AFRICA'S TRADE AND VOLATILITY IN EXCHANGE RATE: AN ECONOMETRIC CALCULATION

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Abstract

The study estimates effects of volatility in mutual exchange rate of a selection of African countries in relation to US dollar on aggregate exports of Africa countries from March 1, 2005 to March 30, 2018 using GMM estimator. This is indebted by the fears being upstretched as whether the variation in exchange rate of Africa currencies vis-à-vis US dollar in current time have stimulated export growth. The results show that current and historical volatility had negative and significant effects on aggregate exports of all selected Africa countries in the study. Also, speculation effect of exchange rate volatility is negative and significant for all countries except Liberia. The study advices Africa monetary authorities to certify total adherence to implementation of exchange rate stabilization policies.

Keywords: Africa countries, export, exchange rate volatility, E-GARCH model

JEL classification: Q24, H30, M16

1. BACKGROUND TO THE STUDY

Trading relations are utmost imperative aspects of nations and exchange rate is fundamental factor that influence trade and hence economic activities. This could be reason why volatility in foreign exchange market has always attracted substantial consideration in economics. In many of Africa countries, exchange rate administration has endured substantial changes over four decades. This according

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to Mordi (2006) is particularly due to existence of many parallel market operations existing side-by-side the officially acknowledged foreign exchange market.

To theory, it all depends on the role played by market agents, exchange rate volatility may adversely or positively influence exports. Thus, considering two exporting countries and assuming absence of forward market for foreign exchange such that the exporters cannot lock a price, such exporters become vulnerable to risk at the point of the conversion.

A floating rate is randomly volatile and it relies on changes in currency. So, a higher degree of currency change points to greater volatility in exchange rate which is an indication of the extent to which the currency varies over the period. In effect, exchange rate's volatility constitutes the global trade speculation threat effect as it increases exchange rate risk.

The purchasing country has to go for the purchase of foreign currency like US dollar or currencies of those countries where transactions need to be done. Exchange rate volatility is worrisome as it exposes importers and exporters to exchange rate risk (Umoru, 2018). Equally, utmost changes in exchange rate do not reflect changes in incomes, prices and pivotal factors of comparative. However, overall evidence is most often adjudged as mixed given the sensitivity to the choices of proxies for exchange rate volatility, and countries considered. Hence, motivation to advance research into effect of exchange rate instabilities on export is imperative for a developing resource-based economy like Nigeria.

Moreover, euro-zone currency and sovereign debt crises, US dollar volatility among others seems to provoke current debates. Hence, we estimated precisely, the effects of conditional volatility in mutual exchange rate of selected African countries and the speculation effect of exchange rate volatility on aggregate exports of these countries to the US. The sixteen African countries are Nigeria, Madagascar, Sudan, Cameroun, Tanzania, Zambia, Namibia, Uganda, Senegal, Sierra Leone, Gambia, Mauritania, Niger, Mozambique, Malawi and Swaziland.

The next presents some stylized facts and export profile of selected Africa countries. The third section reviews the theoretical and empirical texts. The fourth section is composed of theoretical framework and methodology. Results and hence empirical estimates are analysed in the fifth section. The sixth concludes the study with policy references.

2. OVERVIEW OF SELECTED AFRICA COUNTRIES

Many Africa countries have experienced periods of trade expansion, but these have generally not been sustained. According to the World Bank (2005), Africa’s export has fluctuated mostly as exports to Asian countries accounted for

just 10% of total merchandise while export in services has been so insignificant. This shows that trade trends are changing quite rapidly for Africa and such performances have not met the exportation policy of the Africa governments.

Also, Africa countries have been bedevilled with slackening growth which raises fears over their capability to survive the weak global economy due to reversal of foreign investors' risk enthusiasm coupled with loss of confidence which makes such investors fly capital from the African markets to more stable markets.

Hence, the deficiency makes these countries to go for trade and the relevant research question becomes, how can Africa circumvent the volatility risk effect of exchange rate? This requires an econometric evaluation of relevant data across the selected Africa countries with a view to maximize Africa's gains from foreign trade to boost economic growth.

The poor trade performance of Africa countries in world trade is the consequence of the fact that Africa's GDP per-capita has grown slower as analysed in the previous section compared to Latin America or East Asia and also output elasticity of trade in these regions of the world exceeds unity, hence, as the regions grow, their trade volumes expanded more than equitably.

The cross-national variation in trade performance within Africa shown in Table 1 reveals that Nigeria, Gambia, Namibia, Uganda, Swaziland and Mozambique recorded highest export growth of 11.05, 18.37, 9.73, 7.76, 6.98 and 19.13 respectively in dollar value over the period, 2009 to 2016 while Madagascar, Mauritania, Malawi and Niger recorded negative export growth rate of 13.54, -2.41, -4.48 and -7.56 respectively.

