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EFFECTS OF EXCHANGE RATE VOLATILITY ON OUTPUTS IN SOME SELECTED WEST AFRICA COUNTRIES

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ABSTRACT: *This study investigates empirically the effect of exchange rate volatility on the output level of the five English speaking countries in ECOWAS, namely Nigeria, Ghana, Gambia, the Sierra Leones and Liberia, over the period 1991 to 2014. Co-integration test and error correction modelling were used as estimation techniques. Estimates of co-integration relations were obtained and the short-run and long-run dynamic relationships between the variables were obtained for each country utilizing the tests. In general, exchange rate volatility has a significant impact on outputs at least for all the countries considered in the study, with all except Liberia having negative impact.*

KEYWORDS: Exchange rate Volatility, ECOWAS

JEL; F36

INTRODUCTION

Many economies of the world are basically interested in measures that can guarantee them a viable and robust economic statues. These quest is more pronounced among the less developed countries (LDCs) than the developed countries (DCs) of the world. To achieve this noble objective, developing economic are constantly implementing policies that would not just increase their output but also, placed them in a very competitive position in the global economy. Among the English speaking countries in the ECOWAS sub-region in Africa, one of the policies embark upon is the management of their exchange rate level to encourage productivity. This step is in line with the understanding that exchange rate volatility (ERV) remain a source of concern as currency values partially determine the price paid or received for output and, consequently, this affects the profits and welfare of producers and consumers (Choudhri & Schembri, 2014). This implies that, ERV can influence the volume of output a country can produce since the cost of production is been determined by the cost of production.

In theory, scholars and researchers have put forward suggestions that exchange rate volatility may effects outputs negatively or positively. Bundesbank (2010) opined that market agents more than ERV determine the level of output. This position is been supported by the view of previous scholars like Cushman (1983) and Lastrapes (1992) who maintained that if economic agents are moderately risk averse the impacts of exchange rate volatility on outputs will be negative. Additionally, some scholar believed that the negative impact may come directly through uncertainty and adjustment costs, and indirectly through its effect on allocation of resources and government policies (Aliyu, Yakub, Sanni, & Duke, 2013). Also, some scholars reported the possibility of both positive and negative relationships, and some still submitted a no relationship between these variables (Bergvall, 2004; Lama & Medina, 2010). However,

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numerous studies still submitted the existence of positive relationship between ERV and output (Aron., Elbadawi, & Khan, 1997; Bahmani-Oskooee, 1991; Gbesola & Garba, 2014).

The overall evidence is best characterized as mixed as the results are sensitive to the choices of proxies for exchange rate volatility, sample period, model specification, and countries considered. Nevertheless, the relationship is still vital enough to be explored especially for the principal ECOWAS countries namely, Nigeria, Ghana, Gambia, Sierra Leones, and Liberia, due to various macroeconomic events, for instance the global financial crisis in 2007/2008. Due to these events the relationship between their major trading partners is of interest. More so, for most of these countries production activity have been one of the major engines of economic growth.

Based on the inconclusiveness of previous study in terms of theoretical and empirical findings, this study tries to take a different approach in analyzing the relationship. Previous work used autoregressive conditional heteroscedastic (ARCH) and generalized autoregressive conditional heteroscedastic (GARCH 1,1) to investigate the long run and the short run relationship between exchange rate volatility and output level. The existence of inconclusiveness in the explanation of the relationship between exchange volatility and output have led policy makers and researchers to investigate the nature and extent of the impact of such movements on volume outputs. However, this study investigate this relationship performing Granger causality test in the vector error correction (VECM) framework as in the study of Baak (2008). Furthermore, this study looked at the relationship from an aggregate point of view (ECOWAS) not at country level. Thus in the light of international trade, the purpose of this study is to investigate the impact of five

