ASYMMETRIC SHOCKS AND FEASIBILITY OF A WEST AFRICAN MONETARY UNION: SVAR AND S-SVAR APPROACH

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ABSTRACT

Asymmetric shocks are crucial and constitute the requisite conditions for an optimum currency area. This study employed the structural vector autoregressive (SVAR) model to identify the predominant shocks affecting ECOWAS countries and further analysed the dynamic evolution of the predominant shocks using the State-Space VAR (S-SVAR) model on secondary data from 1975 to 2015. The SVAR reveals that the global GDP and monetary shocks predominantly affect ECOWAS Countries. The S- SVAR results clearly indicate that the identified shocks are asymmetric and oscillate irregularly after a time lag of one year. Also, the convergence after unexpected macroeconomic disturbances (shocks) takes longer periods with different time paths, and with some countries finding it difficult to converge even in the long run. Thus, the envisaged West African Monetary Union is not feasible. ECOWAS members should be given ample time for them to satisfy the requisite conditions of an optimal currency area and their policies need to be timely and quick to respond to shocks before they start manifesting.

Keywords: *Asymmetric shocks, Mmonetary Uunion, Ooptimal Currency Area, SVAR, S- SVAR*
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I. Introduction

Countries opting for a single currency must be prepared to lose their monetary policy autonomy to a neutral Central Bank. This phenomenon remains topical among practitioners of macroeconomic policies and leaves much to be desired, most especially as the Euro-zone, which seems to be a standard model for an optimum currency area toggles from one crisis to the other. However, the desire to establish a monetary union is predicated on the symmetry/asymmetry of shocks that affect candidate countries, and not on the Euro-zone model.

Symmetric shocks are crucial because they provide information on the desirability and costs of a union's monetary policy (Tsangarides & Qureshi, 2008), Karras, 2006; De Grauwe, 2005) and constitute the requisite conditions for an optimum currency area. The requisite conditions enshrined in the Optimum Currency Area (OCA) theory, advanced by Mundell (1961), McKinnon (1963) and Kenen (1969) are factor mobility, trade openness, product diversification, and similarity of inflation rates and wage stability. Technically, the cost of forming a monetary union will be less if the response to domestic and external shocks by candidate countries is similar (Chuku, 2012).

ECOWAS governments have expressed their desire to form a currency union. To this end, they have adopted different strategies and ratified various Treaties that will enable them to satisfy the requisite conditions as enshrined in the OCA theory. However, different studies have revealed that a monetary union is tentatively not ideal for the entire ECOWAS region, yet the process of introducing a single currency is ongoing. For instance, (Karras 2006; Tsangarides & Qureshi, 2008; Chuku, 2012; Harvey & Cushing, 2015; Nkwatoh, 2018; Sagiru & Irfan, 2019) have examined the nature of shocks affecting ECOWAS countries. These studies have shown that the shocks resonating across the entire region are asymmetric and uncorrelated, suggesting that the cost of forfeiting their monetary autonomy will be very high. In his submission, Houssa (2008) concluded that adjustments to form a monetary union will be difficult because most ECOWAS countries are mainly affected by uncorrelated supply shocks. Certainly, uncorrelated shocks in the entire region are due to fact that the responses and adjustments to macroeconomic disturbances by the respective governments are not similar and timely.

Studies on the envisaged West African monetary union have employed the structural vector auto regressive (SVAR) model to ascertain the degree of symmetry/asymmetry of shocks among member countries. Their findings are instructive. However, the modelling of shocks using the SVAR model is static, whereas shocks are dynamic and evolve over time with changes in economic activities. Thus, this study first of all, identified the predominant shocks affecting ECOWAS countries using the SVAR model, and further analysed the dynamic evolution of the predominant shocks using the State-Space VAR (S-SVAR) model (Klaman Filter approach) introduced by (Boone, 1997). The beauty of this approach is that it brings out the dynamic behaviour of shocks (symmetric/asymmetric). It further shows how respective countries respond/adjust to these shocks and informs us on the convergence time path of both the external and domestic shocks, and constitute a significant contribution to the existing literature in West Afirca.

The balance of the paper is as follows: Section II discusses the empirical literature, Section III ushers in the methodology and sources of data. Section IV presents the results and analysis, while the conclusion and recommendations are contained in Section V.