Table 1. *Growth of Total Exports*

Countries	1964-94	1964-75	1975-85	1985-94
Madagascar	19.44	55.89	9.01	-13.54
Sudan	10.23	18.06	8.19	2.91
Senegal	11.23	15.24	13.15	4.21
Nigeria	9.25	13.37	3.11	11.05
Mauritania	9.77	23.85	5.24	-2.41
Gambia	8.13	13.92	-7.44	18.37
Malawi	7.51	8.78	16.91	-4.48
Zambia	8.79	12.90	8.04	4.61
Niger	4.80	10.36	9.83	-7.56
Cameroun	5.87	7.02	7.66	2.48
Namibia	4.77	7.66	-2.86	9.73
Uganda	-	-	7.10	7.76
Sierra Leone	4.09	5.80	4.93	1.04
Burkina-Faso	-	-	0.33	1.02
Mozambique	5.47	8.01	1.32	6.98
Swaziland	3.40	2.83	-10.13	19.13

Source: UN COMTRADE

Table 2 shows the development of exports and export diversification in Africa countries for 2000 and 2017. Real exports of goods and services grew by more than 20 percent in Chad, Zambia and Sudan and by 10-20 percent in Mozambique, Ethiopia, Uganda and Lesotho. The biggest exporter in 2008 was South Africa, followed by Cote d'Ivoire, Sudan, Chad, Kenya, Zambia and Botswana.

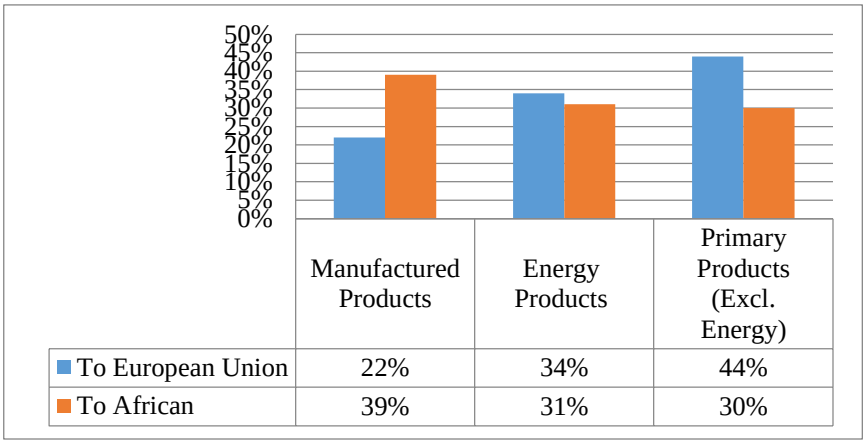

Figure 2. *Structure of Africa's Exports*
Source: IMF World Economic Outlook, 2016

The structure of exports in Africa countries as shown in Figure 2 above is such that primary products dominated with 44% to the Europe, not manufactured nor energy products. The deduction is that Africa countries are just developing and hence hardly manufacture something substantial.

Table 2. *Exports and Export Diversification, 2000 contrasted with 2017*

Country	Real Exports			HHI: Market		
	2000	2017	CAGR	2000	2017	CAGR
Madagascar	221	586	7.8%	0.12	0.11	-0.5%
Cameroun	3,523	5,608	3.6%	0.1	0.16	3.9%
Tanzania	1,410	3,511	7.3%	0.09	0.13	2.7%
Gambia	739	905	1.6%	0.1	0.13	2.3%
Sudan	946	1,621	4.2%	0.18	0.2	0.8%
Malawi	378	232	-3.7%	0.09	0.1	1.0%
Mauritania	572	1,124	5.3%	0.15	0.19	1.6%
Liberia	2,151	3,464	3.7%	0.19	0.21	0.6%
Mozambique	372	2,805	16.8%	0.1	0.14	2.9%
Namibia	1,554	2,887	4.9%	0.01	0.12	19.0%
Senegal	1,277	1,797	2.7%	0.15	0.15	0.2%
Malawi	27,951	49,410	4.5%	0.06	0.09	3.3%
Nigeria	481	5,087	19.9%	0.09	0.33	11.0%

Swaziland	824	2,058	7.3%	0.21	0.06	-8.7%
Zambia	1,517	2,842	4.9%	0.06	0.07	0.9%
Uganda	402	1,629	11.4%	0.09	0.14	3.4%

Source: U.N. Comstat, HS 1988/92 and World Development Indicator,
*NB: Exports at 2000 prices. A lower HHI denotes more diversification. *Base year 1999. **Base year 1996, *** Base year 1997*

As shown in Chart 3, South Africa, Cote d'Ivoire and Nigeria drives the growth in exports between 2009 and 2016. The point is that there is a significant variation within West African countries in terms of trade performance.

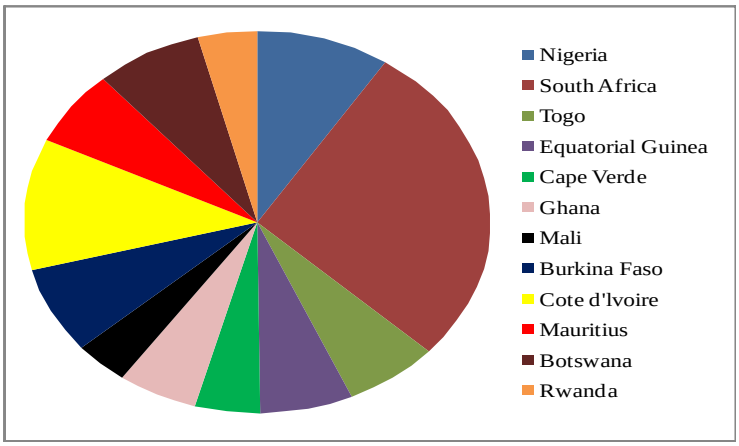

Figure 3. *Share of Export Growth by Country, 2009 – 2016*
Source: IMF World Economic Outlook, 2016

The apprehension has been that Africa's conditions in terms of poor infrastructure, its layout, or its dependence on primary products make it an exceptional scenario in which exports are not responsive to prices as well as traditional instruments of commercial policy.

