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RESEARCH PAPER

Investigating Macroeconomic Shocks Transmission in African Countries

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Abstract
The recent events on the global scene have pointed once again to the importance of the increasing level of interdependence among markets. Economic volatility in one or several countries is easily transmitted to neighbors and even beyond. Consequently, national economic issues need to be considered from a regional/global perspective. Therefore, this paper seeks to investigate the extent of macroeconomic shocks transmission among eight leading African countries selected based on the size of the economy and regional distribution. This is critical to give a further assessment of economic integration efforts in the continent and also reveal the pattern of macroeconomic reactions to continental shocks among African countries especially in the aftermath of commodities and crude oil prices shocks and other unobserved factors including diffusion of technological progress. To achieve this objective, we employed Global Vector Autoregression (GVAR) using data from 1990 to 2016 to examine the extent of shocks transmission of Real GDP among these countries. Also, we introduced data from important trading partners from developed and developing countries as expected in a standard GVAR model. The GVAR method is very appropriate in this context as it combines individual country-specific models in which variables are related to country-specific foreign variables in a consistent manner. This method is preferred to others in the literature as it allows us to address the curse of dimensionality problem. The results show evidence of macroeconomic shocks transmission among African countries including the North African countries and Sub-African countries. However, the results further indicate that African countries are largely influenced by external shocks rather than shocks from the African region.
Keywords: Macroeconomics, GVAR, Integration, Africa.
JEL Classification: E6, C5, F15, N17.

Introduction

In recent years, there is an increasing demand for African economic integration. To this effect, several regional blocs in the continent have made efforts to improve trade relations. In some cases, they set strategies in motion to actualize the attainment of monetary union. Currently, Africa's current integration landscape contains an array of regional economic communities, including eight recognized as the building blocks of the African Union. These eight are namely: AMU, CEN-SAD, COMESA, EAC, ECCAS, ECOWAS, IGAD, and SADC (UNECA, 2015).

Specifically, ECOWAS agreed to form a second monetary union, the West African Monetary Zone (WAMZ) with the expectation that WAEMU and WAMZ will merge to form a wider monetary union in ECOWAS (Debrun et al., 2005). East African Community (EAC) which was formed 7 July 2000 planned to establish customs union (2005), common market

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(July 2010), monetary union, and ultimately political federation of East African States (Davoodi, 2012). Also, COMESA successfully established a Free Trade Area (FTA) on 31 October 2000 to facilitate regional integration through zero customs tariffs on goods traded among the Member States. This was followed by the establishment of the Customs Union in June 2009. In addition, COMESA aspires to become a common market by 2017 and a full Economic Community by 2025 (Woolfrey, 2016). Similar efforts are being made by other regional blocs across the continent.

To appraise efforts towards economic integration at the regional level, studies have been conducted with mixed results. However, the preponderance of the studies concentrates on the West African Monetary Zone (WAMZ), Southern African Development Community SADC, and the East African Monetary Union (EAMU). Studies by Coleman, 2011; Ekpoh and Udoh, 2013; Harvey and Cushing, 2015 constitute some of the empirical efforts in the WAMZ bloc and ECOWAS sub-region. Also, the study by Zerihun et al. (2014); Nzimande and Ngalawa (2016) & Nzimande (2017) are recent empirical investigations on business cycle synchronization and its determinants in SADC. Similarly, a study by Kishor & Ssozi (2011)& Mafusire, & Brixiova (2013) are notable efforts on shock transmission in East Africa.

Despite this plethora of studies at the sub-regional level, studies are scanty at the level of Africa and this is the ultimate goal of sub-regional efforts. Apart from scanty empirical activities in Africa as a whole, the bulk of the studies available in the region focused on business cycle synchronization alone without giving full consideration to macroeconomic shocks transmission. It is against this background that this study searches for empirical shreds of evidence of macroeconomic shocks transmission among African countries. This is very crucial as intraregional trade has been identified by key observers as the decoupling factor for emerging economies from the spillovers of industrial countries (Erten, 2012). Apart from this background, the study is divided into four sections. Section two discusses African trade especially intra-regional trade and economic growth. A review of the extant literature is addressed in section three while section four focuses on data and methods. Lastly, results and discussion are presented in section five.

Macroeconomic Performances of Selected African Countries

For comparative analyses, the key macroeconomic variables of selected eight African countries are put side by side. Table.1 shows the average rate of inflation between 2000 and 2016. Based on the data, Angola has the highest inflation throughout the period under consideration followed by Nigeria. This may be a result of huge revenue in these two oil-based economies. Cameroon and Algeria enjoy a relatively low and stable inflation rate among the selected countries. Similarly, table 2 presents data on the exchange rate in selected countries. The data shows the exchange of the local currency to US dollars. Cameroon and Cote d'Ivoire have the highest exchange rate and followed by Nigeria with continuous depreciation of her currency throughout the period. However, apart from Cameroon and Cote d'Ivoire, virtually all the selected countries have huge currency depreciation during the period under review. This may be connected to global commodity price shocks because most of these countries heavily rely on commodities exports.

Table. 3 and 4. Show countries' performances on GDP growth and Interest rate. On average, Nigeria has the highest GDP growth rate and followed by Angola. However, the two countries from North Africa seem to enjoy a relatively more stable economy given the persistence in their GDP growth rate. Kenya also exhibits similar characteristics. Data in table 4 as presented indicate that countries with inflation rates Angola and Nigeria inherently exhibit high-interest rates. This indicates that monetary authorities in these countries are using the high-interest rate to bring down inflationary

Table 1. Inflation Rate

Country	Variable	2000-04	2005-09	2010-14	20015-16
Algeria	Inflation (annual %)	0.339163	3.593624	4.699897	5.591346
Angola	Inflation (annual %)	145.6442	14.94417	10.85734	22.50774
Cameroon	Inflation (annual %)	1.867639	3.286789	2.210137	1.775875
Cote d'Ivoire	Inflation (annual %)	2.944873	3.114612	2.09552	0.981815
Egypt	Inflation (annual %)	4.693839	10.38264	9.600928	12.08606
Kenya	Inflation (annual %)	7.823932	13.99987	7.991421	6.439979
Nigeria	Inflation (annual %)	13.54267	10.92018	10.66224	12.35727
South Africa	Inflation (annual %)	5.489851	6.761159	5.346041	5.457267

Source: Research finding.

Table 2. Exchange Rate

Country	Variable	2000-04	2005-09	2010-14	20015-16
Algeria	Official exchange rate	76.32247	70.48911	76.96145	105.0673
Angola	Official exchange rate	46.75526	79.71898	95.22582	141.8586
Cameroon	Official exchange rate	650.2976	489.9233	493.2251	592.2288
Cote d'Ivoire	Official exchange rate	650.2976	489.9233	493.2251	592.2288
Egypt	Official exchange rate	4.798367	5.624897	6.311752	8.85833
Kenya	Official exchange rate	77.71946	72.29998	85.32371	99.84141
Nigeria	Official exchange rate	119.1234	130.6364	155.5046	222.9664
South Africa	Official exchange rate	8.02284	7.382228	8.660007	13.73427

Source: Research finding.

Table 3. GDP Growth Rate

Country	Variable	2000-04	2005-09	2010-14	20015-16
Algeria	GDP growth (annual %)	4.788179	2.991507	3.291508	3.531733
Angola	GDP growth (annual %)	3.28393	15.56393	4.81995	1.170814
Cote d'Ivoire	GDP growth (annual %)	-0.74849	2.159284	5.204077	8.589329
Egypt	GDP growth (annual %)	3.711187	6.05092	2.848337	4.334851
Kenya	GDP growth (annual %)	2.592647	4.553823	6.061739	5.781024
Nigeria	GDP growth (annual %)	11.52075	6.337742	5.742108	0.517912
South Africa	GDP growth (annual %)	3.612297	3.578838	2.545223	0.789104

Source: Research finding

Tables 4. Interest Rate

Country	Variable	2000-04	2005-09	2010-14	20015-16
Algeria	interest rate (%)	8.841667	8	8	8
Angola	interest rate (%)	94.98235	26.62869	18.02962	16.33118
Cameroon	interest rate (%)	19.33333	9.6	0	0
Cote d'Ivoire	interest rate (%)	0	5.299833	5.20685	5.224583
Egypt	interest rate (%)	13.4415	12.51	11.60833	12.6125
Kenya	interest rate (%)	17.91267	13.73597	16.59381	16.32312
Nigeria	interest rate (%)	21.87567	17.1258	16.733	16.85793
South Africa	interest rate (%)	14.05417	12.35833	9.041667	9.9375

Source: Research finding.

Apart from these key macroeconomic variables, we compare intraregional trade in Africa with other developing regions of the world in Figure 1. Specifically, we also examine intra-

regional trade performance in selected African countries. Starting with figure one, it is observable for the figure that intraregional trade in Africa is low compared to other developing regions of America and Asia. This suggests that the regions can do better than they are doing currently in terms of intra-regional trade as this may help to mitigate external shocks from outside the region. However, intra-regional trade has witnessed an improved performance in recent time moving from 12% in 1995 to 19% in 2016.

Figure.2. shows the extent of intra-regional African trade in selected countries. This is measured by African trade (Import and Export) as a percentage of total trade. From the figure, it is clear that Cote d'Ivoire has the largest volume of intra-regional African trade among the countries with a peak of 40% in 2013 but followed by a sharp decline in the year 2014. And, by 2016 the country only managed to achieve 25% intraregional African trade though this is still well above what other countries achieved during the same period. A country like Kenya and Cameroon also performed relatively well. However, big economies like Nigeria, Egypt, and South Africa have not been impressive in terms of intra-regional African trade but South Africa is relatively doing better in recent times.

Similarly, Figure 3 presents intra-trade performances at the sub-regional level, it can be deduced from the figure that the East-African region outperformed other regions with an average of 15% during the period under consideration but Southern-African countries are catching up quickly in this regard.