LITERATURE REVIEW

Theoretical explanation of the impact of ERV on macroeconomic parameter has been postulated by different scholars from different perspectives. Various approach like asset approach, the sterilization approach, exchange rate and the trade balance approach, and the overshooting exchange rates approach. The overshooting theory of exchange rates has been used in this studyfor it best explained exchange rate volatility since it give room for the incorporation of shocks in its analysis and modelling. Dornbusch (1976) opined that the hypothesis shows that with sticky prices in goods market, ERV is need to temporarily equilibrate the economy in response to monetary policies. Various scholars have contributed in the explanation of the nature of the relationship between ERV and countries output levels. Previous researchers like, Agu (2008); Arize, Malindretos, and Slottje, (2008); Brada and Jose (1988); Chit (2008); Dellas and Tavlas (2013); Hooper and Kohlhagen (1978) and Yin-Wong and Rajeswari (2013) in their separate analysis reported a negative relationship between ERV and macroeconomic indicators. Conversely, scholars like Broda (2011); Caglayan and Demir (2014); Choudhri and Schembri (2014); Hall, Hondroyiannis, Swamy, Tavlas, and Ulan (2010) and Shehu and Youtang (2012) maintained that there is a significant relationship between ERV and macroeconomic parameters. However, some studies submitted a mixed finding in the relation among the macroeconomic variables and ERV (Bahmani-Oskooee & Payesteh, 1993; Dognalar, 2002; Sercu & Vanhulle, 1992; Ye, Hutson, & Muckley, 2014; Yuksell, Kuzey, Ender, & Sevinc, 2012).

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Empirical reports from scholars like Aliyu *et al.*, (2013); Elbadawi, Kaltani, and Soto (2012); Elbadawi and Sato (2005); Gnimassoun and Coulibaly (2014); Lensink (1995) and Obadan (2006) maintained that an increase in ERV negative effect volume of outputs. On the other hand, some scholars in their submissions believed that the relationship between ERV and output is positive (Coudert, 2013; Division, 2009; Mordi, 2006; Olugbenga & Oluwole, 2011). However, the work of researchers like Kasman and Kasman (2006); Aliyu et al., (2013); Personal, Archive, Siew-ling, Mansor, and Khim-sen (2012) reported an ambiguous relationship between exchange volatility and macroeconomic parameters.

METHODOLOGY

This study investigates the long run and short run relationship between exchange rate volatility and output in some selected country in ECOWAS sub-region. As a tradition with any time series data, the unit root test is conducted using Augmented Dickey Fuller (ADF) tests. Also, the Co-integration by Engle and Granger (1987)) would be conducted. Since Co-integration does not indicate the direction of causality, the direction can be detected through the VECM model derived from long run vectors of Co-integration. As in the studies of Arize, Malindretos, and Slottje (2008), Baak (2008) and Aliyu *et al.*, (2013) the following additional specification were made as an adopted by this research as in Equation [1] and Equation [2] respectively.

[1] $$IIP = f(ERV, FC)$$

[2] $$IIP_{ijt} = \alpha_0 + \alpha_1 ERV_{ijt} + \alpha_2 FC_{ijt} + \varepsilon_{ijt}$$

Equation [2] transformed to Equation [3] in its log form

[3] $$\ln IIP_{ijt} = \alpha_0 + \alpha_1 \ln ERV_{ijt} + \alpha_2 \ln FC_{ijt} + \varepsilon_{ijt}$$

where IIP_{ijt} denotes index of industrial production used as a proxy for output which is measure as the total industrial productivity outlay for the years under consideration in the various countries, ERV_{ijt} is the volatility of bilateral exchange rates of the studied countries and is measure as the variance differential for the countries' exchange rates, FC_{ijt} is representing the crisis dummy due to the global financial meltdown in mid-2007 to the of 2008 and ε_{ijt} denotes the error term. All variables are in natural logarithms and *t* represents the time period. The main sources of the data are the data base of the World Bank World Development Indicators and various issues of World Investment Report (WIR) and International Financial Statistics (IFS).

Empirical Results

This discuss the results of various tests that was conducted. The ADF unit root tests, the Johansen co-integration tests and the VECM was conducted for all the selected countries respectively. The unit root tests results for the various countries as shown on Table 1 indicated that this series are non-stationary in their levels forms 1(0) since the t-statistic for all the series are statistically insignificant. However, all the series become stationary at order one 1(1). Therefore, this study concludes that the series co-integrate at order one and no higher order differencing is required. Also, this study agrees with the previous work of Nelson and Plosser (1982) but disagrees with Baak (2008).

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Furthermore, co-integration tests was conducted after the units root tests order one 1(1) results for the series was obtained. The Johansen and Juselius (1990) multivariate co-integration tests was used to test for the existence of co-integration relationship, both for trace and maximum eigenvalue statistics. From the overall results, there exist at least on co-integration vector in the system. Based on this, the study therefore conclude that the GDP growth level and exchange rate volatility exhibits a long relationship among the studied countries co-integrating system. This implies, that the series in the system move together and cannot move far from each other as been depicted by table 2.1 to 2.5 respectively.