2.1. LITERATURE ON EXCHANGE RATE VOLATILITY AND ITS EFFECTS

So many studies have projected a positive relationship between exchange rate volatility and international trade while others have anticipated negative relationship since the 1990s with many studies yielding little or no support for neither a positive nor a negative effect. Obiora and Igue (2006) and Aliyu (2009) reported negative effect of exchange rate volatility on Nigeria's exports to the US. Similarly, Isitua and Neville (2006) reported that exchange rate volatility had a negative and significant effect on Nigeria's export though their research concentrated only on oil exports.

Yinusa and Akinlo (2008), Omojimite and Akpokodje (2010) and Akinlo and Adejumo (2014) found positive volatility effect of exchange rate on export in

Nigeria. Opaluwa, Umeh and Ameh (2010) found that fluctuation in exchange rate adversely affected output of the manufacturing sector in Nigeria. Studies by Ibikunle and Akhanolu (2011) and Akinlo and Adejumo (2014) obtained negative and insignificant relationship between total export and exchange rate volatility in Nigeria. Umoru and Oseme (2013) empirically found cyclical trade effect of exchange rate shocks in Nigeria.

There are studies that have been conducted for other countries namely Pakistan, South Africa, Poland, Korea, Hungary, Bangladesh, Pakistan, India, Tunisia, Egypt, Israel, Morocco, Algeria, UK, EU, Turkey, Romania and numerous Asian countries. For example, an econometric study by Arinze, Malindretos and Kasibhatla (2003) of a sample of ten LDCs (including South Africa) found that exchange rate variation exerts a significant negative effect on export in most of the countries studied. However, South Africa was an important exception where exchange rate volatility impacted positively on exports.

De Vita and Abbott (2004) used the ARDL to remark that UK's export to the EU are unaffected by exchange rate fluctuation. Feenstra and Kendall (2005) provide no evidence of a single instance in which variation in exchange rate had a negative and significant impact on trade. Gheong, Mehari, and Williams (2005) established that unexpected variation in exchange rate escalated export prices in UK and consequently decreased trade volume. This is similar to results of Abolagba et al. (2010).

The study by Rey (2006) indicated a significant relationship, negative for four countries (Algeria, Egypt, Tunisia, and Turkey) and positive for two (Israel and Morocco). Humayon, Ramzan, and Ahmed (2007) observed that uncertainty in exchange rate caused decline in Pakistan's export. Shah, Mehboob and Raza (2010) found that fluctuation of exchange rate causes reduction in Pakistan's trade. To Hasan (2013), uncertainty of exchange rate highly affected trade between Pakistan and UK and between US and UAE while Sandu and Ghiba (2011) reported that exchange rate volatility discouraged exports in Romania. In the study by Yousaf and Sabit (2015), when exchange rate appreciated by one percent, export declines by 0.21 percent.

2.2. LITERATURE GAP

The controversy regarding the effect of volatility on export shows the need to further embark on a similar research. While, some of the above mentioned studies focused only on oil exports, others examined the J-curve effect of exchange rate devaluation (see Umoru and Oseme, 2013). Also, some of the previous studies estimated the effect of exchange rate uncertainty in place of volatility on export. What makes the present study unique is its focus on total exports, devises the appropriate measure of volatility in exchange rate and the speculation effect of exchange rate volatility.

3. THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

Theoretical Framework: Building on Mundell-Fleming theoretical framework, the study builds the theory that volatility in exchange rate increases risk of trade and so depresses trade flows (Chowdhury, 1993). The underlying theory provides that an overvalued currency exchanges at a low rate for foreign currency while an undervalued currency exchanges at a high rate for the foreign currency. This induces expectations of devaluation which lead to capital flight.

Given that the Mundell-Fleming model describes an open economy by classically portraying relationship between nominal exchange rate and an economy's output of a country such that the IS curve equation becomes:

$$Y= C + I + G + NX \qquad (1)$$

Where Y is GDP, C is consumption, I is investment, G is government spending and NX is net exports. The LM curve equation becomes:

$$M/P= L (i, Y) \qquad (2)$$

Where M is money supply, P is average price, L is liquidity and i is interest rate. A higher interest rate or a lower GDP lowers money demand. Also, *BoP* equation is:

$$BoP= CA + KA \qquad (3)$$

Where CA is current account and KA is capital account. Bringing together IS components of we have:

$$C= C[Y - T, i - E(\pi)] \qquad (4)$$

Where T is tax, $E(\pi)$ is the expected rate of inflation and $i - E(\pi)$ is Fisher's identity which captures the difference between nominal interest and expected inflation rates. Relatively, investment is also a function of real interest rate and income as show in equation (5).

$$I= I [i - E(\pi), \Delta Y] \qquad (5)$$

Where Y_{t-1} is GDP in previous day and government spending is an exogenous variable as given in equation (6).

$$G= \overline{G} \qquad (6)$$

$$NX= NX [e, Y, Y^*] \qquad (7)$$

Where *e* is real exchange rate of the local currency, Y* is GDP of USA. Higher GDP of SSA countries leads to more spending on imports and hence leads to lower exports, while higher GDP of America leads to higher exports by SSA countries.