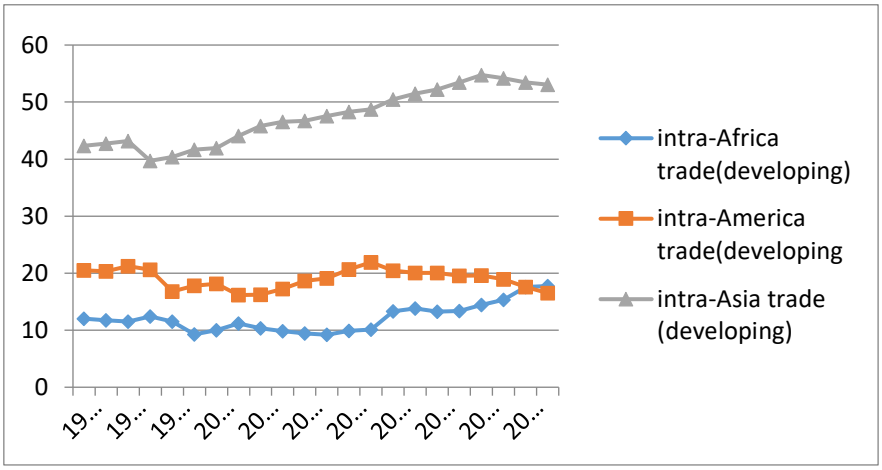

Figure 1. Compare Intra-African with other Developing Regions
Source: Author's calculations based on IMF DOT data.

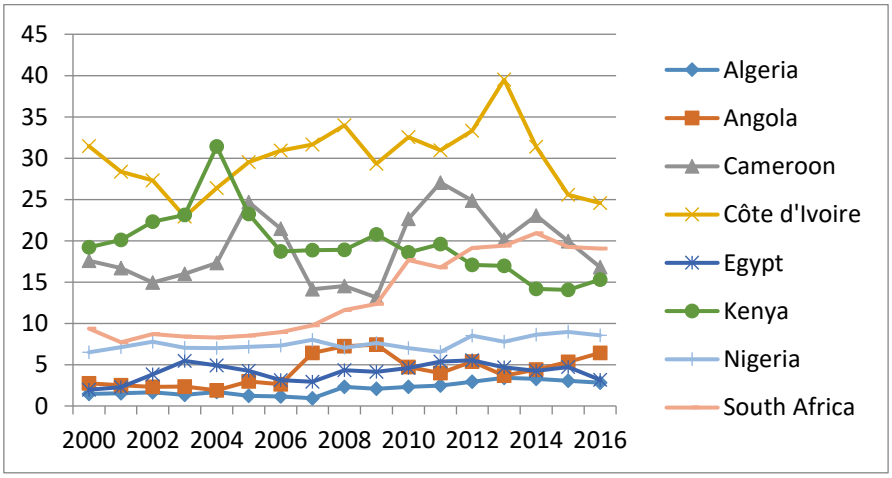

Figure 2. Intra –African Trade in Selected African Countries
Source: Author's calculations based on IMF DOT data.

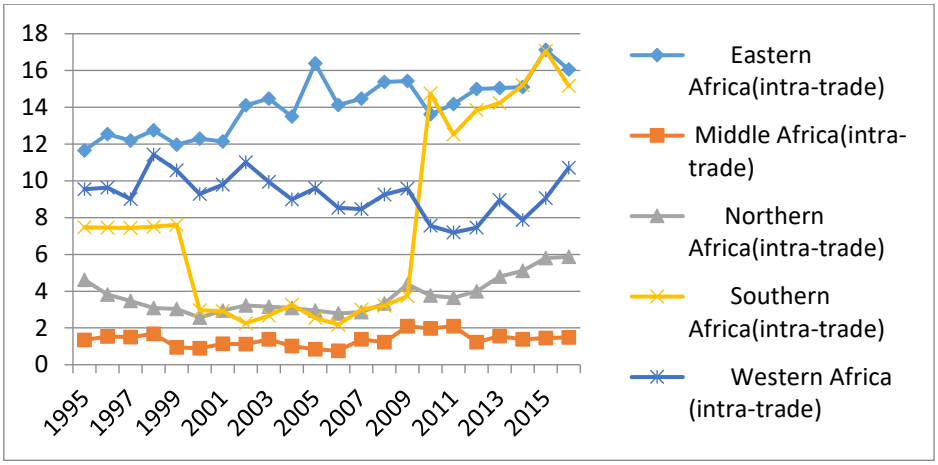

Figure 3. Intra-trade in Sub-Regions
Source: Author's calculations based on IMF DOT data.

Literature Review

The literature on macroeconomic shocks transmission is quite robust and extensive in recent times especially among the developed countries thanks to the global 2008 financial crisis. However, Africa and other developing regions of the world have not benefited substantially from this literature. There is a paucity of literature on South-South macroeconomic shocks transmissions, unlike North-South macroeconomic shocks transmissions. As a result of this, the bulk of the review in this study focused on North-South macroeconomic shocks transmissions.

Bayoumi and Swiston (2009) employed Vector autoregressions of real growth from1970 to estimate spillovers between the United States, the euro area, Japan, and an aggregate of smaller countries. They found that the United States generates the largest spillovers to other regions and they are principally transmitted through financial channels. Poirson and Weber's study (2011) used a VAR framework to establish that the U.S. and Japan are the key source of growth spillovers during the crisis and the recovery process for many economies.

In another related study by Erten (2012), the study adopted a Bayesian vector autoregressive (BVAR) technique to analyze the robustness of emerging economies' growth performance to several external demand shocks. The study found that more than fifty 50% of the variation in the real GDP growth of Latin American emerging economies is explained by external factors from Eurozone and the U.S. What runs across these studies is that the external shocks from the Eurozone, U.S Japan, and China systematically responsible for a large portion of the variation in domestic GDP growth of many countries.

Focusing on Africa, a study by Kose and Riezman (2001) analyzed the role of external shocks in explaining macroeconomic fluctuations in African countries using a stochastic, dynamic, multi-sector equilibrium model of a small open economy. The model was specifically calibrated to represent a typical African economy. In the model, the external shocks consist of trade shock and financial shock. While trade shock is modeled as fluctuations in the prices of exported primary commodities and imported capital goods, the financial shock is modeled as fluctuations in the world real interest rate. The results of the study confirmed that trade shock has an important role to play than financial shocks in explaining the macroeconomic fluctuation of African countries.

In another related study by Adom et al. (2010), they investigated the existence of macroeconomic interdependence in eight countries in the continent i.e. Algeria, Egypt, Côte d'Ivoire, Nigeria, Cameroon, Kenya, Angola, and South Africa. The countries were selected from different sub-regions across the continent based on economic relevance. It was observed in the study that there are common trends in real outputs, price levels, private consumptions,

investments, trade flows, and government expenditures among these eight countries. Also, they noted that there exist common cycles in real outputs, investments and trade flows among these eight countries. And the study concluded that there is the existence of some macroeconomic interdependence among these countries.

Data and Methodology

Basically, for this study GVAR method was adopted to investigate the existence of macroeconomic shock transmission among the selected African countries. To carry the analysis required for this study, quarterly data of Real GDP, Inflation Rate, and Interest Rate data were obtained for each country included in the GVAR model estimated. The data were sourced from the World Bank Development Indicators (WDI) and the International Monetary Fund database**.** These macroeconomic variables as introduced in our model represent fundamental channels through which goods and financial markets interact. In line with the work of Smith and Galesi (2014) and Oyelami and Olomola (2016), cross-country linkages were performed using a weight matrix constructed from trade.

Specifically, two countries were selected from four major regional blocs based on economic size. We also introduced countries outside the continent selected based on their trade relations with African countries. The selected African countries are; Algeria, Angola, Cameroon, Cote Ivoire, Egypt, Kenya, Nigeria, and South Africa, and the countries outside the region include Brazil, China, Euro Area, India, Japan, and United States. Before estimating the specified GVAR model, efforts were made to investigate the descriptive properties and correlations of growth rate and inflation rate considered to be two important variables among selected African countries. This will provide an appropriate guide during shocks simulation.

Table 5. Descriptive Statistics of Growth

	ALGERIA	ANGOLA	COTE	EGYPT	KENYA	NIGERIA	SOUTH
Mean	3.196830	53.07318	2.514039	8.679952	9.526827	11.78470	5.817635
Median	3.253684	13.73145	2.467191	9.421577	9.378396	11.57798	5.701901
Maximum	8.894585	324.9969	6.308528	18.31683	26.23982	18.87365	11.53645
Minimum	0.339163	7.279562	0.453030	2.269757	1.961308	5.382224	1.385382
Std. Dev.	2.523971	81.98811	1.626209	4.313826	5.433985	3.820984	2.226994
Skewness	0.489532	2.408610	0.790428	0.227704	1.644452	0.187828	0.699122
Kurtosis	2.557137	8.245008	2.831945	2.735612	6.391780	2.192336	4.404694
Jarque-Bera	0.817909	35.92363	1.790203	0.196419	15.81075	0.562019	2.782513
Probability	0.664344	0.000000	0.408566	0.906459	0.000369	0.755021	0.248763
Sum	54.34611	902.2440	42.73866	147.5592	161.9561	200.3400	98.89979
Sum Sq. Dev.	101.9269	107552.8	42.31290	297.7456	472.4511	233.5987	79.35207

Source: Research finding.

Table 6. Growth Correlation

ALGERIA	ANGOLA	CAMEROON	COTE	EGYPT	KENYA	NIGERIA	SOUTH	
ANGOLA	-0.168335							
CAMEROON	0.115606	-0.116223						
COTE_D	-0.250960	-0.053420	0.333197					
EGYPT	-0.322229	0.638040*	-0.317034	-0.129191				
KENYA	-0.170324	0.331470	0.165682	0.305248	0.000164			
NIGERIA	0.124525	0.239399	0.445717	-0.221761	0.062739	0.043917		
SOUTH	0.274070	0.623914*	0.019838	-0.480618	0.314094	0.080106	0.305105	1.000000

Source: Research finding.