Finally, VECM were conducted to test the short run relationship after the long run relationship has been established by the co-integration tests. Following the Baak (2008) approach, each explanatory variables where regressed at different lag and each lag variable that is found not significant will be omitted from the regression as shown on Table 3. The results suggest for the long-run equilibrium relationship among the variables in each export function and are further supported with the negative sign of the each of error terms coefficient (ECTijt-1) in the outputs function. Also, all systems passed the diagnostic tests that was performed.

The result suggests a positive relationship in the short-run between outputs and the bilateral exchange rate, for Nigeria and Ghana. This result denotes that, when depreciation of the exporting country's currency (depreciations of the domestic currency for the Ghana) usually leads to an increase in outputs (from the foreign trading partners). However, this finding does not apply for Liberia, Gambia and Sierra Leones, where the results are mixed and lead to sign ambiguity.

The short-run effects of the exchange rate volatility are more complicated. There are positive effects in the outputs of Liberia to her foreign trading partners, the results further suggest for the negative relationship between outputs and exchange rate volatility, from Sierra Leones and Nigeria to the international trading partners. The results are found to be mixed in the Ghana and Gambia systems. Therefore, as a conclusion, the effects of the exchange rate volatility to Ghana and Gambia are ambiguous, while the same relationship for Liberia and the Sierra Leones/Nigeria are positive and negative, respectively. Finally, the table also shows significant effects from the crisis dummy to outputs. Therefore, to take into account the crisis dummy in the systems is vital in order to capture the structural break that occurred during the 2007/2008 global financial crisis.

CONCLUSION

This study offers some new results for the exchange rate volatility and output in some selected ECOWAS countries over the period from 1991 to 2014. In order to capture for the short and long run relationship between the variables under estimation, this study performed the Johansen and Juselius (1990) tests and error correction model in order to capture for the short- and long-run relationship between the variables in the systems. In general, exchange rate volatility has a significant impact on outputs at least for all the countries considered in our sample, and the impact overall is negative except for Liberia.

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APPENDIX

Table 1: The Augmented Dickey Fuller (ADF) unit root tests results

Nigeria				
Data Series	**At Level**		**At first difference**	
	without time	**with time**	**without time**	**with time**
$IIPijt$	-2.427868 (4)	-2.521241 (4)	-8.874507(4)a	-9.102132(4)a
ERV_{ijt}	0.877209 (4)	-0.623721 (4)	-6.326191 (4)a	-6.342029 (4)a
$GARCH_{ijt}$	-1.813164 (4)	-2.007750 (4)	-6.755567 (4)	-6.760214 (4)a
Ghana				
Data Series	**At Level**		**at first difference**	
	without time	**with time**	**without time**	**with time**
$IIPijt$	-2.302174 (2)	-1.978127 (4)	-7.078184 (4)a	-8.204661 (a)
ERV_{ijt}	-1.601437 (4)	-1.202155 (4)	-6.3125610 (4)a	-6.301789 (4)a
$GARCH_{ijt}$	-1.467871 (4)	-1.808162 (4)	-5.780231 (4)a	-5.771231 (4)a
Gambia				
Data Series	**At Level**		**At first difference**	
	without time	**with time**	**without time**	**with time**
$IIPijt$	-2.341821 (4)	-3.141712 (4)	-8.701156 (4)a	-8.80132 (4)a
ERV_{ijt}	-1.416857 (4)	-1.181236 (4)	-5.894261 (4)a	-5.90170 (4)a
$GARCH_{ijt}$	-2.373271 (5)	-2.907617 (4)	-10.12402 (4)a	-10.31424 (4)a
Sierra Leone				
Data Series	**At Level**		**At first difference**	
	without time	**with time**	**without time**	**with time**
$IIPijt$	-2.024108 (4)	-1.316109 (4)	-9.109431 (4)a	-9.31651 (4)a
ERV_{ijt}	-1.371663 (4)	-1.041172 (4)	-5.814752 (4)a	-5.70811 (4)a
$GARCH_{ijt}$	-1.498918 (4)	-1.317004 (4)	-8.218312 (4)a	-8.47017 (4)a
Liberia				
Data Series	**At Level**		**At first difference**	
	without time	**with time**	**without time**	**with time**
$IIPijt$	-2.017113 (4)	-2.693139 (4)	-8.971640 (4)a	-9.10141 (4)a
ERV_{ijt}	-1.781733 (4)	-1.613718 (4)	-5.841613 (4)a	-5.56274 (4)a
$GARCH_{ijt}$	-2.71510 (4)	-3.101197 (4)	-5.619181 (4)a	-5.49010 (4)a

Notes: Figures in parentheses are the lag order selected based on the SIC where 'a' indicates significance at the 1% level of significant.

