*(.00)	
PP-Statistic	-651.9*(.00)		-274.39*(.00)	
ADF-Statistic	-524.1*(.00)		-29.015*(.00)	

Note: * *0.05 level of Significance*

Source: Author's results

Table 5 contains the results from the test for ARCH effects on each variable to determine the suitability of GARCH family models on each country dataset. Overall, thirteen countries were fit for GARCH estimations.

Table 5. *Test results for ARCH effects*

Countries	EXD L-M statistic (p-value)	CPI L-M statistic (p-value)	Remark
Benin	7.96(0.00)	298.03(0.00)	present
Burkina Faso	7.96(0.00)	1.76(0.22)	N/A
Cameroun	4.20(0.04)	34.47(0.00)	present
Cote d'Ivoire	7.96(0.00)	94.29(0.00)	present
Togo	7.96(0.00)	40.13(0.00)	present
Mali	7.96(0.00)	63.28(0.00)	present
Niger	7.96(0.00)	0.035(0.85)	N/A
Senegal	7.96(0.00)	157.53(0.00)	present
Nigeria	28.81(0.00)	0.26(0.60)	N/A
Angola	0.002(0.96)	58.33(0.00)	N/A
Tunisia	6.77(0.00)	8.73(0.00)	present
South Africa	135.72(0.00)	4.38(0.03)	present
Namibia	76.78(0.00)	17.74(0.00)	present
Rwanda	0.003(0.95)	43.28(0.00)	N/A
Congo	0.20(0.64)	29.28(0.00)	N/A
Gabon	4.20(0.04)	341.77(0.00)	present
Chad	4.20(0.04)	11.23(0.00)	present
Ghana	122.45(0.00)	115.54(0.00)	present
Malawi	2.98(0.05)	317.43(0.00)	present
Egypt	0.006(0.97)	4.15(0.04)	N/A

Source: Author's results

Table 6 below reveals DCC GARCH estimates. For Cameroun, the alpha value of the DCC model, -0.0108 ($p=0.00<.05$) reveals that there is a negative and significant correlation between the volatility of daily rates of CPI and the corresponding volatility of EXD. In other words, there is short-term persistence of both variables implying that small changes in rates are followed by small changes, and larger changes are followed by large changes in the short run. The beta value at 0.4819 reveals a positive correlation between the volatilities of CPI and EXD However, the p value is 0.22 ($p>.05$) and thus signifies that the correlation of volatilities of CPI and EXD for Cameroun is insignificant in the long term. Overall, a sum of DCC coefficients implies that conditional correlation in Cameroun's CPI and EXD changes with time.

In like manner, South Africa had no significant correlation in the short term (-0.0035; $p=0.82>.05$) but had volatility behaviors for daily values of both variables correlating significantly in the long term (0.6418; $p<.05$). There was also a noticeable turn in nature of volatility direction from inverse (negative coefficient) to direct (positive coefficient). South Africa's weekly-assigned values had similar significance patterns with non-significance of short-term correlations though the

coefficient became positive rather than negative (0.0112; p>.05) and significance of long term (0.6481; p>.05). Togo also had similar correlation patterns recording dynamic conditional correlation overtime on daily and weekly bases. Tunisia, like South Africa, had no visible correlation in the short run but the magnitude of significance increased as well as nature of the association changed from negative to positive (-0.0028: p=0.14; 0.83227: p=0.00). Although on weekly rates, Tunisia has positive coefficients in both the short and long run (0.0198 and 0.9459). Significance patterns of weekly rates remain unchanged with insignificance found in the short run (p=.18>.05) and significance in the long run (p=.00<.05).

Angola had EXD and CPI volatilities having a positive conditional correlation in the short term (0.6043). The correlation was also found to be direct in that volatility of EXD is associated with volatility in a similar direction and magnitude as the volatility of CPI in the short term (p<.05). In the long term however, the nature of the relationship remains the same as depicted by the positive coefficient (0.0659), but this is found to lose significance with p-value greater than 0.05 (0.76). Angola's volatilities of weekly variable rates were consistent with the short term relationship observed in that of daily rates (positive and significant). However, unlike the daily rates, positive and significant correlation continues in the long term.

The short and long-run DCC estimations for Chad were both negative at -0.0107 and -0.05 respectively. Only the short-run estimation had p-value of less than 0.05 implying that there is a short run, a negative correlation between commodity prices and exchange rate devaluation in Chad but this does not extend to the long run. The conditional correlation in the model was found to be dynamic given that the sum of both coefficients is less than 1. Still, within Chad, the weekly frequency of data had 0.0873 and 0.7943 short and long-term coefficients revealing a direct connection between the consumer price index and exchange rate devaluation. Benin also recorded the same pattern of correlation and significance though in different magnitudes both in the short run (-0.0273; p>.05) and long run (-0.05; p<.05) respectively. The weekly volatilities for both variables also correlated significantly and negatively in the short run (-0.05; p<.05) but this reversed in the long run to a positive significant relationship (0.3095; p<.05).

Gabon had DCC Coefficients of -0.0108 and -0.05 found to be significant at the 5% level of significance. For Gabon, a significant negative correlation exists between EXD volatility and CPI volatility in the short run and it lingers into the long run. Differently stated, the volatilities of both variables move in opposite directions such that the higher volatility of one will be accompanied by lower volatility of the other. Cross volatility is persistent in the long and short term. Gabon had inconclusive correlational weekly volatility results as standard errors were not computed. Namibia also had negative coefficients for long and short-run measurements of -0.003 and 0.05, respectively. However, while the correlation was insignificant in the short run (p=.66>.05), correlation between the volatilities of both variables became evident in the long run (p=.00<.05). Weekly rates had a direct association contrary to daily negative ones with short and long run coefficients at

0.0228 and 0.8421. Significance is unreached in the short run (p=.49>.05) but it becomes evident in the long run (p=.00<.05).