Note: * significant at 5% significance level

Table 7. Inflation Correlation

	ALGERIA	ANGOLA	COTE	EGYPT	KENYA	NIGERIA	SOUTH
ALGERIA							
ANGOLA	-0.561805*						
COTE_	-0.276751	0.159931					
EGYPT	0.588219*	-0.627171*	-0.065456				
KENYA	0.147692	-0.148789	0.595375*	0.497932*			
NIGERIA	-0.165005	0.012648	0.229204	-0.150416	-0.134165		
SOUTH	0.222891	0.002438	0.387338	0.250121	0.309984	-0.197365	1.000000

Source: Research finding.
Note: * significant at 5% significance level

GVAR Model Specification

GVAR model is majorly designed to solve the problem of dimensionality. However, it is not fundamentally different from ordinary VAR. It can simply be referred to as an augmented VAR model (VARX) that incorporates domestic variables and their foreign counterparts calculated as weighted averages using any variable of interest such as trade and capital flows among the countries. Also, in (VARX) model, global variables such as oil price and any other global commodity price of interest are included. Following the work of Dees, Mauro, Pesaran & Smith (2007), country-specific VARX*(1, 1) models can be specified for all countries.

$$X_{it} = \delta_{i0} + \delta_{i1}t + \Phi_i X_{i,t-1} + \Lambda_{i0}X^*_{it} + \Lambda_{i1}X^*_{i,t-1} + \Gamma_{i0}d_t + \Gamma_{i1}d_{t-1} + \varepsilon_{it} \quad (1)$$

Where t is the linear time trend, Φ is the k x k matrix of lagged dependent variables $X_{i,t-1}$, Λ_{i0} and Λ_{i1} represent $k_i \times ki^*$ matrices of coefficients of foreign variables X^*_{it} and $X^*_{i,t-1}$ including both contemporaneous and lagged values. Also, Γ_{i0} and Γ_{i1} represents $k_j \times kj^*$ matrices of coefficients of global variables d_t and d_{t-1} while ε_{it} is a $k_1 \times 1$ vector of idiosyncratic shocks assumed to be serially uncorrelated with zero mean and nonsingular covariance matrix. Respectively, δ_{i0} and δ_{i1} serves as intercept and trend.

Empirical Results

In an attempt to determine the fitness and stability of GVAR, which constitute important attributes of estimated GVAR results for reliable inference purposes, three features are very fundamental. They are; eigenvalues, the model persistence profile, and the graphs of the generalized impulse responses (Dees et al., 2007). A GVAR model is considered stable if all eigenvalues stay within the unit circle with a certain number fallen on the unit circles, persistence profile converges to zero within 40 periods and the impulse responses stabilizes at about 40 horizons. In addition, the weak exogeneity test of foreign variables should also be established. The three conditions aforementioned are inherently part of the assumptions that underline the GVAR model which is discussed in the appropriate section; however, the test of weak exogeneity of foreign variables is a preliminary test that deserves immediate attention.

The Weak Exogeneity Test of Foreign variables

The estimation of the GVAR model is predicated on the assumption that foreign variables are weakly exogenous. Following Dees *et al.* (2007), a weak exogeneity test was performed using

joint significance of the estimated error-correction terms for the country-specific foreign variable. The results are presented in Table 8. The results of exogeneity tests show that we can accept the hypothesis of weak exogeneity for most of the foreign variables excerpt in a few cases of government expenditure in euro, Japan, and Ivory-cost. Largely, the hypothesis of weak exogeneity assumptions is accepted at a 5% level in 30 out of 36 cases, representing 83%.

Table 5. Descriptive Statistics of Growth

Country	F test	Fcrit_0.05	ys	ps	rs
ALGERIA	F(2,84)	3.105157	23.53718	3.862752	1.614349
ANGOLA	F(2,84)	3.105157	3.359657	3.563843	3.395034
BRAZIL	F(2,84)	3.105157	14.16504	5.534567	4.546404
CAMEROON	F(2,84)	3.105157	7.169783	4.59146	3.601624
CHINA	F(3,83)	2.714565	3.814685	7.541466	3.326376
IVORY	F(3,83)	2.714565	6.918727	1.125989	0.790058
EGYPT	F(2,84)	3.105157	1.752797	8.483761	3.033178
EURO AREA	F(2,84)	3.105157	14.65919	1.016771	0.28383
INDIA	F(0,86)				
JAPAN	F(1,83)	3.955961	10.12576	1.315605	4.00066
KENYA	F(1,83)	3.955961	8.77E-05	40.37445	4.080953
NIGERIA	F(2,84)	3.105157	2.122895	5.446117	4.027521
SOUTH AFRICA	F(2,84)	3.105157	3.572325	0.236387	6.0054
UNITED STATES	F(2,84)	3.105157			

Source: Research finding.

Average Pairwise Cross-section Correlation

Contemporaneous Effects of Foreign Variables on Domestic Counterparts

Table 9 shows how contemporaneous effects of foreign variables on their domestic counterparts in selected African countries. The essence of this analysis is to establish contemporaneous inter-linkages of variables across selected countries. In this context, attention is directed towards the selected African countries. The results from this analysis are interpreted in the form of elasticity because they indicate the degree of responsiveness of domestic variables to change in their foreign counterparts. Also, the decision of significance is arrived at using Robust- t ratios. It can be established from the results that real output has the highest of level co-movement between domestic variables and their foreign counterparts. Specifically, in the case of output, 6 out of 8 selected African countries have their output significantly influenced by foreign output, 4 out of 8 in the case of inflation, and 0 out of 8 in the case of the interest rate.

Talking about the magnitude, 1% positive change in foreign real output in a given quarter will cause a 1.9% increase in output in Algeria, 0.2% in Egypt, 0.6% in Kenya, 2.0% in Nigeria, and 0.3% in South Africa. However, Angola and Cameroon appeared not to benefit from this positive change. Overall, the oil-rich countries of Algeria and Nigeria seem to benefit more from positive change in foreign output than other African countries. In the case of the inflation rate, the results show that the foreign inflation rate influences their domestic counterparts differently in selected African countries. But, focusing on statistically significant results, a 1% increase in the foreign inflation rate will bring about an increment of 0.13% in domestic inflation in Cameroon, 0.08% in the Ivory Coast, and 0.46% in Kenya. Contrarily, a Similar 1% increase in the foreign inflation rate causes a decrease of 0.03% in Egypt. However, while foreign real output and inflation rate demonstrate contemporaneous inter-linkages of variables,

between foreign and their domestic counterparts, interest rate fails to demonstrate similar potential.

Table 9. Contemporaneous Effects of Foreign Variables on Domestic Counterparts

		Y	p	r
ALGERIA	Coefficient	1.968*	-0.007	0.062
ALGERIA	t-ratio_White	(4.877)	(-0.550)	(0.643)
ANGOLA	Coefficient	-1.427*	0.0210	-1.587
ANGOLA	t-ratio_White	(2.323)	(1.423)	(-0.987)
CAMEROON	Coefficient	-0.832	0.136*	0.183
CAMEROON	t-ratio_White	(-1.913)	(3.206)	(0.822)
IVORY	Coefficient	-0.275	0.081*	0.353
IVORY	t-ratio_White	(-0.516)	(2.898)	(1.652)
EGYPT	Coefficient	0.276*	-0.039*	0.366
EGYPT	t-ratio_White	(2.742)	(-5.822)	(1.106)
KENYA	Coefficient	0.661*	0.461*	0.784
KENYA	t-ratio_White	(3.084)	(5.800)	(0.742)
NIGERIA	Coefficient	2.057*	-0.024	0.057
NIGERIA	t-ratio_White	(3.263)	(-0.453)	(0.697)
SOUTH AFRICA	Coefficient	0.319*	-0.005	0.059
SOUTH AFRICA	t-ratio_White	(2.611)	(-1.035)	(1.019)

Source: Research findings from the GVAR model. Note: Figures in brackets are White's adjusted t-ratio.*Indicate significance.

Generalized Impulse Response Functions

Impulse –Response Function in GVAR is similar to Impulse –Response Function obtained in other variants of VAR because they are all dynamic analyses that show how variables respond to shocks in other variables within the model. However, in the case of GVAR, Impulse – Response Function shows how domestic variables respond to shocks to either other domestic variables or foreign variables. With the capability provided by this important component of GVAR, it is possible to investigate international shocks transmission between domestic variables and foreign variables. Also, the tool provides the opportunity to visualize the extent of shocks propagation within the identified quarter or longer period. To empirically investigate the extent of shocks transmission among African countries, we simulated one standard error positive shock to RGDP in selected African countries but only present results that are significant to minimize space.

Result of the GIRF on one Standard Error Positive Shock to Real GDP

Figures 4-11 show the responses of Real GDP in selected African countries to one standard error positive shocks to other African countries in the model. Starting with Algeria in figure four, one standard error positive shock that increases Real GDP in Algeria by 0.14% at its peak positively affects RGDP in Angola, Cameroon, and Ivory Coast. However, the shock has a negative effect on RGDP in Egypt, Kenya, Nigeria, and South Africa though from the graph the effect is persistent both in the short run and long run. Also, one standard error positive shock in Egypt presented in Figure 5 has a positive influence on RGDP in all selected African countries except Cameroon. This suggests that Egypt has more macroeconomic links with other African countries than Algeria going by the level of symmetric responses to one standard error

positive shock from the country. The results of one standard error positive shock simulated for Angola and Cameroon failed to produce statistically significant results in terms of responses from other selected African countries.

In Figure 6, the graph of one standard error positive shock to REAL GDP in the Ivory Coast is presented. From the graph, selected African countries show asymmetric responses to this shock. The shock has a positive effect on RGDP in Algeria, Angola, and Cameroon while it produces a negative effect on RGDP in Egypt, Kenya, Nigeria, and South Africa. Also, the shock has a persistent effect both in the short run and long run in the case of Angola, Cameroon, Egypt, and Kenya but the effect seems to subside for other countries especially in the short run. Unlike the Ivory coast, the graph of one standard error positive shock to REAL GDP in Kenya has a persistent positive effect on RGDP of other African countries in the model except for Cameroon in the short run. However, in the long run, all African countries show signs of positive effects in their RGDP.

Focusing on the biggest economy in the continent Nigeria, the results of one standard error positive shock to RGDP in this economy is presented in figure 8. And it demonstrates that other African countries in the model show asymmetric responses in the short run. A positive shock to RGDP in Nigeria has a persistent positive effect on RGDP in Algeria, Angola, Egypt, Kenya, and the Ivory coast in the short run. However, it has a negative effect on neighboring country Cameroon. The effect of this shock on the South African economy which is the second biggest economy in the continent is also complicated as it shows a negative effect in the short run but turns positive in the long run. This demonstrates that despite the size of the Nigerian economy in Africa, the economy may not have close macroeconomic links with other African countries as expected. Generally, in the long-run RGDP in all selected African countries can be positively influenced by one standard error positive shock to RGDP in Nigeria.

