	(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.

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