Ghana had CPI and EXD volatilities with significant correlations in the short term and long term with coefficients of -0.0049 and 0.8794 (p<.05). CPI and EXD volatilities had negative correlations in the short term. However, the nature of the association reverses in the long term such that volatilities of both variables begin to move in the same direction unlike in opposing directions found in the short term. Weekly estimations were inconsistent as revealed by non-computed errors and t-stats. Malawi and Mali had similar results with coefficients -0.0005 and 0.3747 (p<.05) for the former, and -0.0114 and 0.6242 (p<.05) for the latter. Weekly volatilities of study variables in Malawi had short-term and long-term correlations of 0.1669 and 0.6942, respectively. A significant correlation is observed in the short-term (p=0.00<.05) and extends to the long run (p=0.00<.05). However, rather than an inverse pattern of correlation in the short term, a direct relationship is observed through short and long runs. Mali's correlation for weekly volatility had no correlation in both long and short run with p-value larger than 0.05 in both DCC parameters. The model still maintained though that conditional correlation was time-varying for the country. Senegal had a different result with no p-value less than 0.05. In other words, there is no significant correlation between EXD volatility and CPI volatility in the country.

Table 6. *Multivariate GARCH DCC output*

Countries	Daily			Weekly		
	DCC (Arch)	DCC (Garch)	CC Persistence	DCC (Arch)	DCC (Garch)	CC Persistence
Togo	-0.0077	0.4541	0.4464	-0.05	0.3612	0.3112
	-1.46	842.529	-	-355.208	56.594	-
	0.14	0.00	-	0.00	0.00	-
Tunisia	-0.0028	0.83227	0.82947	0.0198	0.9459	0.9657
	-1.46	842.529	-	1.313	23.374	-
	0.14	0.00	-	0.18	0.00	-
Senegal	-0.0016	0.7532	0.7516	0.2073	-0.05	0.1573
	-1.776	0.357	-	19.286	-3.599	-
	0.07	0.72	-	0.00	0.00	-
Angola	0.6043	0.0659	0.6702	0.0995	0.7983	0.8978
	4.177	0.3	-	45.712	93.829	-
	0.00	0.76	-	0.00	0.00	-
Malawi	-0.0005	0.3747	0.3742	0.1669	0.6942	0.8611
	-138.458	14.457	-	3.751	7.629	-
	0.00	0.00	-	0.00	0.00	-

Namibia	-0.003	-0.05	-0.053	0.0228	0.8421	0.8649
	-0.434	-6.681	-	0.688	3.577	-
	0.66	0.00	-	0.49	0.00	-
SA	-0.0035	0.6418	0.6383	0.0112	0.6481	0.6593
	-0.223	350.838	-	0.579	17.095	-
	0.82	0.00		0.56	0.00	-
Ghana	-0.0049	0.8794	0.8745	0.1	0.85	0.95
	-32.945	114.73	-	na	na	-
	0.00	0.00	-	-	-	-
Benin	-0.0273	-0.05	-0.0773	-0.05	0.3095	0.2595
	-22.556	-0.667	-	-237.182	144.69	-
	0.00	0.5	-	0.00	0.00	-
Mali	-0.0114	0.6242	0.6128	-0.0147	0.1873	0.1726
	-262.194	389.839	-	-0.569	0.243	-
	0.00	0.00	-	0.56	0.80	-
Chad	-0.0107	-0.05	-0.0607	0.0873	0.7943	0.8816
	-31.253	-0.545	-	3.356	11.331	-
	0.00	0.58	-	0.00	0.00	-
Gabon	-0.0108	-0.05	-0.0608	0.1611	0.8546	1.0157
	-430.31	-24.172	-	na	na	-
	0.00	0.00	-	-	-	-
CAM	-0.0108	0.4819	0.4711	-0.0245	0.3196	0.2951
	-115.209	1.213	-	-122.29	8.372	-
	0.00	0.22	-	0.00	0.00	-

Source: Author's results

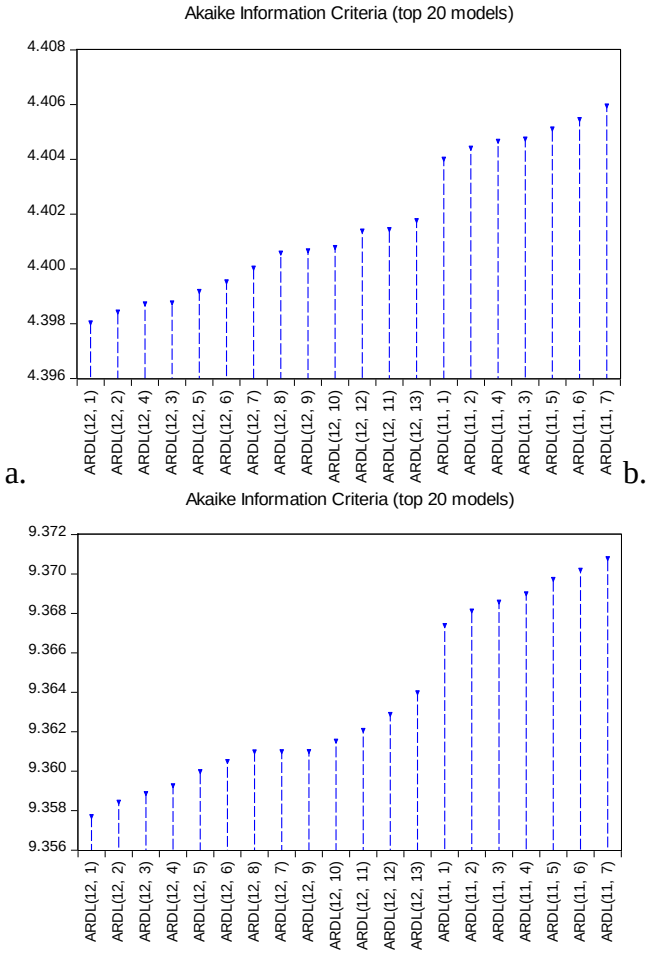

Figure 5*. CPI-EXD ARDL Model selections- (a) daily frequency; (b) weekly frequency*
Source: Author's plot

Figure 5 above are the top 20 models selected automatically for the estimation of short and long-run relationships between CPI and EXD with CPI as the dependent variable. The ARDL estimates displayed in Table 7 reveal that the (12,1) model was the most efficient model. In other words, values of CPI for 11 immediate past periods are included in the model. In the short run of Table 6, the consumer price index was found to be negatively and significantly affected by its value in the past 11 days ($p<.05$). The value of CPI 2 days ago was most significant in the model. Today's CPI consequently goes in the opposite direction of a point change in yesterday's CPI by 0.8 index points; CPI for 2 days ago by 0.66 points; CPI for 3 days ago by 0.517 points; CPI for 4 days ago by 0.4 points; CPI for 5 days ago by 0.325 points; CPI for 6 days ago by 0.304 points; CPI for 7 days ago by 0.24 points; CPI for 8 days ago by 0.22 points; CPI for 9 days ago by 0.17 points; CPI for 10 days ago by 0.13 points; and CPI for 11 days ago by 0.06 points.