In the case of South Africa, both one standard error positive and negative shock to RGDP were simulated this is based on the perceived economic influence of the country on other African countries through Foreign Direct Investment (FDI) in the telecommunication sector. However, these results are almost the same as that of Nigeria. A positive shock to RGDP in South Africa has a positive effect on RGDP in all selected African countries except Algeria and Cameroon in the short run. In the long run, the situation remains the same except for a bit of improvement in the case of Algeria. The results show that the two biggest economies (Nigeria and South Africa) in the continent have a mutual influence on each other, however, South Africa seems to have a more direct effect on the Nigerian economy. In addition, the results of one standard error negative shock to RGDP in South Africa have a negative effect on other countries in the region except for Cameroon that has consistently proven to be nonconformist.

To investigate how African countries respond to external shocks, we perform a simulation of one standard error negative shock to the Chinese economy which is currently the biggest trading partner with the continent. The results as presented in figure 11 indicate that one standard error negative shock to RGDP in China has a negative effect on RGDP in selected African including Cameroon in the short run. However, this does not persist in the long run as the effect dissipate and all the African countries in the model demonstrate the ability to converge back to their long-run equilibrium after the shock.

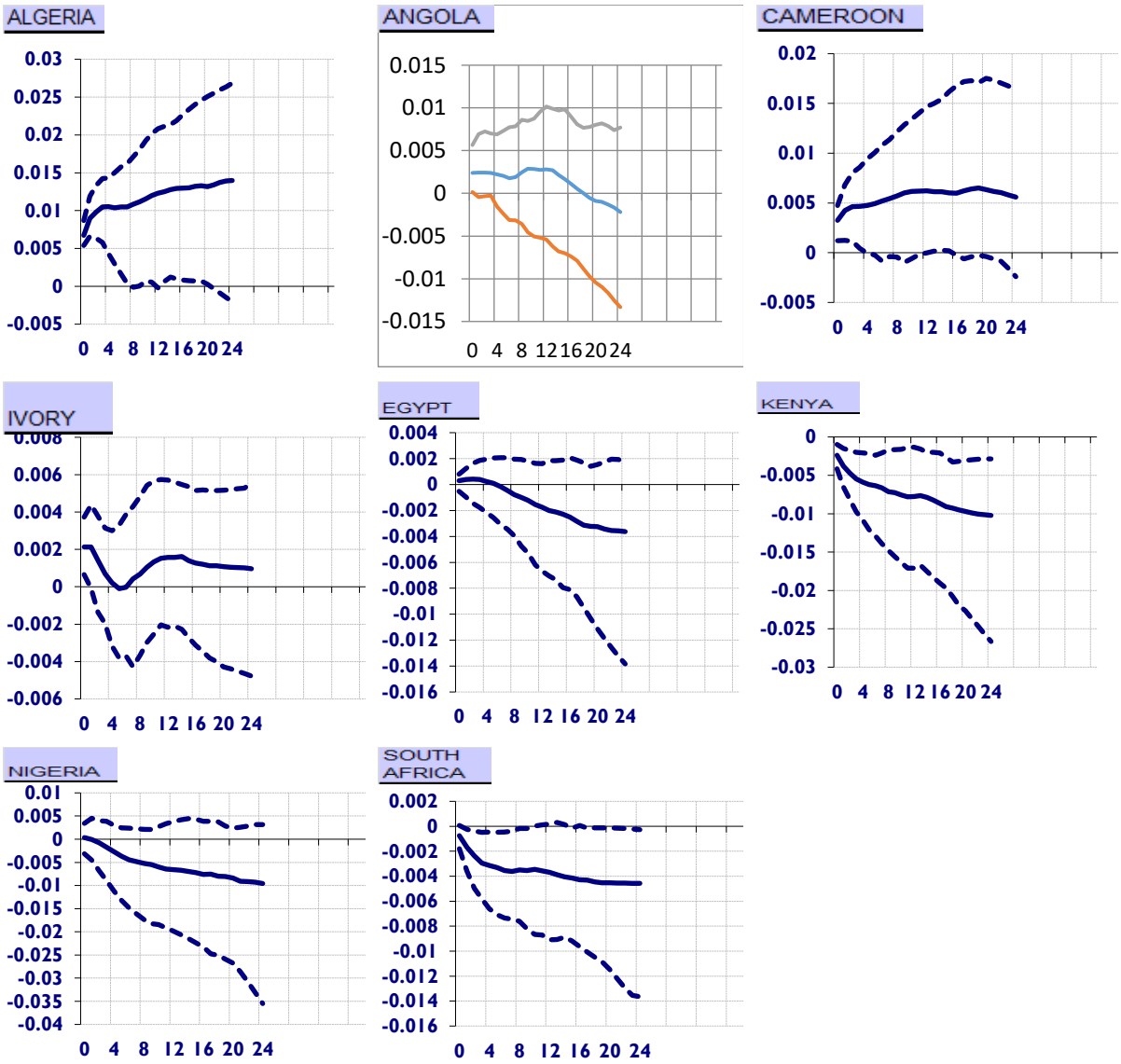

Figure 4. Generalized Impulse Response Functions One s.e. Positive Shock to ALGERIA REAL GDP
Source: Research finding.

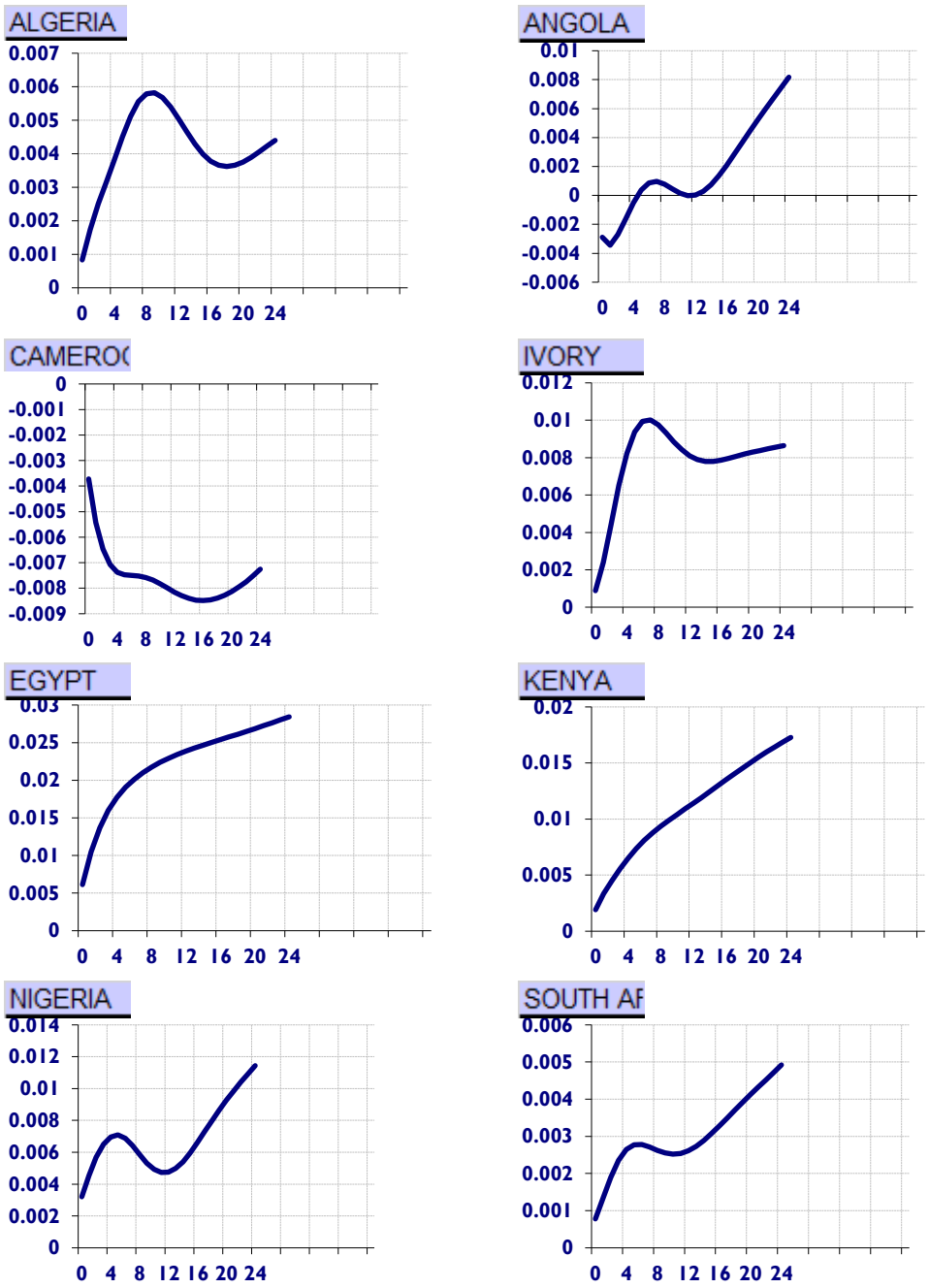

Figure 5. Generalized Impulse Response Functions One s.e. Positive Shock to EGYPT REAL GDP
Source: Research finding.