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The co-integration results for Nigeria

Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical
H0	H1						
r=0	r>0	76.80314*(**)	58.50	62.57	44.10114*(**)	30.16	28.67
r≤1	r>1	29.03021	37.02	44.65	17.21091	23.72	27.34
r≤2	r>2	18.36037	19.98	31.05	10.36611	18.90	19.72
r≤3	r>3	6.112041	10.01	17.12	4.310071	13.02	11.09
r≤3	r>3	1.4430915	3.16	4.13	1.611919	3.06	4.15

Note, the notation 'r' represents the number of co-integrating vectors. The superscript (**) indicates statistically significant at 5% and (*) at 1%. The critical values for the Johansen and Juselius test were obtained from Osterwald-Lenum (1992).

The co-integration results for Ghana

Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical
H0	H1						
r=0	r>0	78.02465*(**)	57.31	76.07	43.11325*(**)	30.27	32.60
r≤1	r>1	29.70216	37.33	54.46	14.21171	23.09	29.04
r≤2	r>2	18.35167	24.78	30.61	10.32131	18.06	17.20
r≤3	r>3	7.102310	15.41	17.14	4.301922	11.53	14.03
r≤3	r>3	1.013918	2.71	4.05	1.532921	2.01	4.60

Note, the notation 'r' represents the number of co-integrating vectors. The superscript (**) indicates statistically significant at 5% and (*) at 1%. The critical values for the Johansen and Juselius test were obtained from Osterwald-Lenum (1992).

The co-integration results for Gambia

Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical
H0	H1						
r=0	r>0	86.93364*(**)	68.52	76.07	47.10336*(**)	33.46	38.77
r≤1	r>1	39.83028	47.21	54.46	19.36090	27.07	32.24
r≤2	r>2	20.46938	29.68	35.65	12.46644	20.97	25.52
r≤3	r>3	8.002940	15.41	20.04	5.369981	14.07	18.63
r≤3	r>3	2.632959	3.76	6.65	2.632959	3.76	6.65

Note, the notation 'r' represents the number of co-integrating vectors. The superscript (**) indicates statistically significant at 5% and (*) at 1%. The critical values for the Johansen and Juselius test were obtained from Osterwald-Lenum (1992).

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The co-integration results for the Sierra Leone

Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical
H0	H1						
r=0	r>0	73.61454*(**)	45.32	52.16	46.10115*(**)	21.06	32.61
r≤1	r>1	24.44135	30.20	39.01	16.35102	22.07	27.04
r≤2	r>2	13.52037	21.70	28.12	13.06501	15.18	21.11
r≤3	r>3	4.100821	10.11	15.26	5.327012	10.12	11.22
r≤3	r>3	3.711504	5.04	6.05	1.710918	2.10	3.11

Note, the notation 'r' represents the number of co-integrating vectors. The superscript (**) indicates statistically significant at 5% and (*) at 1%. The critical values for the Johansen and Juselius test were obtained from Osterwald-Lenum (1992).

The co-integration results for Liberia

Hypothesis		λ Trace	5% critical value	1% critical value	λ Max	5% critical value	1% critical
H0	H1						
r=0	r>0	83.10064*(**)	52.41	61.01	36.10336*(**)	24.46	29.42
r≤1	r>1	35.64127	40.32	49.67	11.24081	27.07	32.24
r≤2	r>2	18.01871	27.62	30.45	10.35104	19.32	22.03
r≤3	r>3	6.103412	13.22	18.10	4.001701	9.05	14.31
r≤3	r>3	1.642013	2.16	4.32	1.642013	2.16	4.32

Note, the notation 'r' represents the number of co-integrating vectors. The superscript (**) indicates statistically significant at 5% and (*) at 1%. The critical values for the Johansen and Juselius test were obtained from Osterwald-Lenum (1992)