Exchange rate devaluation impacted CPI with a coefficient of 0.592% on a daily basis while on a weekly basis, devaluation impacted CPI by 0.97%. Simply

stated, falling local currency values cause commodity prices within national boundaries to rise. The probability value was lesser than 0.05, revealing that the impact of EXD was totally significant. For the long-run equation, exchange rate devaluation also had significant impact on CPI with a coefficient of 18.67 ($p<.05$). In other words, a percentage increase in EXD will cause CPI to increase by 18.67 percent. Weekly statistics maintained positive influence of lagged values of CPI on the current price level. However, some lagged values were found to be insignificant, specifically lag 2, and lag 10. The third week from the current week had the largest impact of 0.545. in sum, Exchange rate devaluation had significant impact on commodity prices at short and long term periods. In the absence of EXD, CPI would remain at 2.97 units during the week while during the day, the price level will settle at 1.76 units as depicted by the constant values. Long-run statistics for both daily and weekly data revealed that EXD is a direct and significant predictor of CPI with a coefficient of 7.74791 and 18.6719 given p-values that are lesser than 0.5, i.e ($p<.05$).

Table 7. *ARDL results I*

CPI	**Daily**			**Weekly**	
Variable	Coefficient	Prob.*		Coefficient	Prob.*
Long Run Equation					
exd	7.74791	0.0000		18.6719	0.0007
Short Run Equation					
cointeq01	-090516	0.0008		0.912110	0.0000
d(cpi(-1))	0.804412	0.0000		0.148768	0.4059
d(cpi(-2))	0.666634	0.0234		0.383102	0.0332
d(cpi(-3))	0.517931	0.0000		0.545229	0.0006
d(cpi(-4))	0.401872	0.0000		0.301569	0.0474
d(cpi(-5))	0.325630	0.0000		0.441275	0.0009
d(cpi(-6))	0.304071	0.0000		0.503823	0.0000
d(cpi(-7))	0.249276	0.0000		0.370734	0.0004
d(cpi(-8))	0.225269	0.0000		0.262331	0.0004
d(cpi(-9))	0.171277	0.0000		0.228304	0.0000
d(cpi(-10))	0.128941	0.0358		0.069192	0.0787
d(cpi(-11))	0.059751	0.0000		0.024360	0.0615
d(cpi(-12))	0.021604	0.0000		0.000152	0.0037
d(exd)	0.592727	0.0000		0.97444	0.0030
c	1.764455	0.0174		2.97100	0.0000

Source: Author's results

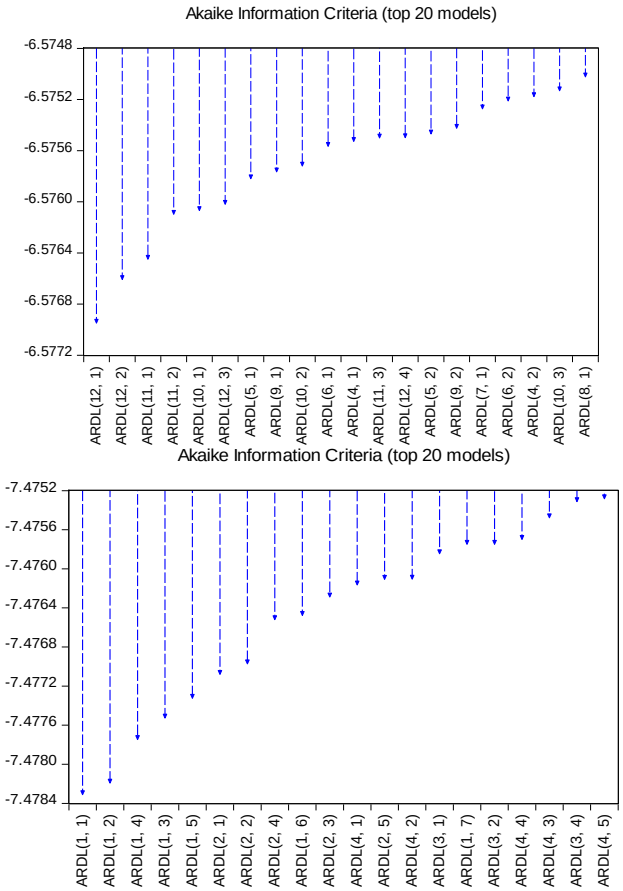

Figure 6. *EXD-CPI ARDL model selections- (a) daily frequency; (b) weekly frequency*
Source: Author's plot

Figure 6 also report the top 20 models selected automatically for the estimation of short and long-run ARDL equation with EXD as the dependent variable. As shown in Table 8, unlike the other models with CPI as the dependent variable, this ARDL model with EXD as the dependent variable had its most efficient weekly estimation model as the (1,1) model. CPI had no significant influence on EXD in the for both the daily and weekly frequency data set as revealed by probability values of 0.87685 and 0.56431 respectively (p>.05). what this implies is that commodity prices do not influence exchange rate devaluation. Examining short-term, the study finds an insignificant association between CPI and EXD with the coefficient of CPI being 1.97236 for the days and 0.12604 for the weeks with insignificant p-values of 0.7729 and 0.3996, respectively. In the short run, previous levels of devaluation attract further devaluation in the current period with noticeable p-values. This is because all coefficients are positive, revealing that past currency devaluation rates causes more devaluation. The short-run adjustment process (COINTEQ01) for each of the models is negative (-0.64823) and (-0.99748) as expected and significant at 0.05 in both daily and weekly data. The significance confirms the co-integrating relationship of all the variables in the study. The error

correction term reveals that overall, our model adjusts from deviation towards long-run equilibrium after external shocks in the economies of African countries.