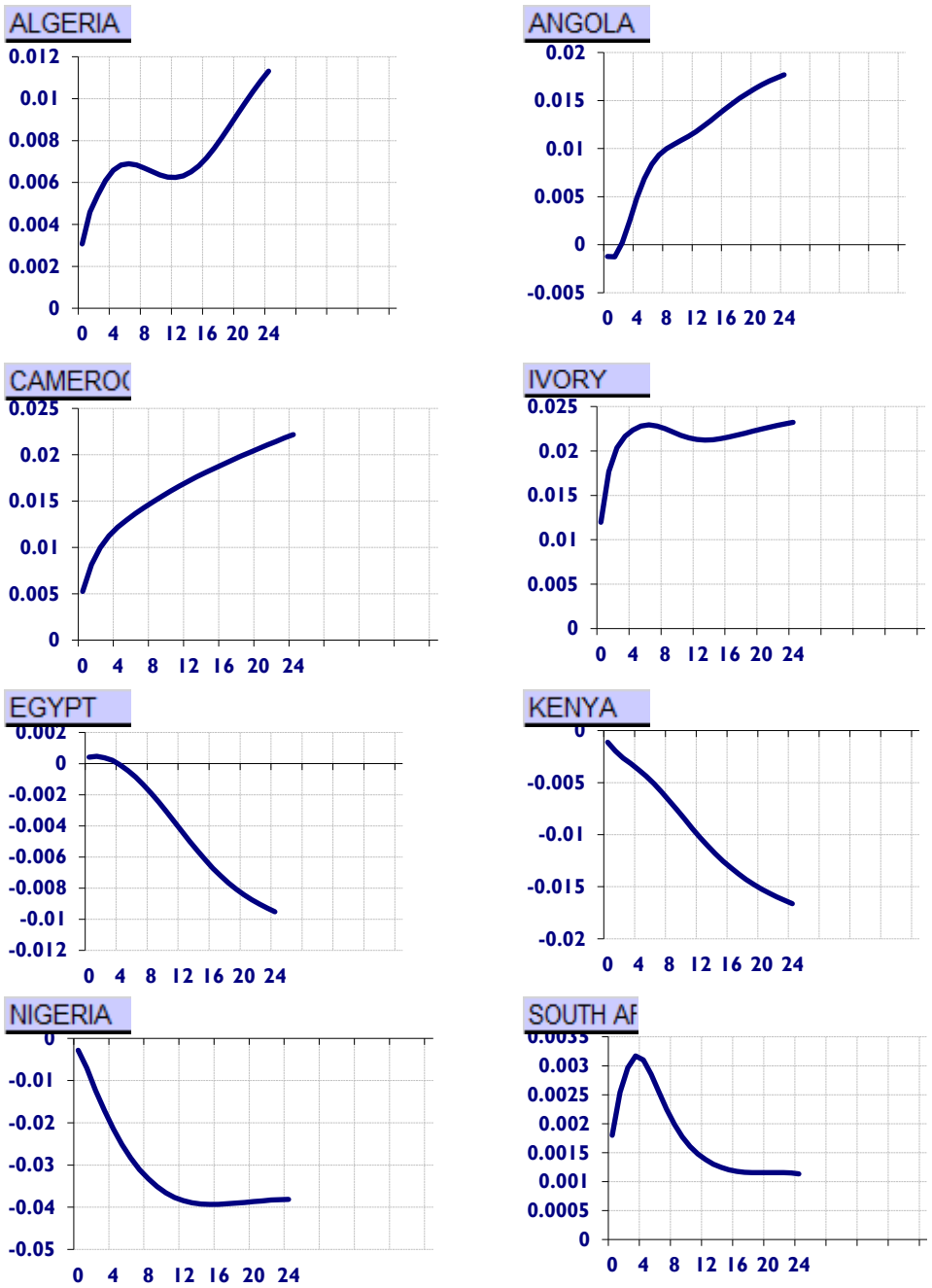

Figure 6. Generalized Impulse Response Functions One s.e. Positive Shock to IVORY REAL GDP
Source: Research finding.

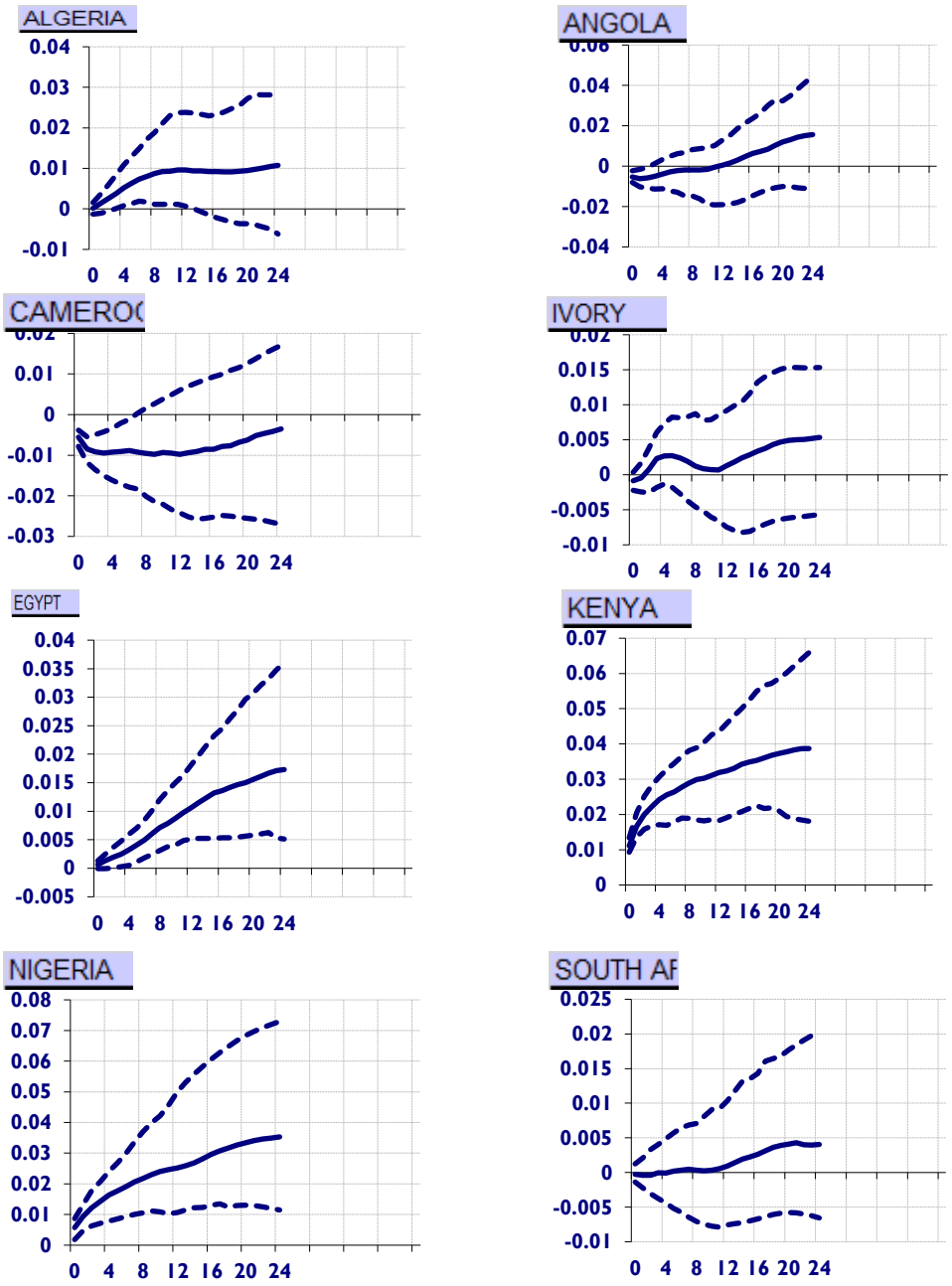

Figure 7. Generalized Impulse Response Functions One s.e. Positive Shock to Kenya REAL GDP
Source: Research finding.

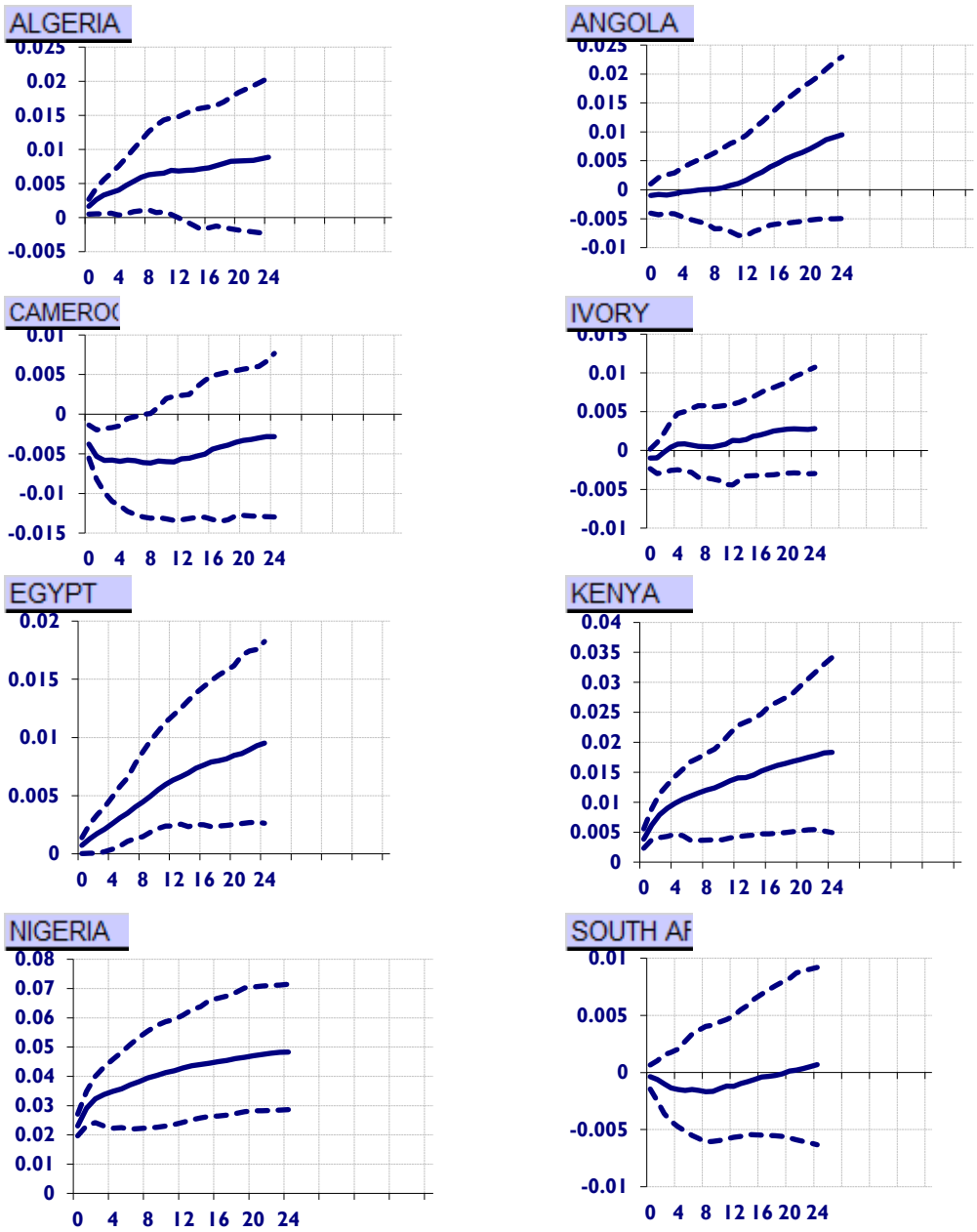

Figure 8. Generalized Impulse Response Functions One s.e. Positive Shock to NIGERIA REAL GDP
Source: Research finding.