The underlying theory provides that an with overvalued currency, the country's exports is relatively expensive and imports cheaper while with an undervalued currency, the country's exports is relatively cheaper and imports expensive. In other words, the overvalued currency exchanges at a high rate for foreign currency while the undervalued currency exchange at a low rate for foreign currency. Theoretically, export of SSA countries provides valuation of the currency of sub-Sahara countries. The demand for the currency for purchase of goods influences exchange rate of the currency before the goods.

Modelling Conditional Volatility of Exchange Rate: The Exponential Generalized Autoregressive Conditional Heteroscedasticity (E-GARCH) model was specified in this study. According to Hansen and Lunde (2005), volatility determined through E-GARCH (1, 1) model is a weighted average of past squared residuals as specified.

$$Ln(\sigma_t^2) = b_0 + \sum_{j=1}^{p} b_j Ln(\sigma_{t-j}^2) + \sum_{i=1}^{q} b_i \left(\left| \frac{e_{t-i}}{\sigma_{t-i}} \right| \right) + b \frac{e_{t-1}}{\sqrt{\sigma_{t-1}^2}} \quad (8)$$

Where σ_t^2 is the conditional volatility of real exchange rate, e_{t-i} represents ARCH (1,1) component which measures volatility in exchange rate of the previous day while σ_{t-j}^2 is the GARCH (1,1) component which measures lagged forecast variance, b_j are effects of forecast variance, b_i are volatility effects. We included the speculation component such that *b* becomes the parameter that measures exchange rate speculation effect and b_0 is the nuisance parameter.

We included the speculation component such that *b* becomes the parameter that measures exchange rate speculation effect such that b < 0, it indicates that good news (positive shocks) as regards exchange rate speculation generates lesser volatility while b > 0 indicates that bad news (negative shocks) generates enormous volatility and what causes foreign exchange speculation is the existence of too many parallel markets popularly known as the black markets. All these jointly cause the volatile behaviour of exchange rate.

b_0 is the mean (nuisance) parameter. Following Hassen and Lunde (2005) and Zivot (2009), E-GARCH model is covariance stationary only when $b_j < 1$. The corresponding variance and mean equations are thus specified:

$$Ln(\sigma_t^2) = b_0 + b_2 e_{t-1}^2 + b_1 Ln(\sigma_{t-1}^2)$$
$$r_t = \mu_t + \upsilon_t,\ b_0 > 0, b_2 \geq 0, b_1 \geq 0 \ and\ \upsilon_t = \sigma z \qquad (9)$$

Where *z* is standardized residual returns, *p* is number of lagged components of σ_t^2 and *q* is number of lagged e^2 terms, r_t is daily exchange rate, μ_t is average returns and υ_t is residuals. The constraints $b_2 \geq 0, b_1 \geq 0$ are needed to ensure σ_t^2 is strictly positive (Poon, 2005).

Conditional variance equation becomes a specification of a function of constant term, volatility news from previous day measured as lag of squared residuals from mean equation, (ARCH variable) and previous period forecast variance, (GARCH variable). In effect, equation (9) shows that conditional volatility is explained by current variance (ARCH coefficient) and past variances (GARCH coefficient).

Emanating from the preceding, is our desire for adopting *E-GARCH* model as it spontaneously tests for *ARCH* effects in the sequence of exchange rates (Shephard and Andersen, 2009; Dahiru and Asemota, 2013).

Variables, Data Description and Sources

Total export *(e)* of Africa countries, calculated as the log of the percentage ratio of the daily nominal exports of a Africa country to the US divided by the country's export unit (export value index of the Africa country). Other variables include, exchange rate volatility (σ_t^2), international financial crisis *(f)*, international income *(y)* (see Umoru, 2018). Data for the sample of selected Africa countries were sourced from World Bank database and data span from March 1, 2005 to March 30, 2018.

Methods of Data Analysis

The GMM estimator was used in estimation under the distributional assumptions that standardized residuals obey generalized error distribution was used to estimate the influence of exchange rate volatility and the speculation effects of exchange rate volatility on total exports of SSA countries.

$$\beta_{GMM} = \left(\sum_{t=1}^{N} Z_t X_t^{'} \right)^{-1} \sum_{t=1}^{N} Z_t y_t \qquad (10)$$

The GMM estimator uses the weighted matrix in estimation to track the full description of the DGP and model specification status. Also, it uses instruments to identify parameter estimates based on a non-singular VC matrix while simultaneously minimizing the estimation distance to zero. The Eviews econometric package was utilized.

4. ECONOMETRICS RESULTS

4.1. RESULTS OF TIME SERIES PROPERTIES

Table 3 presents the stationarity patterns of the series in the study based on Phillips Perron (PP) technique. According to the results, none of the series could gain stationarity at level but at first difference with time trend. Thus, all the variables are integrated of order one at the 5% level with critical value of -3.896.