Table 8. *ARDL results II*

EXD	Daily		Weekly	
Variable	Coefficient	Prob.*	Coefficient	Prob.*
	Long Run Equation			
cpi	0.215923	0.87685	0.00045	0.56431
	Short Run Equation			
cointeq01	-0.64823	0.0000	-0.997480	0.0000
d(exd(-1))	0.00724	0.0539	0.46132	0.03459
d(exd(-2))	0.08934	0.0002	-	-
d(exd(-3))	0.03037	0.0064	-	-
d(exd(-4))	0.01206	0.0013	-	-
d(exd(-5))	0.02057	0.0079	-	-
d(exd(-6))	0.02415	0.0015	-	-
d(exd(-7))	0.03626	0.0007	-	-
d(exd(-8))	0.04001	0.0026	-	-
d(exd(-9))	0.02502	0.0003	-	-
d(exd(-10))	0.01350	0.0002	-	-
d(exd(-11))	0.01274	0.0012	-	-
d(exd(-12))	0.00044	0.0001		
d(cpi)	1.97236	0.7729	0.12604	0.3996
c	0.000634	0.0280	0.000869	0.1265

Source: Author's results

Panel SVAR estimations

Daily Estimation. The structural VAR model for daily data in Figure 7 below showed that CPI had intermittent responses in subsequent periods to one deviation shock in itself. The intermittent non-zero responses were also found to decline in magnitude as the periods progress as shown in shorter peaks for periods farther from the origin. A change in the consumer price index causes an inverse reaction from the time of change till the second day after the change reaches 0 at the end of day 2. The response picks up again by day 12 falling to zero as quickly as it rose on the 15th day. The cycle repeats itself by the 25th day, the 36th day, and the 48th day. Thus, consumer prices have a 12-period cycle period in which it responds significantly to changes within themselves. The study found no response of CPI to shocks from exchange rate devaluation daily.

EXD also did not respond largely to shocks from its internal dynamics except in the initial 2 days of its variation. The response was also found to be negative. When a currency's value further declines, the other two days will have a further decline as a result of the change in value that occurred. In other words, after two days, EXD goes on to be affected by new shocks from other more recent

changes. EXD also had a very weak response to innovation shocks in CPI as revealed by the straight curve very close to 0.00.

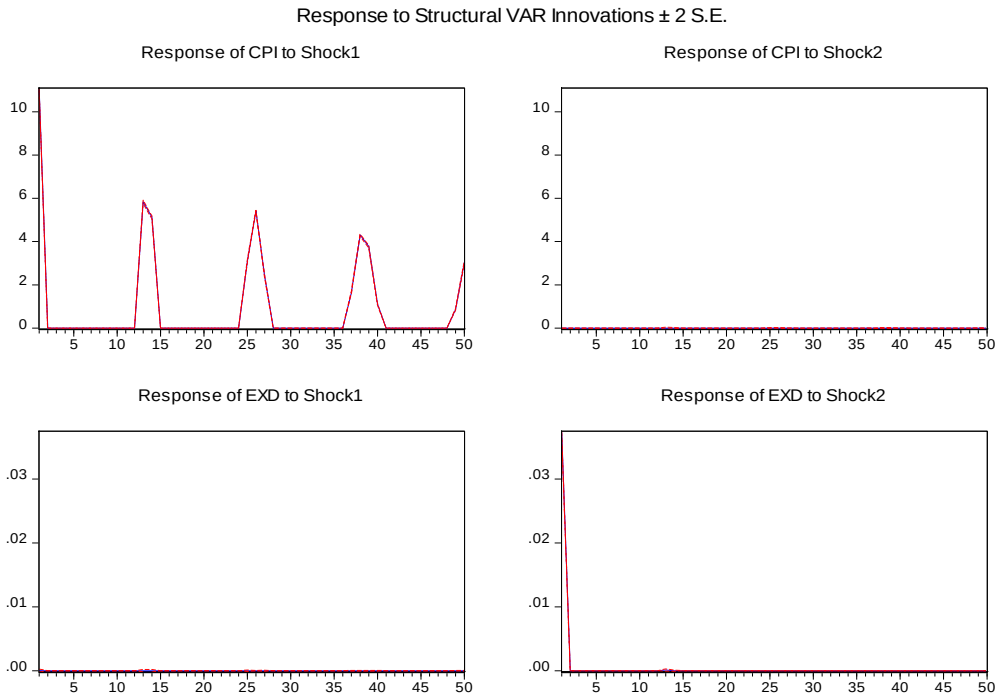

Figure 7. *Daily structural VAR responses*

The FEVD of Table 9 revealed that for fifty days, EXD explained a significant proportion of the changes in consumer prices by accounting for 99% of the total variations in CPI while CPI hardly responded to shocks from its internal dynamics (0.0000). The AR root graph revealed that the VAR model is stable as shown in Figure 8 below.

Table 9. *Daily Variance Decomposition of CPI*

Period	S.E.	CPI Shock 1	EXD Shock 2
1	0.037262	3.43E-05	99.99997
13	0.037262	3.77E-05	99.99996
24	0.037262	3.81E-05	99.99996
25	0.037262	3.91E-05	99.99996
48	0.037262	4.25E-05	99.99996
50	0.037262	4.33E-05	99.99996

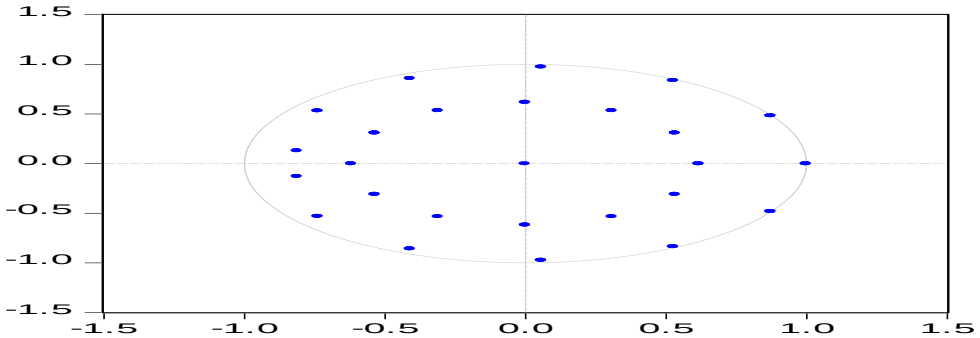

Figure 8. *Stability graph*

Weekly Estimation. The IR function graphs for weekly data in Figure 9 below reveal the effects of shocks from alterations in exchange rate devaluation, also referred to as innovation shocks. The dynamic response of EXD to CPI showed no significant response of exchange rate devaluation to commodity prices till the twelfth period when there is a slight positive response of EXD of less than 0.005 change to one deviation shock to commodity prices. The response remains positive till period 14 when the response begins to fade and EXD returns to equilibrium. The graphs also showed that EXD responds contemporaneously and inversely to shocks within itself. A rise in the devaluation rate in period 0 will cause devaluation to fall up to period 3, in this case, week.