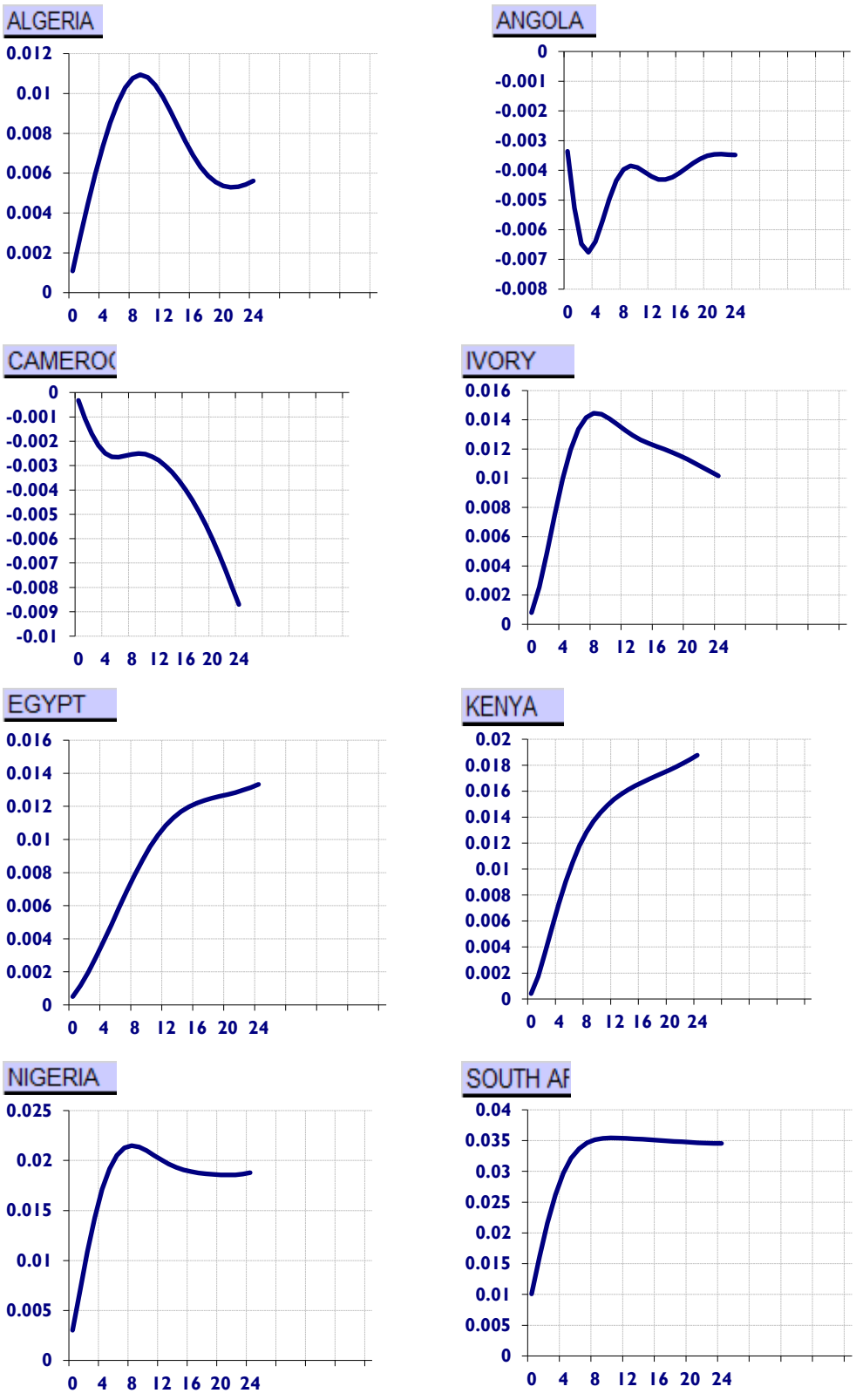

Figure 9. Generalized Impulse Response Functions One s.e. Positive Shock to SOUTH AFRICA REAL GDP

Source: Research finding.

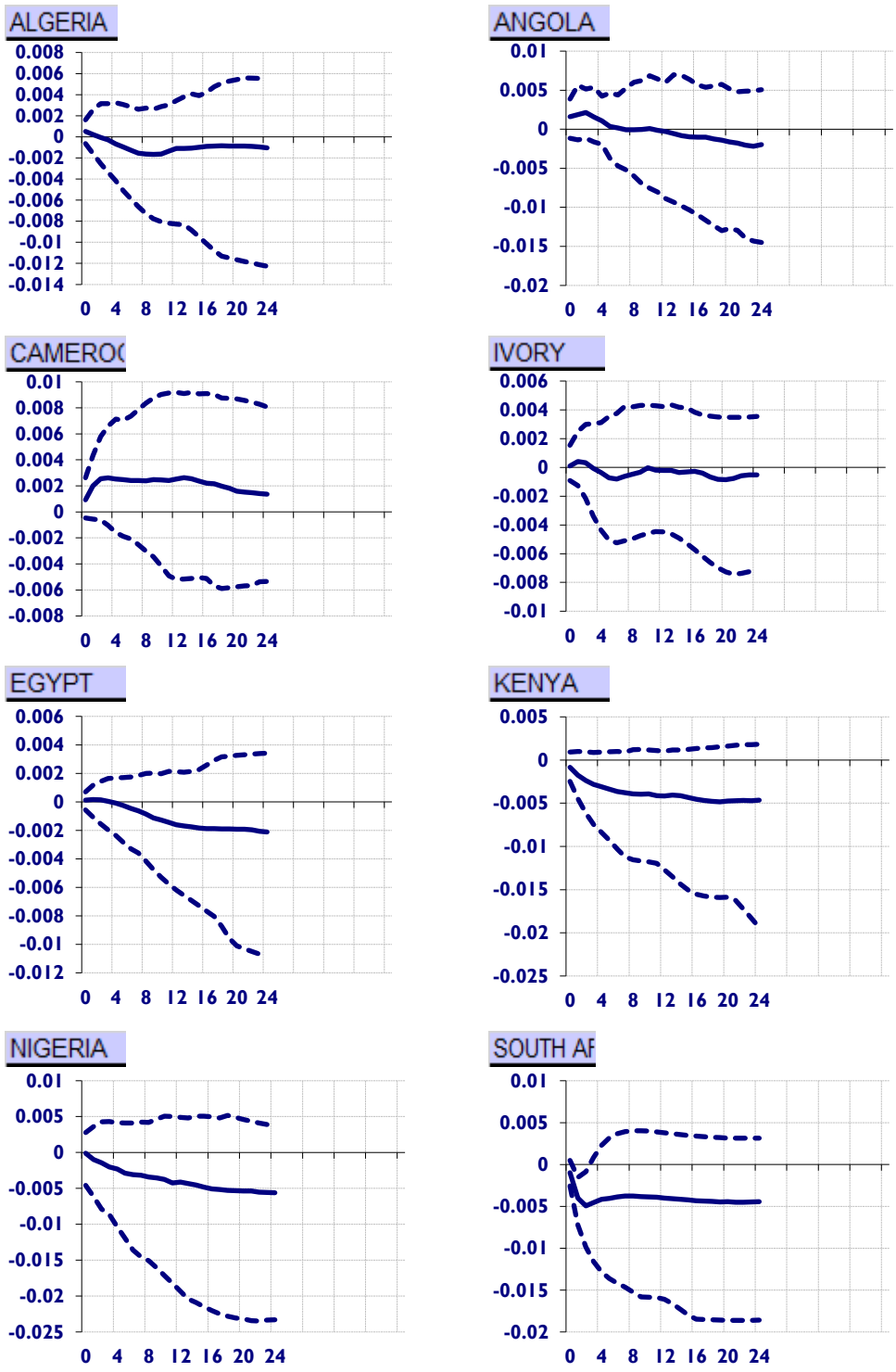

Figure 10. Generalized Impulse Response Functions One s.e. Negative Shock to SOUTH AFRICA REAL GDP

Source: Research finding.