II. LITERATURE REVIEW

Many studies have operationalized the optimum currency area theory using the Blanchard-Quah decomposition of shocks between supply and demand, while employing the structural vector auto regressive (SVAR) approach introduced by Bayoumi & Eichengreen (1992). In their initial study, Bayoumi & Eichengreen (1992) found more idiosyncratic and significant shocks among EU countries than across US regions using annual regional data from 1970 to 2008. In a similar study, *Ramos and Suriach (2004)* submitted that the degree of asymmetry of shocks is less among Euro-zone members than other regional groupings opting for a monetary union. However, a broader European monetary union will be costly because candidate countries wishing to join the EMU have more idiosyncratic shocks than existing members (Horvath & Rátfai, 2004).

A plethora of studies has simulated the Blanchard and Quah model using the SVAR to evaluate the feasibility of a monetary union in Asia, Gulf Cooperation Council, SADC, East Africa and Latin America. For instance, Ling (2001); Sato, Zhang and McAlee (2005); Huang and Guo (2006); Tang (2006); Jeon and Zhang (2007); Koh and Lee (2010); Allegret & Sand-Zantman (2007); Forhad (2014) among others reached the conclusion that the Asian region is not fit for a monetary union because member countries displayed asymmetric shocks. However, East

Asian countries can participate in a common currency area because their shocks have the same sizes with similar speed of adjustments (Shafighi & Gbarleghi, 2016; Fuang & Guo, 2016). Earlier studies on Latin American: Bayoumi and Eichengreen (1994), Licandro (2000), Hallwood, Marsh and Scheibe (2006), Foresti (2007), McKnight and Sánchez (2014), Guimarães and Monteiro (2014) etc., have established the existence of considerable asymmetries of shocks that requires substantial reforms before a Latin American monetary union could be formed. Foresti, (2007) concluded that higher policy coordination is imperative before starting any economic integration process in Latin America, while Hafner & Kampe (2018) foresees a monetary union from greater economic and political integration.

Many studies using the Blanchard and Quah framework have concluded that the demand shocks of Gulf Cooperation Council are asymmetric, thus making them poor candidates for a monetary union (see, Abu-Bader & Abu-Qarn, 2008); Al-Turki, 2007; Benbouziane, Benhabbib, & Benamaar, 2010; Louis, Balli & Osman, 2010; Alshehry & Slimane, 2012; Kandil & Trabelsi, 2012; and Arfa, 2012). Likewise, Buigut and Valev (2005) submit that SADC economies may not benefit from a currency union their economic shocks were highly not correlated. However, a monetary union for the Common Market for Eastern and Southern Africa (COMESA) is possible, but member countries will become more vulnerable to shocks, thereby, reducing the potential benefits of monetary integration (Njoroge, Opolot, Abuka & Okello, 2011). Similar studies have shown that macroeconomic convergence was impossible for East African countries (Shiek, Azam, Rabby, Alam & Khan, 2011; Mafusire & Brixiova, 2013; Siele, 2018).

The few studies in West Africa using the Blanchard and Quah model have all shown that a degree of asymmetry of shocks among member countries is relatively higher, indicating member countries are not fit for a monetary union (Fielding, Lee & Shields, 2004; Opoku-Afari & Kinful, 2005; Housa, 2008; Chuku, 2012; Ekong & Onye, 2012; Harvey & Cushing, 2015; Nkwatoh 2019; Sagiru & Irfan, 2019).

Although, the SVAR method has been extensively used in literature, it however does not consider how shocks if any, have evolved over time, especially when the economic interdependence among candidates' economies keep changing (see Boon, 1997; Maza and Villaverde, 2006; Mikek, 2007; Radomskyy, 2007; Zdzienicka, 2009). In a nutshell, the SVAR model assumes that shocks are static making it difficult to account for the dynamic changes occurring in an economy.

Studies have extended the SVAR model by estimating the time-varying parameters via the Kalman filter (state-space VAR) approach introduced by (Boone 1997) to remedy the static effect of the SVAR model. Analysing the similarities in shocks between 15 EU countries using the AD-AS framework from 1963 to 1994, (Boone, 1997) reached the conclusion that European economies displayed a strong asymmetric behaviour. Accordingly, Maza and Villaverde (2006) showed that shocks in the Spanish region had been mostly symmetric and to a greater extent, did not affect the process of regional convergence between 1975 and 2005. Other studies include: Mike (2007), Jondeau and Sahu (2004), Sato and Zhang (2005), Giannone and Lenza (2014), Bañbura & Giannone & Lenza (2015). The findings of these studies reveal that the shocks of candidate countries become symmetrical and correlated over time, even though some studies (Xu, 2006; Xu, Waed & Gan, 2007) have shown contrary results.