Examining CPI response in the IRF, CPI like EXD responds negatively and sharply within the next two periods from when one deviation shock occurs within itself, after which it converges to zero. By the twelfth week, it suddenly rises causing above 10-units rise in CPI in that period. The thirteenth period then witnesses a halt in positive response and response reverses cutting through equilibrium first in a negative direction by the 14^{th} period and returning to equilibrium by the 15^{th} period. CPI had no significant response to EXD as the IRF showed a chart maintaining unity (zero) till between the 12^{th} and 14^{th} period where minimal negative and then positive response is seen, before re-convergence to zero.

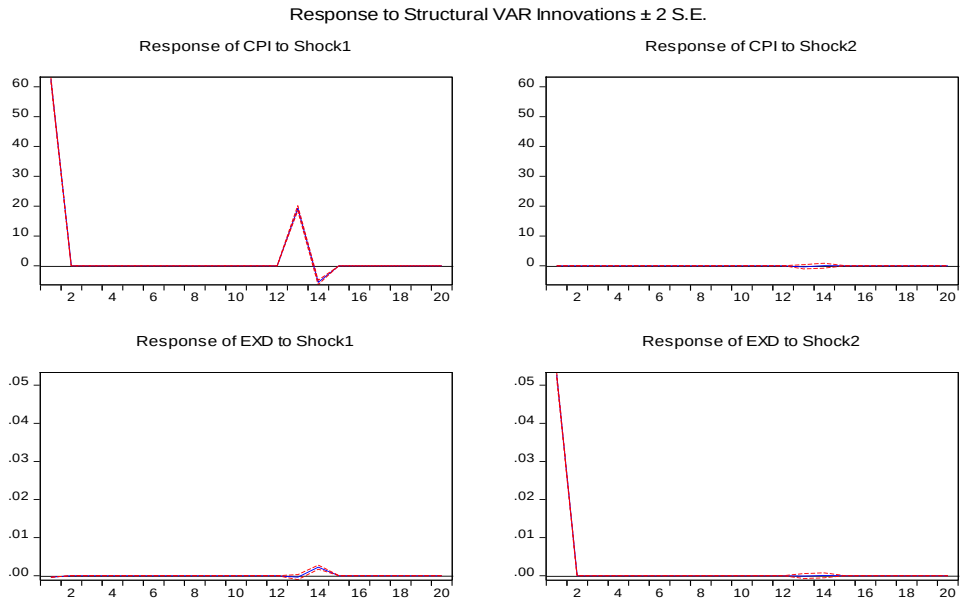

Figure 9. *Weekly structural VAR responses*

Table 10. *Weekly Variance Decomposition of CPI*

Period	S.E.	EXD Shock1	CPI Shock2
1	62.54068	100.0000	0.000000
12	62.54068	100.0000	0.000000
13	65.46041	99.99733	0.002669
20	65.69331	99.99725	0.002751

Table 10 shows that the forecast variance decomposition showed that in the first 12 periods, the dynamic response of CPI to EXD was complete as 100% variation in consumer prices was wholly accounted for by devaluation of currencies. This indeed signified a significant response of consumer price level to exchange rate devaluation. Again, CPI could hardly respond to shocks from its internal dynamics (0.0000). By period 13, CPI was found to explain 0.0026% of the change by itself. As the periods extend, the self-explanatory power or impact of CPI increases but at a very low rate. The large values of the explanatory power of EXD of changes in CPI confirm that African countries, devaluation is the major factor responsible for rising commodity prices.

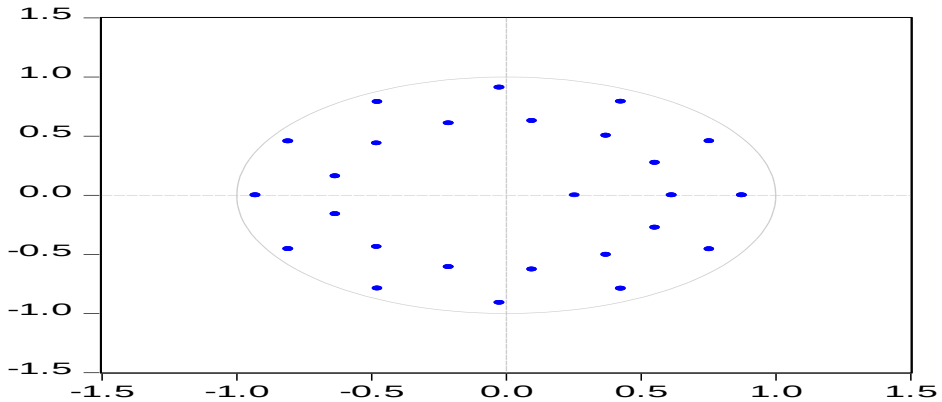

Figure 10. *Stability graph*

5. POLICY DISCUSSION OF RESULTS

Exchange rate devaluation is largely exogenous and do significantly influence commodity prices un. The prices of commodities change significantly change as a result of daily or weekly changes in exchange rates. In the long run, however, the relationship is inverse depicting that when local currencies experience devaluation over some time, changes in commodity prices, measured by CPI will reduce. A consistent 10 percent devaluation of the currency would have no significant change in commodity prices by the next day or next week or a few periods after. However, this rate of devaluation assuming constant value will lead to changes in product price differences but at a falling rate as against the rising units needed to purchase foreign currencies. Applying this to real-world situations, commodities examined in the CPI are most likely locally-produced commodities because imported commodities in an economy experiencing devaluation would be plagued with rising prices as more units of local currency are required to get the imported product at a specified rate. Therefore, exchange rate devaluation is a means through which monetary regulators can influence inflation in the economy over time. SVAR results negated the findings of the ARDL as CPI and EXD were not found to respond significantly react to innovations in each other. Instead, the individual trends for both variables are independent of each other and are influenced by other economic factors other than the other factor in this study.

CPI was found to influence EXD only after the seventh day negatively. Weekly estimates as well revealed a negative significant influence in the short run. Rising commodity prices are expected to reduce devaluation rates. This seems to be applicable when countries do more exports. The increased demand for commodities causes prices to expand. The demand will also cause countries that import from such countries to demand local currencies more increasing currency value (decreasing devaluation rates).