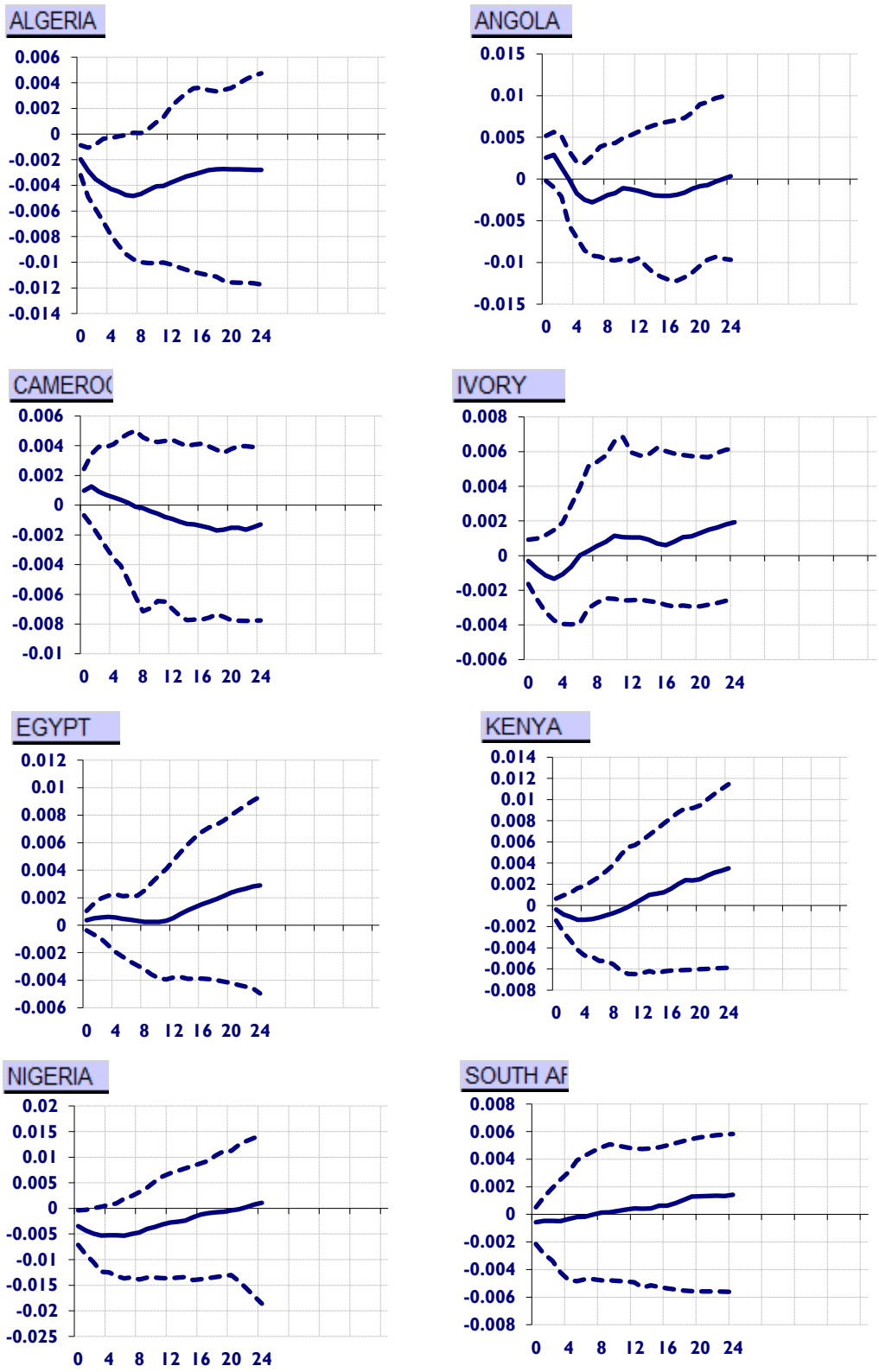

Figure 11. Generalized Impulse Response Functions One s.e. Negative Shock to CHINA REAL GDP
Source: Research finding.

Generalized Forecast Error Variance Decompositions (GFEVDs) of Real GDP

In efforts to determine the extent of vulnerability of selected African countries to external shocks and to give room for analysis of the relative importance of the shocks, we investigated

the proportion of the N-step ahead forecast error variance of AFRICAN countries REAL GDP explained by conditioning on contemporaneous and Future Innovations of the country equations. To this effect, six out of eight selected African countries are closely investigated and the results are presented in table 10 -16. Considering the GFEVD of RGDP in the case of Algeria, the results as presented in table 10 indicate that the forecast error of real RGDP in the country has the highest contribution to its variance decomposition in the short term. The variable contributes more than 52% during the horizon. Apart from this contribution, only forecast error of real RGDP in the United States demonstrates a substantial influence on variance decomposition of RGDP in Algeria throughout the horizons. Across the periods, short, medium, and long terms forecast errors from African countries do contribute much to the variance decomposition of RGDP in Algeria.

Also in table 11, the results of GFEVD of RGDP in Egypt are presented. As expected, Egypt's forecast error of real RGDP dominates its variance decomposition in the short-term contributing more than 90% during this horizon. In the medium-term and long-term, variance decomposition of RGDP is largely dominated by forecast error of real RGDP in the United States. Unlike the situation in Algeria where no African country made a meaningful contribution, forecast error to RGDP in Kenya has a modest contribution to variance decomposition of RGDP in Egypt and this shows a bit of connection between the two countries. Despite the United States' domination in other African countries, the situation is different in Ivory Coast. Table 12 shows the contribution of forecast error of real RGDP from other countries to variance decomposition of RGDP in Ivory Coast. Aside from the substantial contribution of forecast error of RGDP from the country throughout horizons, African countries like Cameroon, Egypt, and South Africa also make meaningful contributions to variance decomposition of RGDP in Ivory Coast. This might indicate that the country is properly linked with other African countries. The case of Kenya as presented in table 13 is also devoid of the United States domination but a non-African country like India asserts some level of influence on the country's RGDP variance decomposition.

The results of RGDP variance decomposition for Nigeria and South Africa are presented in Tables 14 and 15. The results show that the biggest economies in the continent are largely externally dependent as forecast from the United States majorly explains the forecast in these countries. In the case of South Africa, other countries like Japan and India also influence the variance decomposition of RGDP in the country. Contrary to expectation Nigeria and South Africa fail to show serious economic interdependency by way of contribution to variance decomposition in their respective country's RGDP and ditto for other African countries.

Table 10. The proportion of the N-step ahead Forecast Error Variance of ALGERIA REAL GDP Explained by Conditioning on Contemporaneous and Future Inn ovations of the Country Equations

	ALGERIA	ANGOLA	BRAZIL	CAMEROON	CHINA	IVORY	EGYPT	EURO AREA	INDIA	JAPAN	KENYA	NIGERIA	SOUTH AFRICA	UNITED STATES
	Y	Y	y	y	Y	y	y	y	y	y	y	y	y	y
0	0.522854	0.067912	0.043411	0.038074	0.06872	0.062529	0.00786	0.011493	0.016398	0.010091	0.001024	0.05572	0.001627	0.124466
1	0.350351	0.064204	0.057121	0.023534	0.061391	0.046668	0.009037	0.010814	0.0066	0.012011	0.002566	0.052271	0.005564	0.129713
2	0.256694	0.057789	0.062116	0.014501	0.056723	0.038274	0.009449	0.011445	0.002879	0.01289	0.010218	0.052551	0.008623	0.132852
3	0.205767	0.051142	0.064117	0.009639	0.055604	0.035211	0.009592	0.013009	0.001975	0.013615	0.019614	0.053916	0.011967	0.136679
10	0.098693	0.01741	0.038389	0.002174	0.053551	0.028658	0.01189	0.017705	0.014828	0.019035	0.065709	0.073928	0.033982	0.176423
11	0.094762	0.015493	0.034707	0.00201	0.05158	0.02794	0.012178	0.017441	0.016183	0.019477	0.067629	0.075734	0.035336	0.181692
12	0.091989	0.013992	0.031599	0.001844	0.049441	0.02733	0.012401	0.017041	0.017148	0.019779	0.06861	0.077076	0.036256	0.186447
22	0.084489	0.008208	0.018211	0.000813	0.032129	0.024434	0.013298	0.011681	0.018866	0.020027	0.062689	0.082303	0.03721	0.220528
23	0.083918	0.007953	0.017696	0.000778	0.031019	0.024245	0.013399	0.011257	0.019022	0.020072	0.062049	0.082831	0.037348	0.223781
24	0.083312	0.007727	0.017252	0.000751	0.029989	0.024048	0.013505	0.010854	0.019204	0.020127	0.061447	0.083388	0.03753	0.227112

Source: Research finding.

Table 11. The proportion of the N-step ahead Forecast Error Variance of EGYPT REAL GDP Explained by Conditioning on Contemporaneous and Future Innovations of the Country Equations

	ALGERIA	ANGOLA	BRAZIL	CAMEROON	CHINA	IVORY	EGYPT	EURO AREA	INDIA	JAPAN	KENYA	NIGERIA	SOUTH AFRICA	UNITED STATES	DOMINANT UNIT MODEL
	Y	Y	y	y	Y	y	y	y	y	y	y	y	y	y	pmat
0	0.001502	0.014731	0.010353	0.010342	0.003104	0.004218	0.92902	0.073324	0.001128	0.018261	0.026411	0.047665	0.006205	0.086411	0.000898
1	0.000579	0.013088	0.007196	0.011089	0.002267	0.002363	0.898036	0.074078	0.002898	0.022984	0.033379	0.048206	0.009872	0.109276	0.000374
2	0.000247	0.011538	0.005011	0.011856	0.001538	0.001377	0.863116	0.072576	0.005555	0.02766	0.041464	0.049393	0.014329	0.132932	0.000335
3	0.000227	0.010373	0.003476	0.012618	0.000953	0.000804	0.825448	0.069998	0.008863	0.03246	0.050563	0.050781	0.019421	0.156931	0.001233
10	0.005582	0.009092	0.000839	0.017274	0.001427	0.003445	0.55371	0.051837	0.040977	0.054509	0.120673	0.062249	0.055787	0.310452	0.013761
11	0.006368	0.009145	0.000977	0.017668	0.001555	0.004576	0.523999	0.050451	0.045022	0.055223	0.128485	0.063612	0.059066	0.327636	0.015362
12	0.007043	0.009212	0.001235	0.018002	0.00161	0.005827	0.497572	0.049441	0.048632	0.055426	0.135342	0.064895	0.061678	0.343272	0.016862
22	0.010544	0.013274	0.012612	0.020197	0.000772	0.018572	0.355696	0.04838	0.06918	0.04684	0.177163	0.078397	0.065261	0.427709	0.027592
23	0.010938	0.014198	0.014577	0.020432	0.000709	0.019474	0.348444	0.048205	0.070824	0.045983	0.180834	0.080001	0.064741	0.430708	0.028245
24	0.011386	0.015212	0.016609	0.020676	0.000657	0.02029	0.34178	0.047934	0.072533	0.045207	0.18457	0.081626	0.064226	0.433062	0.028822

Source: Research finding.