Table 3. *Stationary Test of Variable (with Time Trend)*

Variables	Nigeria	Madagascar	Sudan	Cameroun
f	-6.723 (3)	-9.158 (3)	-5.721 (3)	-9.258 (3)
y	-9.254 (3)	-14.013 (3)	-7.223 (3)	-6.053 (3)
σ_t^2	-10.528 (3)	-7.625 (3)	-9.521 (3)	-11.341 (3)
e	-6.792 (3)	-8.5992 (3)	-7.0392 (3)	-9.1492 (3)
Variables	Tanzania	Zambia	Namibia	Uganda
f	-5.623 (3)	-6.463 (3)	-9.1238 (3)	-5.1232 (3)
y	-6.094 (3)	-8.059 (3)	-6.152 (3)	-8.351 (3)
σ_t^2	-7.534 (3)	-5.623 (3)	-12.542 (3)	-9.245 (3)
e	-10.692 (3)	-6.591 (3)	-8.791 (3)	-6.932 (3)
Variables	Senegal	Sierra Leone	Gambia	Malawi
f	-4.123 (3)	-9.461 (3)	-8.321 (3)	-7.498 (3)
y	-10.114 (3)	-12.563 (3)	-6.947 (3)	-6.286 (3)
σ_t^2	-12.628 (3)	-12.495 (3)	-14.324 (3)	-13.978 (3)
e	-15.143 (3)	-12.122 (3)	-8.293 (3)	-7.456 (3)
Variables	Mozambique	Niger	Swaziland	Mauritania
f	-9.143 (3)	-14.189 (3)	-5.349 (3)	-16.271 (3)
y	-4.982 (3)	-7.152 (3)	-9.153 (3)	-10.289 (3)
σ_t^2	-8.231 (3)	-6.1230 (3)	-7.234 (3)	-6.721 (3)
e	-6.725	-9.542	-10.355	-17.546

	(3)	(3)	(3)	(3)
Figures in parentheses are the lag order				

The co-integration results for each county are reported in Table 4. The number of co-integration relation(s) was determined on the basis of maximum and trace eigenvalue statistics.

Overall, we found at least one co-integration relation for countries. Specifically, in the case of Nigeria, the results of trace test established two co-integration relations at 5% significant level since the computed values of 123.735 and 119.296 exceeds the 5% critical values of 120.465 and 106.372 respectively. Consistent with the trace result is the maximum eigenvalue statistics of 98.392 and 78.346 which exceeds the critical values of 72.351and 65.172 respectively at the 5% level.

For Zambia, the trace test established two co-integration relations while the maximum eigenvalue statistic reported one co-integration relation at 5% significant level. For Namibia, trace test statistics, 93.235 and 85.216 exceeds the 5% critical values of 90.165 and 80.372 respectively. Consistently, the maximum eigenvalue statistics of 73.192 and 58.745 exceeds the critical values of 65.345 and 50.372 respectively at the 5% level. Hence, the Namibian economy has two co-integration relations.

In the case of Tanzania, both the trace and maximum eigenvalues test provided evidence of one co-integration relation at 5% significant level since the calculated trace and maximum eigenvalue statistics of 86.234 and 60.392 exceeds the critical values of 72.665 and 55.145 respectively. In the cases of Madagascar, Uganda, Mozambique and Malawi both the trace and maximum eigenvalues test established four co-integration relations at 5% significant level.

For Senegal, trace test results established zero co-integration relation while the maximum eigenvalue test reported one co-integration relation as the calculated value of 43.192 exceeds the 5% critical value of 35.645. In the Sierra Leone case, there is one co-integration relation. In Gambia, trace test statistics, 46.451 and 39.850 exceeds the 5% critical values of 37.115 and 26.237respectively.

Correspondingly, maximum eigenvalue test statistics of 26.190 and 23.456 exceeds the 5% critical values of 21.645 and 22.732 respectively. These imply two co-integration relations for the Gambian economy. For Swaziland, the trace test reported two co-integration relations while the maximum eigenvalue test reported same co-integration relations. Other countries with two co-integrating vectors include Cameroun, Niger and Mauritania.

Table 4. *Co-integration Results*

Nigeria				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
123.735	98.392	120.465	72.351	None*
119.296	78.346	106.372	65.172	At most 1*
86.347	50.291	94.367	51.062	At most 2*
67.256	23.250	72.412	49.287	At most 3*
Zambia				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
113.125	78.192	100.165	72.593	None*
102.136	67.526	92.461	69.325	At most 1*
72.147	58.142	85.527	59.362	At most 2*
56.256	39.530	65.432	40.389	At most 3*
Namibia				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
93.235	73.192	90.165	65.345	None*
85.216	58.745	80.372	50.372	At most 1*
70.547	43.256	74.362	46.063	At most 2*
52.256	22.130	60.452	29.285	At most 3*
Tanzania				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
86.234	60.392	72.665	55.145	None*
55.256	48.746	56.547	49.332	At most 1*
43.142	33.256	44.365	36.263	At most 2*
25.256	19.136	28.153	20.585	At most 3*
Madagascar				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
95.245	89.336	83.625	64.345	None*
89.259	72.142	66.542	51.372	At most 1*
73.143	53.257	45.362	26.293	At most 2*
55.251	26.975	12.123	18.584	At most 3*
Uganda				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
66.204	52.392	52.665	45.345	None*
45.216	38.741	46.347	39.752	At most 1*
33.132	23.253	34.365	26.261	At most 2*
15.056	10.139	15.753	13.295	At most 3*
Mozambique				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
57.934	46.792	32.495	20.385	None*
35.426	30.243	26.345	18.452	At most 1*
23.152	16.255	14.367	12.263	At most 2*
9.426	4.532	5.725	3.278	At most 3*