The patterns of volatility of commodity prices and exchange rate devaluation were ununiformed in African economies. For economies that had negative correlation coefficients, the volatility of the two buildings was found to move in

opposite directions. Positive and significant DCC values revealed that the volatility of both variables moved in similar patterns either inversely or positively. Thus, policymakers may be able to influence the devaluation rate by fixing prices on certain goods to alter volatility patterns and ultimately, the value placed on local currency. Furthermore, all African economies studied were characterized by volatility persistence implying that future values of variables could be predicted from past values with a significant level of precision. Policymakers can thus engage in economic planning with the bid to take up inflation-targeting and expansionary policies.

6. CONCLUSION

This study sought to determine the relationship dynamics between exchange rate devaluation and consumer prices from the daily and weekly rate perspectives using multivariate DCC-GARCH model, SVAR model, and ARDL modeling techniques, respectively. The rationale for adopting a multi-analysis approach to explain the dynamics of exchange rate devaluation and consumer price patterns in selected African countries. EXD was found to influence commodity prices negatively and sigfnicantly for both periods of analysis. CPI also had a negative influence on EXD though this did not extend to the long term for weekly rates. In sum, the dynamic response of consumer price level to devaluation of currencies was complete as 100% variation in consumer prices was wholly accounted for by devaluation of currencies. This indeed signified a 100% response of consumer price level to exchange rate devaluation. Volatility was found in EXD and CPI of different countries. Volatility persistence with changing conditional correlations existed for the dual variables existed in countries that were analyzed with GARCH estimations. Overall, daily rates were more explanatory than weekly ones. The study concluded EXD and CPI behaviors do not have causality relationships as they are largely independent of themselves, However, there is a negative correlational relationship between both, and this may be in the short run or long run dependent on the country of interest. Specific findings to study objectives are stated below:

The prices of commodities significantly change as a result of daily or weekly changes in exchange rates. In the long run, however, the association is inverse depicting that when local currencies experience devaluation over some time, changes in consumer prices, measured by CPI will reduce. A consistent 10 percent devaluation of the currency would have no significant change in consumer prices by the next day or next week or a few periods after. However, this rate of devaluation assuming constant value will lead to changes in product price differences but at a falling rate as against the rising units needed to purchase foreign currencies. Applying this to real-world situations, commodities examined in the CPI are most likely locally-produced commodities because imported commodities in an economy experiencing devaluation would be plagued with rising prices as more units of local currency are required to get the imported product at a specified rate. Therefore, exchange rate devaluation is a means through which monetary regulators can influence inflation in the economy over time.

Weekly estimates as well revealed negative significant influence between devaluation and price level in the short run. Rising commodity prices are expected to reduce devaluation rates. This seems to be applicable when countries do more exports. The increased demand for commodities causes prices to expand. The demand will also cause countries that import from such countries to demand local currencies more increasing currency value (decreasing devaluation rates). The patterns of volatility of commodity prices and exchange rate devaluation were ununiformed in African economies. For economies that had negative correlation coefficients, the volatility of the two buildings was found to move in opposite directions. Positive and significant DCC values revealed that the volatility of both variables moved in similar patterns either inversely or positively. Thus, policymakers may be able to influence the devaluation rate by fixing prices on certain goods to alter volatility patterns and ultimately, the value placed on local currency. Furthermore, all African economies studied were characterized by volatility persistence implying that future values of variables could be predicted from past values with a significant level of precision. Policymakers can thus engage in economic planning with the bid to take up inflation-targeting and expansionary policies. Except for Senegal, other countries studied showed that volatility of currency devaluation and commodity prices at one time or the other (short or long run or both) have recognizable patterns of behavior that can be associated with the other whether inversely or directly. All countries examined have movements in EXD and CPI time-varying conditional correlation. Conclusively, there is a negative correlational relationship between both, and this may be in the short run or long run dependent on the country of interest. Encouraging local production through means such as tax rebates for manufacturing will improve the predictive power of EXD and CPI for better achievement of economic goals.