III. DATA and METHODOLOGY

To account for all ECOWAS protocols and agreements and also, to fully capture the dynamic behaviour of their macroeconomic variables with respect to the convergence criteria, this study used secondary data from 1975 to 2015 extracted from IFS-CD Rom published by the IMF, World Development Indicators published by World Bank and WAMA indicators published by the West African Monetary Agency. The variables considered are: World Oil Prices (WOP), Global GDP (GGDP), Real Gross Domestic Product (RGDP), Real Effective Exchange rate (REER) and Domestic Prices proxied by Inflation (INF). Fourteen ECOWAS countries: Benin, Burkina Faso, Cape Verde, Cote D'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo were considered with the exception of Liberia due to paucity of data.

Model specification

First, the study employed the SVAR to identifies the predominant shocks in the short run, medium term and long-run using derived from the variance decomposition. To this end, the 2-variable VAR model premised on Blanchard and Quah (1998) AD-AS framework is extended to a 5-variable VAR model. The SVAR model with restrictions and five shocks i.e., World Oil Price -WOP, Global GDP - GGDP, Domestic Real GDP -DRGDP, Real Effective Exchange Rate - REER and Inflation – INF is specified as follows:

$$\begin{bmatrix} \Delta WOP_t \\ \Delta GGDP_t \\ \Delta DGDP_t \\ \Delta REER_t \\ \Delta INF_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & 0 & 0 & 0 & 0 \\ A_{21}(L) & A_{22}(L) & 0 & 0 & 0 \\ A_{31}(L) & A_{32}(L) & A_{33}(L) & 0 & 0 \\ A_{41}(L) & A_{42}(L) & A_{43}(L) & A_{44}(L) & 0 \\ A_{51}(L) & A_{52}(L) & A_{53}(L) & A_{54}(L) & A_{55}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_t^{s*} \\ \varepsilon_t^{s*} \\ \varepsilon_t^{s} \\ \varepsilon_t^{d} \\ \varepsilon_t^{m} \end{bmatrix} \text{………………………………….1}$$

The long run restrictions are as follows:

WOP is strictly exogenous: $A_{11}(L) \neq 0$, and $A_{12}(L) = A_{13}(L) = A_{14}(L) = A_{15}(L) = 0.$

GGDP is also strictly exogenous: $A_{21}(L) \neq 0, A_{22}(L) \neq 0,$ and $A_{23}(L) = A_{24}(L) = A_{25}(L) = 0.$

DGDP is affected by supply shocks in WOP and GGDP exclusively: $A_{31}(L) \neq 0, A_{32}(L) \neq 0, A_{33}(L) \neq 0,$ and $A_{34}(L) = A_{35}(L) = 0$.

REER is influenced only by WOP and GGDP shocks, domestic supply and demand shocks: $A_{41}(L) \neq 0, A_{42}(L) \neq 0, A_{43}(L) \neq 0, A_{44}(L) \neq 0,$ and $A_{45}(L) = 0.$

Inf is strictly endogenous, thus prices are influenced by WOP and GGDP shocks, domestic supply and demand shocks as well as monetary shocks Hence, $A_{51}(L) \neq 0, A_{52}(L) \neq 0, A_{53}(L) \neq 0, A_{54}(L) \neq 0$ *and* $A_{55}(L) = 0.$

State-space VAR Model (Kalman Filter)

As discussed earlier, the SVAR model simply shows that shocks are constant over time, whereas shocks are dynamic and change over time due to changes in economic activities. Precisely, the structural shocks of ECOWAS countries were estimated using the Kalman filter technique introduced by Harvey (1989). The linear state-space model has two components - measurement equation (signal) and transition equation (unobserved state), expressed as a system of two equations:

Measurement equation: $Y_t = H\beta_t + A_t Z_t + \varepsilon_t$ ……………………………………….. *3*

Transition equation: $\beta_t = \alpha_t + F_t \beta_{t-1} + S_t \upsilon_t$………………………………………….. 4

Where Y_t is a k-dimensional vector of observable variables and β_t is an m-dimensional vector of unobservable state variables. H_t *and* F_t are two, respectively, k × m and m × m matrices of time-varying coefficients. Z_t *is* an m-dimensional vector of exogenous variables, A_t and S_t are two, respectively, m × g and k × n matrices of parameters. α_t is a k-dimensional vector of constant terms, ε_t and υ_t are two vectors of serially uncorrelated errors, with $\varepsilon_t \sim$ i.d. N(0, Var (ε_t) $\upsilon_t \sim$ i.d. N(0, Var (υ_t) and E [$\varepsilon_t\, \upsilon_s$] = 0,$\forall$ t, s.