Cape Verde				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
56.234	36.392	33.665	25.231	None*
43.356	28.746	26.547	17.332	At most 1*
21.742	13.256	19.365	13.263	At most 2*
9.256	2.136	10.153	5.585	At most 3*
Senegal				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
71.434	43.192	71.965	35.645	None*
53.856	30.756	66.947	42.332	At most 1*
23.942	21.295	45.365	33.243	At most 2*
10.251	2.135	9.153	7.521	At most 3*
Sierra Leone				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
53.451	43.192	45.115	25.645	None*
32.853	22.356	36.237	22.732	At most 1*
15.942	11.294	25.165	13.255	At most 2*
6.251	5.235	7.113	16.423	At most 3*
Gambia				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
46.451	26.190	37.115	21.645	None*
39.850	23.456	26.237	22.732	At most 1*
20.942	11.224	25.165	13.123	At most 2*
5.251	5.205	7.113	9.023	At most 3*
Swaziland				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
89.435	76.450	75.345	52.645	None*
79.822	65.336	66.231	49.732	At most 1*
45.971	31.194	55.285	32.693	At most 2*
33.249	23.300	47.473	25.922	At most 3*
Cameroun				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
121.256	53.192	65.965	45.645	None*
152.856	46.156	56.947	32.332	At most 1*
23.942	11.345	42.165	24.243	At most 2*
10.251	3.635	3.253	2.521	At most 3*
Niger				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
92.426	49.143	65.115	26.341	None*
62.851	32.456	46.237	23.632	At most 1*
18.942	13.294	22.165	14.219	At most 2*
7.251	2.235	5.38	8.452	At most 3*
Sudan				
Trace	Max-eigen	Critical	Critical	Hypothesized

statistic	statistic	V (Trace)	V (Max)	No of CE(s)
66.451	46.190	35.245	26.725	None*
49.850	32.456	27.237	23.412	At most 1*
22.942	15.134	23.165	16.123	At most 2*
4.251	8.236	5.832	3.125	At most 3*
Mauritania				
Trace statistic	Max-eigen statistic	Critical V (Trace)	Critical V (Max)	Hypothesized No of CE(s)
76.135	56.560	63.145	52.645	None*
65.822	53.236	42.231	49.732	At most 1*
12.371	11.194	25.685	23.194	At most 2*
1.249	0.300	0.173	0.021	At most 3*

4.2. EMPIRICAL RESULTS

In Table 5, effects of conditional volatility on exchange rates are reported. The GMM results show that the coefficient of current exchange rate volatility for Nigeria is -0.015 with t-ratio of -2.539, for Zambia, it is -0.017 with t-ratio of -3.119, for Namibia, it is -0.245 with t-ratio of -9.150, for Tanzania, it is -0.196 with t-ratio of -6.345, for Gambia, it is -0.078 with t-ratio of -5.421, for Swaziland, it is -0.096 with t-ratio of -5.389, for Madagascar, the coefficient is -0.015 with t-ratio of -2.344, for Uganda it is -0.007 with t-ratio of -11.991, for Mozambique, the coefficient is -0.023 with t-ratio of -2.755, for Malawi, it is -0.042 with t-ratio of -1.963, for Sudan, the coefficient is 0.006 with t-ratio of -7 and for Mauritania, the coefficient is -0.177 with t-ratio of -9.456. Similarly, the coefficient is -0.012 with t-ratio of -2.519 for Senegal, -0.017 with t-ratio of -1.219, -0.015 with t-ratio of -2.344 for Cameroun, -0.127 with t-ratio of -5.941 for Niger.

By implication, bad news regarding exchange rate speculation also impact negatively on total exports of majority of Africa countries except Zambia while both historical and current volatility in exchange rate also had adverse effects on exports of all countries.

Similarly, the result suggests negative relationship between exports and global financial crisis in all the countries. This result denotes that global financial crisis led to decline exports from Africa to United States. However, this finding does not apply for Liberia where the results are insignificant. The results further suggest negative relationship between exports to the US and exchange rate volatility. The ARCH & GARCH terms are significant at the 5% level. The significance of both the ARCH and GARCH terms indicates that, lagged conditional variance and lagged squared stochastic disturbance have an impact on the conditional variance.

Table 5. *GMM Results of Total Export*

Variables	Nigeria	Zambia	Namibia	Tanzania
Δf	-0.003*** (-1.992)	-0.124 (-1.489)	-1.003*** (-1.789)	-1.201* (-3.480)

Δy	0.521** (2.380)	0.025* (6.233)	0.024** (2.050)	0.024 (1.330)
$\Delta \sigma_t^2$	-0.015** (2.539)	-0.017 (-3.119)	-0.245* (-9.150)	-0.196* (-6.345)
$\Delta \sigma_{t-1}^2$	-0.021* (17.429)	-0.132 (-3.799)	-0.013* (-3.587)	-0.129* (4.568)
C	0.639* (5.000)	1.032 (1.354)	0.620** (2.970)	1.134*** (1.956)
Variance Estimates				
ARCH (1,1)	-0.052* (-5.465)	-0.012*** (-1.971)	-0.012* (-19.672)	-0.032* (-3.672)
GARCH (1,1)	1.379* (9.758)	0.062** (2.015)	1.071** (2.350)	0.351*** (1.986)
J-Statistic F-stat DW-Stat Adjust R^2	0.001 59.367 1.902 0.732	0.000 26.177 2.005 0.922	0.002 39.465 2.902 0.632	0.001 17.353 1.994 0.592
Variables	Madagascar	Uganda	Mozambique	Malawi
Δf	-0.001*** (-1.984)	-0.061** (-2.911)	-0.167 (-3.182)	-0.025 (-2.200)
Δy	0.022 (4.211)	0.009 (2.250)	0.001 (1.998)	0.007 (3.100)
$\Delta \sigma_t^2$	-0.015** (-2.344)	-0.007* (-11.991)	-0.023** (-2.755)	-0.042*** (-1.963)
$\Delta \sigma_{t-1}^2$	-1.005* (-10.000)	-0.174* (-11.935)	-0.091** (-2.455)	-0.014* (-3.022)
C	0.031 (1.890)	0.015*** (1.995)	0.114 (1.333)	1.255* (5.660)
Variance Estimates				
ARCH (1,1)	-0.322* (4.016)	-0.001* (3.002)	-0.062*** (1.978)	-0.021* (7.695)
GARCH (1,1)	0.271* (6.233)	0.399** (2.730)	0.316* (5.052)	0.119** (2.026)
J-Statistic F-stat DW-Stat Adjust R^2	0.000 122.55 2.002 0.961	0.000 106.247 2.955 0.752	0.001 56.273 2.09 0.875	0.001 99.243 1.999 0.625
Variables	Senegal	Sierra Leone	Gambia	Swaziland
Δf	1.003** (2.156)	-0.124 (-1.489)	-0.433** (-2.189)	-0.118* (-5.721)
Δy	0.021*** (1.980)	0.015* (6.423)	0.126* (4.260)	0.025* (3.997)
$\Delta \sigma_t^2$	-0.012** (2.519)	-0.017 (-1.219)	-0.078* (-5.421)	-0.096** (-5.389)