Table 3: Error correction mechanisms dependent exports Sample: 1991 to 2014

Variables	**ECOWAS Countries**				
	Nigeria	**Ghana**	**Gambia**	**Sierra Leone**	**Liberia**
Constant	-0.0010 (-1.57)	0.007 (1.68)c	0.019 (4.673)a	0.003 (0.98)	0.014 (2.30)b
ECTijt-1	-0.2298 {-5.04}a	0.019{-1.79}c	-0.0250{-7.44}a	-0.029 {-5.74}a	-0.014 {-1.56}c
c ΔIIPijt-1	-0.684 (11.32)a	-0.280 (-4.43)a	-0.600 (-9.58)a	-0.377 (-6.19)a	-0.440 (-7.48)a
a ΔIIPijt-2	-0.264 (-3.83)a	-0.089 (-1.20)	-0.559 (-7.68)a	-0.320 (-5.31)a	-0.201 (-3.24)a
ΔIIPijt-3	0.101 (1.58)	-	-0.439 (-6.20)a	-0.179 (-3.24)a	-0.179 (-2.928)a
ΔIIPijt-4	0.164 (2.72)a	0.020 (0.30)	-0.509 (-7.99)a	-0.304 (-4.91)a	-0.192 (-3.13)a
ΔIIPijt-5	-	-	-0.461 (-7.40)a	-0.274 (-4.43)a	-0.224 (-3.524)a
ΔIIPijt-6	-	-0.139 (-2.34)b	-0.528 (-8.98)a	-0.210 (-3.72)a	-0.228 (-3.701)a

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ΔIIPijt-7	-0.200 (-3.57)a	-0.143 (-2.43)b	-0.584 (-9.67)a	-0.159 (-2.84)a	-0.110 (-1.708)c
ΔIIPijt-8	-	-	-0.580 (-9.30)a	-0.270 (-4.34)a	-0.089 (-1.48)
ΔIIPijt-9	0.103 (1.79)c	-	-0.483 (-7.24)a	-0.30 (-4.68)a	-
ΔIIPijt-10	0.101 (1.74)c	-	-0.403 (-5.99)a	-0.190 (-3.40)a	-0.094 (-1.763)c
ΔIIPijt-11	-	- 0.130 (2.18)b	-0.250 (-4.20)a	-	-
ΔIIPijt-12	0.139 (2.60)a	0.258 (4.30)a	-	- 0.210 (3.49)a	0.240 (4.33)a
ΔERVijt-1	-	-	-	-	- 0.156 (1.80)b
ΔERVijt-2	0.960 (2.59)b	-	0.010 (0.10)	0.260 (1.37)	-
ΔERVijt-3	-	0.250 (1.10)	-	-	-
ΔERVijt-4	0.750 (2.07)b	-	-	-	-
ΔERVijt-5	-	-	-	- 0.504 (2.49)b	-0.320 (-2.28)b
ΔERVijt-6	0.504 (1.46)	0.510 (2.30)b	-0.01 (-0.06)	-0.260 (-1.30)	-
ΔERVijt-7	0.840 (2.20)b	-	-	-	-
ΔERVijt-8	-	-	-	-	-
ΔERViijt-9	-	0.50 (2.420)b	-	-	-
ΔERVijt-10	0.430 (1.09)	-	0.213 (1.40)	-	--
ΔERVijt-11	-	-	-	0.240 (1.23)	-0.174 (-2.16)b
ΔERVijt-12	-	-	-	-	-
ΔFCijt-1	-	-0.027 (-1.64)	-	-	-
ΔFCijt-2	-	0.111 (2.62)a	0.134 (3.16)a	0.105 (2.37)b	0.149 (2.70)a
ΔFCijt-3	-	-0.065 (-1.53)	-	-0.092 (-2.10)b	-
ΔFCijt-4	-0.117 (-2.23)b	-0.104 (-2.43)b	-0.037 (-0.91)	-	-0.071 (-1.27)
ΔFCijt-5	-0.093 (-1.60)c	-0.057 (-1.208)	-	-0.031 (-0.73)	-
ΔFCijt-6	-0.081 (-1.05)	-	-	-	-
ΔFCijt-7	-0.113 (-1.12)b	-	-0.006 (-0.14)	-0.034 (-1.08)b	-0.110 (-1.05)c
ΔFCijt-8	-	-	-	-0.051 (-1.21)	-
ΔFCijt-9	-	-	-	-	-

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