Table 12. The Proportion of the N-step ahead Forecast Error Variance of IVORY REAL GDP Explained by Conditioning on Contemporaneous and Future Innovations of the Country Equations

	ALGERIA	ANGOLA	BRAZIL	CAMEROON	CHINA	IVORY	EGYPT	EURO AREA	INDIA	JAPAN	KENYA	NIGERIA	SOUTH AFRICA	UNITED STATES
	y	Y	y	y	Y	y	y	y	y	y	y	y	y	Y
0	0.121355	0.042835	0.001509	0.136148	0.001739	0.851776	0.002163	0.103946	0.003304	0.006583	0.022206	0.024603	0.02	0.030138
1	0.093453	0.052753	0.002615	0.105293	0.005544	0.788278	0.007637	0.101405	0.001035	0.025866	0.014538	0.019185	0.034983	0.024704
2	0.069042	0.060782	0.002681	0.071522	0.008467	0.696533	0.017626	0.090378	0.002378	0.046069	0.00797	0.011958	0.054175	0.016412
3	0.050428	0.066869	0.002259	0.047563	0.01031	0.607034	0.0311	0.078259	0.007326	0.065007	0.005085	0.007387	0.075718	0.010325
10	0.016193	0.054267	0.005465	0.011426	0.005352	0.33539	0.098833	0.030615	0.035366	0.134813	0.007355	0.004717	0.170015	0.020671
11	0.015817	0.050457	0.007612	0.01075	0.005133	0.324413	0.101468	0.027798	0.034994	0.137523	0.007035	0.004729	0.172613	0.023879
12	0.015653	0.046987	0.009796	0.010252	0.004955	0.315688	0.103307	0.025453	0.034453	0.139266	0.006841	0.00484	0.174123	0.027315
22	0.011738	0.026868	0.01216	0.006341	0.002649	0.256184	0.118491	0.013461	0.042608	0.140262	0.020625	0.014902	0.189635	0.083278
23	0.011212	0.025628	0.011575	0.006393	0.002507	0.250132	0.120236	0.012748	0.044327	0.139855	0.022865	0.016447	0.191123	0.090328
24	0.010715	0.02445	0.011023	0.006509	0.002387	0.244194	0.121891	0.012079	0.045987	0.139391	0.025058	0.018007	0.192354	0.097446

Source: Research finding.

Table 13. The Proportion of the N-step ahead Forecast Error Variance of KENYA REAL GDP Explained by Conditioning on Contemporaneous and Future Innovations of the Country Equations

	ALGERIA	ANGOLA	BRAZIL	CAMEROON	CHINA	IVORY	EGYPT	EURO AREA	INDIA	JAPAN	KENYA	NIGERIA	SOUTH AFRICA	UNITED STATES
	y	Y	y	y	Y	y	y	y	y	y	y	y	y	Y
0	0.072276	0.107414	0.059214	0.026355	0.007731	0.005809	0.016974	0.011704	0.081771	0.019616	0.917949	0.088961	0.000795	0.069316
1	0.081157	0.110788	0.054928	0.02722	0.010145	0.006474	0.018694	0.012455	0.096799	0.012165	0.892851	0.090927	0.003987	0.078968
2	0.085863	0.109107	0.050237	0.027817	0.01197	0.007019	0.020304	0.012818	0.110635	0.006986	0.868544	0.093088	0.008932	0.090685
3	0.088291	0.105408	0.045683	0.028001	0.013316	0.00736	0.021923	0.012831	0.121765	0.004056	0.843697	0.093955	0.015014	0.102509
10	0.090376	0.081003	0.033566	0.027421	0.011807	0.014288	0.029327	0.00668	0.158289	0.004911	0.708159	0.092292	0.048461	0.176834
11	0.089489	0.078594	0.033954	0.027358	0.011084	0.015812	0.029862	0.005827	0.160141	0.00524	0.695116	0.092496	0.050431	0.185985
12	0.088529	0.076556	0.034749	0.027316	0.010363	0.017371	0.030354	0.00508	0.161596	0.005483	0.683273	0.092845	0.051864	0.194518
22	0.082299	0.072734	0.055425	0.027744	0.004989	0.029457	0.035169	0.001841	0.169576	0.006044	0.610192	0.10011	0.052902	0.241407
23	0.08223	0.073306	0.057685	0.027825	0.00465	0.030147	0.035616	0.001723	0.170381	0.006092	0.605692	0.100895	0.052602	0.243041
24	0.082245	0.073924	0.05982	0.027906	0.004339	0.030754	0.036042	0.001618	0.171223	0.006156	0.601466	0.101657	0.052312	0.244382

Source: Research finding.

Table 14. The Proportion of the N-step ahead Forecast Error Variance of NIGERIA REAL GDP Explained by Conditioning on Contemporaneous and Future Innovations of the Country Equations

	ALGERIA	ANGOLA	ANGOLA	BRAZIL	CAMEROON	CHINA	IVORY	EGYPT	EURO AREA	INDIA	JAPAN	KENYA	NIGERIA	SOUTH AFRICA	UNITED STATES
	Y	Y	R	y	y	Y	y	y	y	y	y	y	y	y	y
0	0.000611	0.0019	0.012175	0.000641	0. 0138696	0.073066	0.008309	0.010782	0.006161	0.027722	0.02869	0.114513	0.534229	0.009562	0.310579
1	0.003547	0.001148	0.009918	0.000481	0.0145168	0.057367	0.017255	0.00923	0.008263	0.038974	0.03512	0.142277	0.381149	0.017214	0.322123
2	0.015288	0.001449	0.007889	0.000894	0.0159582	0.04575	0.028199	0.008524	0.009582	0.052141	0.037633	0.16029	0.295251	0.023549	0.313946
3	0.029186	0.001999	0.006264	0.001486	0.0172782	0.038129	0.038308	0.00803	0.010534	0.063601	0.038383	0.169884	0.243694	0.028841	0.304921
10	0.064473	0.001131	0.001622	0.010677	0.0177484	0.017243	0.083803	0.004521	0.023782	0.076587	0.030062	0.136421	0.127395	0.038917	0.295459
11	0.063592	0.001109	0.001418	0.011483	0.0174208	0.016029	0.087787	0.004173	0.026387	0.074296	0.028605	0.130771	0.122262	0.038302	0.299177
12	0.062331	0.001127	0.001259	0.011926	0.0171277	0.015029	0.091227	0.003899	0.028963	0.071967	0.027267	0.125954	0.118308	0.037577	0.303351
22	0.051735	0.000808	0.001265	0.00788	0.0167258	0.010663	0.107179	0.004443	0.046171	0.059696	0.020698	0.113	0.112659	0.032688	0.346563
23	0.051449	0.000819	0.001414	0.007506	0.0168671	0.010429	0.107947	0.004714	0.047058	0.05959	0.020477	0.113797	0.113691	0.032526	0.350028
24	0.051292	0.000855	0.001589	0.007177	0.017029	0.010206	0.108651	0.005006	0.047832	0.059645	0.020297	0.114826	0.114837	0.032408	0.353356

Source: Research finding.

Table 15. The Proportion of the N-step ahead Forecast Error Variance of SOUTH AFRICAN REAL GDP Explained by Conditioning on Contemporaneous and Future Innovations of the Country Equations

	ALGERIA	ANGOLA	BRAZIL	CAMEROON	CHINA	IVORY	EGYPT	EURO AREA	INDIA	JAPAN	KENYA	NIGERIA	SOUTH AFRICA	UNITED STATES
	Y	Y	Y	y	y	Y	y	y	y	y	y	y	y	y
0	0.005218	0.014309	5.35E-05	0.000312	0.01816	0.026001	0.004877	0.020484	0.126208	0.107462	0.002513	0.004468	0.815249	0.059431
1	0.007466	0.015569	3.6E-05	0.000158	0.015185	0.020174	0.004985	0.013515	0.123294	0.107557	0.00212	0.004518	0.753894	0.065461
2	0.008817	0.013357	0.000336	0.00023	0.012524	0.016374	0.0053	0.01	0.122375	0.111281	0.002086	0.00445	0.733414	0.071206
3	0.009766	0.010599	0.001056	0.000232	0.010451	0.013805	0.005576	0.007968	0.122281	0.115369	0.002107	0.004509	0.733127	0.076889
10	0.010143	0.002393	0.010531	0.000168	0.003747	0.005123	0.00464	0.002237	0.107713	0.107658	0.003278	0.007238	0.722131	0.107829
11	0.009484	0.002186	0.011355	0.000224	0.003442	0.004634	0.004495	0.00197	0.10451	0.104944	0.00355	0.007551	0.716094	0.111958
12	0.008817	0.002048	0.011906	0.000283	0.003199	0.004228	0.004396	0.001783	0.101399	0.102377	0.003785	0.007777	0.709931	0.116088
22	0.004654	0.001248	0.00909	0.000389	0.001968	0.002376	0.005766	0.00179	0.082981	0.086486	0.003934	0.007276	0.671625	0.147456
23	0.004468	0.001199	0.008661	0.00037	0.001884	0.002296	0.006076	0.001817	0.082458	0.085638	0.003816	0.00712	0.67074	0.149291
24	0.004313	0.001172	0.008267	0.000355	0.001805	0.002224	0.00641	0.001836	0.082155	0.084887	0.003684	0.006955	0.670259	0.150976

Source: Research finding.

Conclusion and Policy Implications

From the study, it is observable that there is an improved Intra- African trade. However, it is far below what is obtainable in other developing regions of the world. Also, the bulk of the improvement can be traced to the effort at the sub-regional level rather than African as a whole. Thus, there is still a need for the formulation and implementation of policies to stimulate African trade. More importantly, there is evidence of macroeconomic shocks transmission in selected African countries and this demonstrates a bit of interdependence amongst African countries' economies. This position is equally maintained by Rasaki and Malikane (2015) and Adom et al. (2010) but contradicts Bayoumi and Ostry (1997). Nevertheless, this can provide a veritable foundation required for the formation of a much anticipated monetary union in the continent, however, the major challenge remains the external dependence of African countries' economies. There is strong evidence from the study that African countries' economies are influenced by external shocks rather than shocks from the African region and this has serious policy implications for monetary unions. This issue has also been raised by Raddatz (2008) and Kose and Riezman (2013).

Based on the issues addressed in this study, the following policy prescriptions will be pertinent to ensure proper linkage and synchronization of African countries' economies. Eliminate or reduction of tariffs on intra-African trade: Many African countries have signed different trade agreements with countries outside the continent. Consequently, this has brought about a reduction in tariffs charged on goods from these countries thus making African goods more expensive. Currently, with average tariffs of 6.1 percent, exporters face higher tariffs when they export within Africa. Also, very important is the issue of the economic diversification of many countries. Many African countries rely on the export of primary products to generate revenue for macroeconomic management and this makes them externally dependent due to commodity price fluctuation. Thus, there must be concrete efforts to diversify their revenue base and also look inward to generate more revenue to finance their infrastructure and this will go a long way to creating a more stable macroeconomic environment. Furthermore, in creating a stable macroeconomic environment, they should be wary of shocks from other African countries' economies and make provision for such in their macroeconomic planning especially shocks from Egypt, Kenya, South Africa, and Nigeria. These four aforementioned countries can serve as anchored economies for the proposed African Monetary Union.

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