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ANNEX A

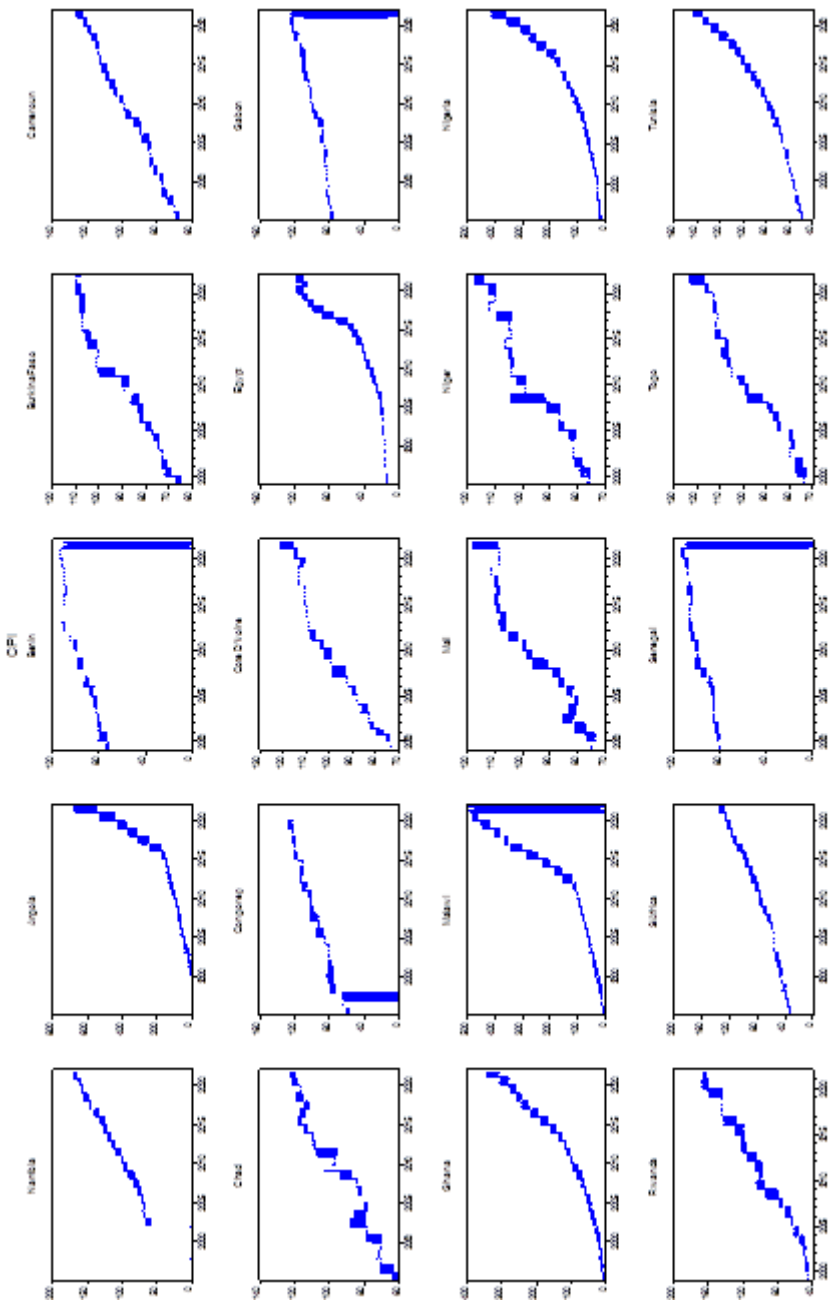

Figure 1*. Daily consumer price*

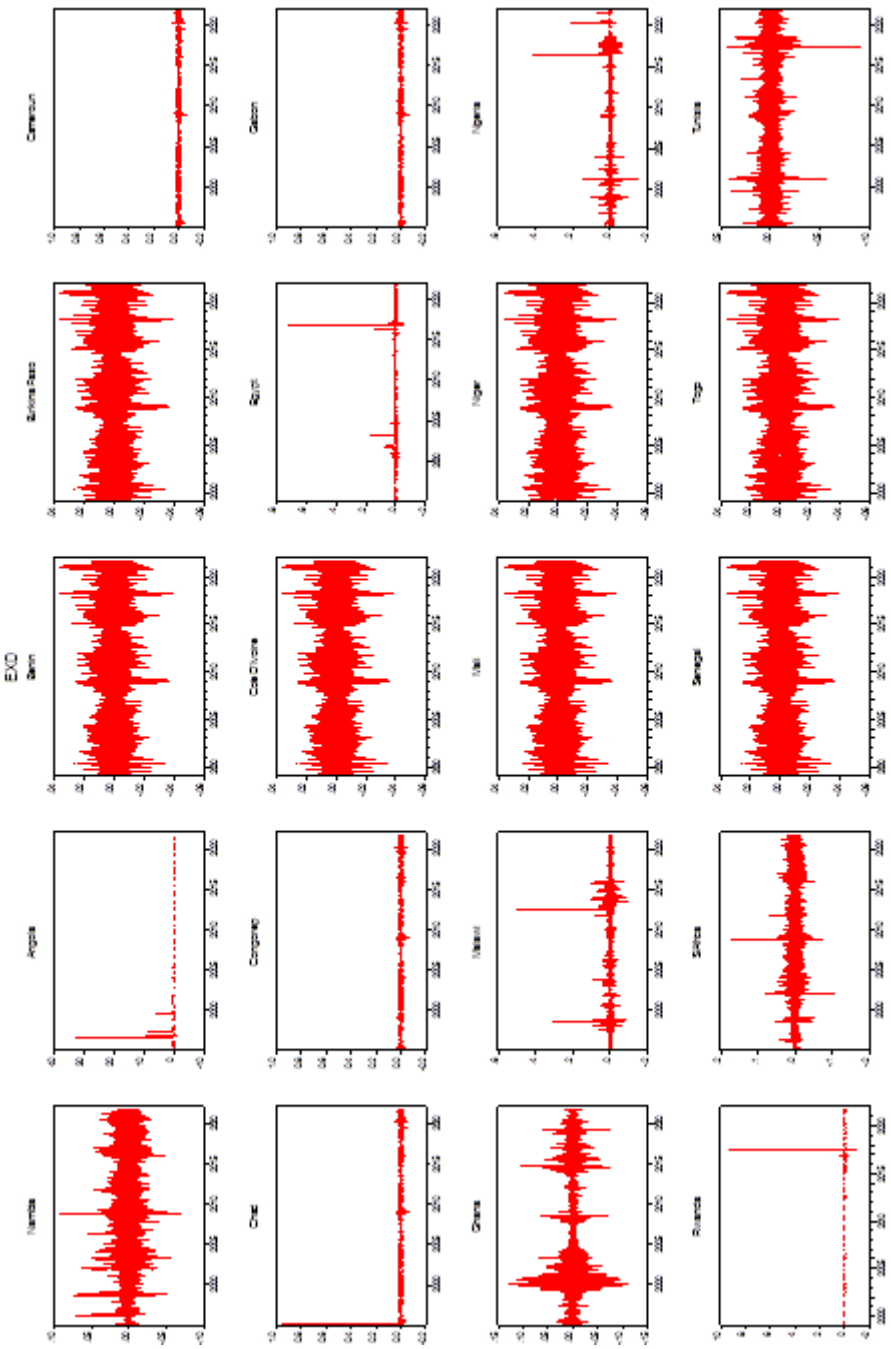