It is assumed ECOWAS countries experience two types of shocks: common shocks and idiosyncratic shocks, thus the dynamic space-state VAR model which estimates the structural shocks of ECOWAS countries is:

$$\left(e_t^i - e_t^j\right) - \alpha_t + \beta_t\left(e_t^i - e_t^k\right) + w_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 5$$

Where, *et* represents the structural shocks and superscripts *i, j* and *k* represent the region's key economy, regional economies and the rest of the world and, w_t is a normally and independently distributed error term with zero mean and constant variance. *át* and *ât* are time-varying coefficients, which evolve according to random walk processes. The time-varying â coefficient measures the temporal relationship between shocks among *i, j* and *k*. Thus, á and â coefficients are simulated into a VAR model and then estimated using the Kalman filter technique to determine the importance of the common component to each country's structural shocks.

IV. PRESENTATION AND ANALYSIS OF RESULTS

The variables were subjected to an Augmented Dicky-Fuller (ADF) and Phillip Perron tests, and a spectra analysis tests before implementing the SVAR, to avoid spurious regression as shown on appendix 1. The results show that all variables are integrated of order one as shown on Appendix 1.

Tests Diagnostics /Stability Test

The optimal lag lengths show that only the SVAR estimates of Benin, Ghana, Sierra Leone and Togo are in conformity with the Akaike Information (AIC) and Swartz Information (SIC) lag selection criteria. The estimates of the SVAR for other countries display serial correlation, hence the serial correlation LM test was employed to determine the appropriate lag lengths. The final lag lengths chosen for the estimations were void of serial correlation since their p-values are greater than 0.05, thus making the different SVAR models robust at their respective identified optimal lags as shown on Appendix 2.

Results reported on Appendix 3 show that the stability condition is satisfied because all the roots of the different SVAR model have a modulus of less than one. Hence, further analysis of the SVAR is justified since all the preliminary diagnostics have been fulfilled.

Variance Decomposition

The variance decomposition identifies the predominant shocks that influence the behaviour of the dependent variables in the SVAR model in the short-run (one-year forecast error), medium term (five-years forecast error) and long-run (ten-year forecast error). Table 2 provides the variability of domestic Real GDP to changes in domestic supply, monetary, demand and external shocks for all the ECOWAS countries. The results show that the shocks responsible for the variability of domestic real GDP are asymmetric. The predominant shocks affecting the domestic real GDP of Benin, Burkina Faso, Cote D'Ivoire and The Gambia are World oil prices followed by global GDP. For Cape Verde, Ghana and Togo, domestic real GDP is predominantly affected by external shocks - global GDP followed by World oil price. For the case of Guinea Bissau, Sierra Leone and Guinea, World oil prices and monetary shocks predominantly affect domestic real GDP.

These shocks persist for the entire period, except for Guinea's domestic real GDP that is mostly affected by shocks in World oil prices and global GDP in the long run. In Mali, monetary and demand shocks predominantly affect domestic real GDP, while in Niger, global GDP and demand shocks predominantly affect domestic real GDP. Lastly, Nigeria's domestic real GDP is affected by Global GDP and monetary shocks, while demand and World oil price shocks affect Senegal's domestic real GDP predominantly. This result indicates that shocks across West Africa are asymmetric and therefore require different policies to cushion their effects. Thus, the cost of surrendering monetary policy autonomy by members to a common Central Bank will be very high.

Chapter 1. Table 2: Variability of Real GDP to Changes in Supply, Monetary and Demand Shocks

		Domestic Real GDP							Domestic Real GDP				
		WOP Supply Shock	GGDP Supply Shock	Domestic Supply Shock	Monetary Shock	Demand Shock			WOP Supply Shock	GGDP Supply Shock	Domestic Supply Shock	Monetary Shock	Demand Shock
Benin	1st	1.0253	5.9082	93.0665	0.0000	0.0000	GuineaB	1st	1.6164	0.5096	97.8740	0.0000	0.0000
	5th	13.4545	7.3446	74.5784	4.2554	0.3672		5th	13.8232	5.4879	66.9648	12.7176	1.0065
	10th	13.4993	7.4196	74.4342	4.2757	0.3711		10th	13.6865	5.7296	66.3475	13.1950	1.0415
Burkina	1st	2.2541	3.7386	94.0073	0.0000	0.0000	Mali	1st	10.2339	0.1690	89.5980	0.0000	0.0000
	5th	5.7391	5.7111	85.5750	2.5840	0.3908		5th	13.5875	5.3847	63.3097	1.4149	16.3032
	10th	5.8974	5.7053	85.3593	2.5932	0.4449		10th	13.1813	5.9097	60.8173	1.7588	18.3329