$\Delta\sigma^2_{t-1}$	-1.021* (6.493)	-0.152* (-3.179)	-1.160** (-2.167)	-0.023 (-1.000)
C	0.149* (5.000)	1.032 (1.054)	0.038* (9.450)	0.124* (3.975)
Variance Estimates				
ARCH (1,1)	-0.072* (-5.145)	-0.042*** (-1.951)	-0.002* (-4.531)	-0.011*** (-1.839)
GARCH (1,1)	1.379* (9.758)	0.062** (2.015)	1.571* (13.395)	1.331* (4.650)
J-Statistic F-stat DW-Stat Adjust R^2	0.000 19.367 1.782 0.932	0.000 26.157 2.005 0.978	0.000 94.168 2.002 0.562	0.001 45.329 1.182 0.924
Variables	Cameroun	Niger	Sudan	Mauritania
Δf	-0.011*** (-1.984)	-0.081 (-2.911)	-0.140 (-2.081)	-0.002* (-5.111)
Δy	0.012* (9.571)	0.001** (2.150)	0.023 (2.397)	0.326 (2.491)
$\Delta\sigma^2_t$	-0.015** (-2.344)	-0.127* (-5.941)	-0.006** (-7.000)	-0.177** (-9.456)
$\Delta\sigma^2_{t-1}$	-0.025* (-3.479)	-0.154* (-12.135)	-0.001** (-2.345)	-0.013** (-2.097)
C	0.131 (1.890)	0.015*** (1.965)	0.139* (3.798)	0.002*** (1.879)
Variance Estimates				
ARCH (1,1)	-0.142* (2.301)	-0.001* (3.92)	-0.001* (1.876)	-0.012* (4.003)
GARCH (1,1)	0.217* (4.213)	0.139** (2.130)	1.179* (4.952)	0.372*** (1.924)
J-Statistic F-stat DW-Stat Adjust R^2	0.000 24.536 2.000 0.861	0.000 16.218 2.153 0.752	0.001 29.262 1.891 0.772	0.001 88.300 2.126 0.652
Instruments: (-1),y(-1),y(-2), f(-1), f(-2) $\sigma^2(-2)$, *e(-1),* $1(-2)$ *C* p-value are in parenthesis below each coefficient estimate, *(**)(***) indicates significance of coefficient @ 1% (5%) (10%) respectively				

The results of conditional volatility based on E-GARCH (1, 1) model are reported in Table 6. The volatility coefficient as measured by the E-GARCH variable passes the significance test implying that volatility in exchange rate is unpredictable in Africa countries.

Table 6. *Estimates of Conditional Volatility based on E-GARCH (1, 1) Model*

Variables	Nigeria	Zambia	Namibia	Tanzania
μ	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
b_0	0.360* (0.001)	0.024 (1.538)	0.034** (0.005)	0.029 (1.228)
b_1	1.002* (0.000)	1.011*** (0.523)	1.052** (0.042)	1.010*** (0.730)
b_2	0.007* (0.001)	0.065* (0.001)	0.024*** (0.367)	0.025** (0.004)
b	-0.785** (0.001)	-0.039** (0.005)	-0.118* (0.000)	-0.122* (0.000)
Log L AIC SC HQC B-P-G	1.035 -2.834 -1.360 -1.064 1.678	7.356 -1.235 1.164 1.085 1.984	2.310 -1.033 1.156 1.447 1.657	5.4923 -1.034 2.192 1.955 1.566
Variables	Madagascar	Uganda	Mozambique	Malawi
μ	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
b_0	0.052* (0.000)	0.011 (0.039)	0.007 (0.051)	0.021 (0.008)
b_1	1.713* (0.001)	1.016** (0.023)	1.052** (0.002)	1.037* (0.000)
b_2	0.123* (0.000)	0.016 (0.584)	0.001* (0.007)	0.0725*** (0.119)
b	-0.115* (0.000)	-0.049* (0.000)	-0.928* (0.000)	-0.022* (0.000)
Log L AIC SC HQC B-P-G	1.489 0.001 39.067 1.902 1.736	7.543 0.001 29.167 2.085 1.895	9.451 0.001 29.167 1.902 1.655	6.528 0.001 29.167 1.902 1.667
Variables	Senegal	Sierra Leone	Gambia	Swaziland
μ	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
b_0	0.007 (0.054)	0.134 (0.009)	0.015** (0.014)	0.016** (0.019)
b_1	0.016 (0.648)	1.130* (0.000)	1.019*** (0.107)	1.035* (0.000)
b_2	0.017* (0.000)	0.018* (0.000)	0.019*** (0.013)	0.014* (0.000)