Figure 2. *Daily exchange rate devaluation*

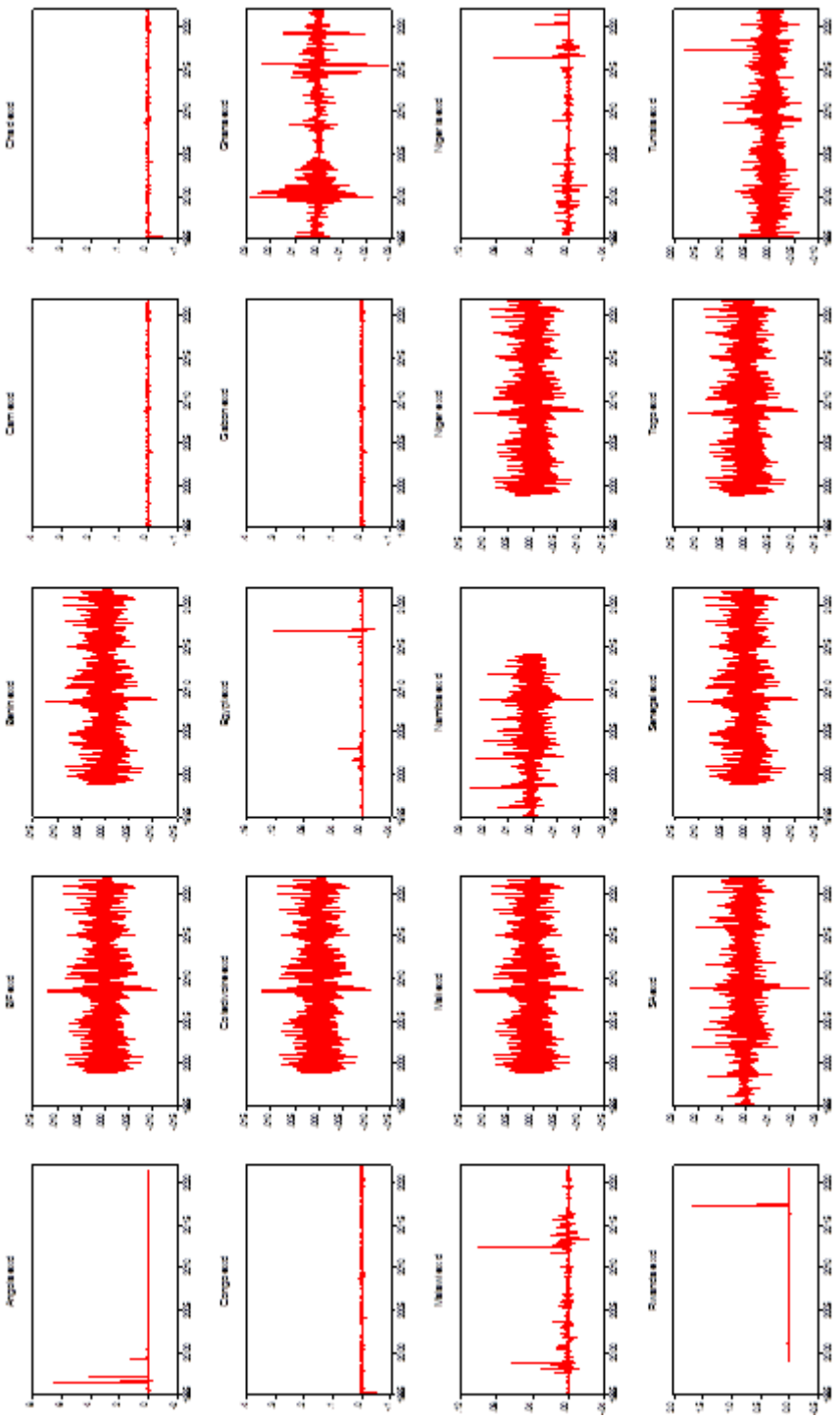

Figure 3. *Weekly exchange rate devaluation*

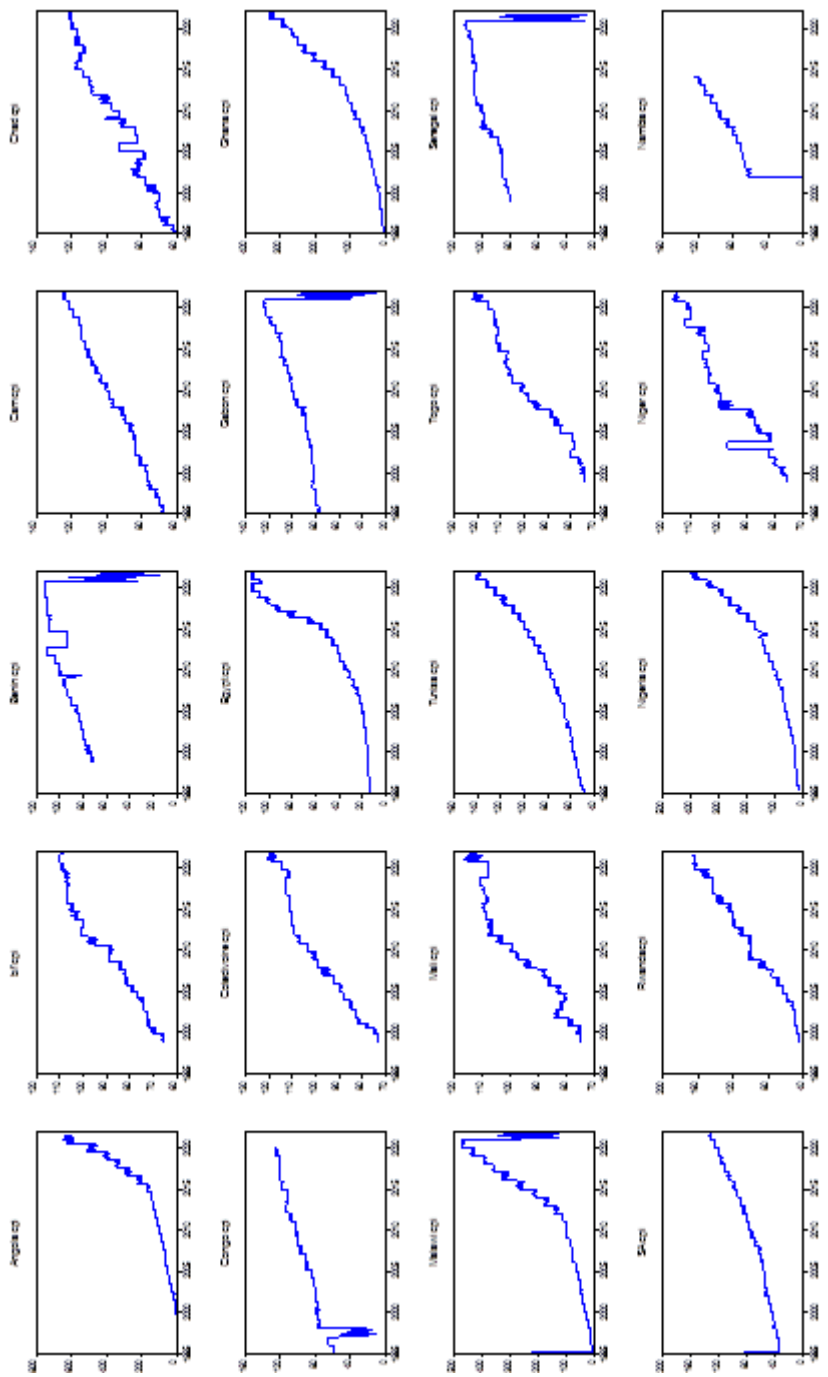

Figure 4. *Weekly consumer prices*