b	-0.145** (0.017)	-0.159* (0.000)	-0.124** (0.000)	-0.169*** (0.054)
Log L	1.125	9.627	1.061	6.49
AIC	-0.055	-2.154	0.001	0.001
SC	0.162	0.064	9.067	2.157
HQC	1.254	1.172	1.202	1.923
B-P-G	1.189	1.153	1.382	1.144
Variables	Cameroun	Niger	Sudan	Mauritania
μ	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
b_0	0.012* (0.000)	0.031 (0.039)	0.003 (0.051)	0.001 (0.008)
b_1	1.013* (0.000)	1.009** (0.023)	1.052* (0.002)	1.049** (0.120)
b_2	0.413* (0.000)	0.016 (0.254)	0.001* (0.007)	0.025*** (0.019)
b	-0.215** (0.004)	-0.049* (0.000)	-0.928* (0.000)	-0.022* (0.000)
Log L	1.489	7.543	9.451	6.528
AIC	0.000	0.000	0.001	0.000
SC	21.467	22.167	23.567	2.167
HQC	1.952	2.085	1.132	1.952
B-P-G	1.936	1.895	1.695	1.667
Figures in ( ) are p-values				

In Table 7, Ljung-Box Q-test and Ljung-Box Q^2-test statistics of standardized and squared standardized residuals respectively shows autocorrelation of residual sequence are statistically insignificant at the 5% level for all lags.

Table 7. *Autocorrelation of Standardized and Squared Standardized Residuals*

Variables	Ljung-Box $Q^{0.25}$			
	Nigeria	Zambia	Namibia	Tanzania
$Q^{0.25}$ (6)	0.046	0.001	0.002	0.001
	(0.735)	(0.116)	(0.100)	(0.007)
$Q^{0.25}$ (12)	2.390	0.047	0.001	0.062
	(0.735)	(0.115)	(0.006)	(0.135)
$Q^{0.25}$ (20)	0.008	0.0162	0.001	0.062
	(0.509)	(0.005)	(0.286)	(0.135)
Variables	Ljung-Box $Q^{0.25}$			
	Madagascar	Uganda	Mozambique	Malawi
$Q^{0.25}$ (6)	0.0271	0.062	0.001	0.062
	(0.281)	(0.135)	(0.056)	(0.095)
$Q^{0.25}$(12)	0.003	0.002	0.007	0.012
	(0.540)	(0.035)	(0.006)	(0.005)
$Q^{0.25}$(20)	0.002	0.046	0.001	0.014

	(0.018)	(0.092)	(0.024)	(0.023)
Variables	Ljung-Box $Q^{0.25}$			
	Senegal	Sierra Leone	Gambia	Swaziland
$Q^{0.25}$ (6)	0.015	0.029	0.001	0.012
	(0.041)	(0.176)	(0.079)	(0.005)
$Q^{0.25}$ (12)	0.003	0.015	0.001	0.091
	(0.068)	(0.005)	(0.032)	(0.360)
$Q^{0.25}$ (20)	0.001	0.002	0.001	0.062
	(0.017)	(0.857)	(0.024)	(0.113)
Variables	Ljung-Box $Q^{0.25}$			
	Cameroun	Niger	Sudan	Mauritania
$Q^{0.25}$ (6)	0.027	0.062	0.001	0.062
	(0.142)	(0.035)	(0.046)	(0.035)
$Q^{0.25}$(12)	0.003	0.004	0.007	0.001
	(0.125)	(0.035)	(0.153)	(0.467)
$Q^{0.25}$(20)	0.002	0.062	0.001	0.062
	(0.173)	(0.197)	(0.089)	(0.026)

Diagnostically, there is absence of autocorrelation in standardized residuals of mean equation. Therefore, estimates are consistent and reliable. However, ARCH effects are present in the variance equation

5. CONCLUSION

Empirically, volatility in exchange rate negatively and significantly affects exports in all selected Africa countries in the study. In fact, estimated GMM results show that current and historical volatility have negative and significant effects on total exports of all the Africa countries in the study. Also, the speculation effect of exchange rate volatility is negative and significant for all the Africa countries except Zambia. The effects of America's GDP, importing country is positive for all countries. This conforms to theoretical expectation that exports and income are positively related.

This could be explained by the fact that volatility in exchange rate reduces activities of investors by strengthening uncertainty over returns of a given investment. Supplementary production costs are procreated which firms pass on to consumers through price escalation. The joint effect is reduction in total exports. Monetary authorities in Africa should certify overall adherence to execution of exchange rate stabilization policies.

6. ACKNOWLEDGEMENTS

First author gratefully acknowledge the financial support from Edo University, Iyamho (EUI) and also appreciate all the constructive comments of the anonymous referees as well as the contributions of all the discussants at the 2018

Academy of Economics and Finance (AEF) Conference in Houston, Texas, US. Remaining errors are our responsibility.

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