	1st	4.7840	11.3829	83.8331	0.0000	0.0000		1st	0.7377	1.3787	97.8836	0.0000	0.0000
Cape	5th	6.4584	17.8116	74.3878	0.2308	1.1114	Niger	5th	2.2276	6.2568	72.6561	3.8634	14.9961
	10th	6.4204	17.7263	74.3389	0.3222	1.1921		10th	2.2896	6.3387	72.3301	3.9646	15.0770
	1st	20.3877	1.1064	78.5059	0.0000	0.0000		1st	0.0075	13.8460	86.1475	0.0000	0.0000
Cote	5th	27.7568	7.0605	55.2305	5.1684	4.7838	Nigeria	5th	6.6093	17.8633	60.2609	13.1046	2.1620
	10th	27.6470	7.1168	55.0059	5.3020	4.9283		10th	9.2699	22.9498	52.2755	10.7584	4.7464
	1st	3.4396	2.8530	93.7075	0.0000	0.0000		1st	0.0000	1.3654	98.6346	0.0000	0.0000
Gambia	5th	19.7568	11.4421	55.8559	1.7980	11.1474	Senegal	5th	4.2503	3.1233	75.4313	2.7932	14.4019
	10th	19.6489	11.9153	54.9414	1.8968	11.5976		10th	4.4987	3.1816	75.0407	2.9374	14.3416
	1st	0.0848	6.2128	93.7024	0.0000	0.0000		1st	1.9415	4.0869	93.9716	0.0000	0.0000
Ghana	5th	5.7864	10.9694	78.9456	3.1704	1.1283	Sierra	5th	20.4888	3.0027	62.7337	9.3523	4.4224
	10th	5.7603	10.9859	78.4378	3.3072	1.5088		10th	22.4779	3.1568	57.9851	11.6013	4.7790
	1st	7.3836	1.5717	91.0447	0.0000	0.0000		1st	0.7548	8.8707	90.3746	0.0000	0.0000
Guinea	5th	18.7714	9.5365	56.0526	9.6440	5.9956	Togo	5th	7.2779	10.8293	78.3238	1.1807	2.3883
	10th	18.5061	10.1642	55.2937	9.7546	6.2813		10th	7.3110	10.8261	78.1702	1.1922	2.5004

Source: Eviews 9.5 Computed Results

Table 3 reports the variability of the real effective exchange rate to changes in external shocks (WOP, GGDP), supply, monetary and demand shocks for all the ECOWAS countries. The variability of real exchange fluctuations across ECOWAS countries is caused by both external and domestic supply shocks. Predominantly, global GDP and domestic GDP are observed in Benin, Burkina Faso, Cote D'Ivoire and Senegal, while external and supply shocks are predominantly responsible for the variability in the exchange rate in Mali, Guinea and Cape Verde. Togo's exchange rate is predominantly caused by domestic supply shock; Gambia predominantly cause by domestic demand; Niger and Sierra Leone predominantly caused by global GDP. Above all, the real exchange rate variation in Nigeria is significantly caused by external and domestic shocks.

Chapter 2. Table 3: Variability of Real Effective Rate to Supply, Monetary and Demand Shocks

		Real Effective Exchange Rate							Real Effective Exchange Rate				
		WOP Supply Shock	GGDP Supply Shock	Domestic Supply Shock	Monetary Shock	Demand Shock			WOP Supply Shock	GGDP Supply Shock	Domestic Supply Shock	Monetary Shock	Demand Shock
	1st	0.6929	0.5406	3.7236	95.0430	0.0000		1st	0.2853	3.6832	21.6870	74.3444	0.0000
Benin	5th	6.3955	11.9718	9.9938	67.7133	3.9256	GuineaB	5th	35.9558	2.1996	15.7636	44.0106	2.0704
	10th	6.4066	11.9405	10.1762	67.5289	3.9478		10th	35.9388	2.2235	15.7850	43.9283	2.1244
	1st	0.1800	2.4996	6.7600	90.5604	0.0000		1st	1.1003	0.3552	1.2694	97.2751	0.0000
Burkina	5th	3.3676	14.7820	8.9477	71.5262	1.3765	Mali	5th	10.5450	7.5257	2.9731	78.9332	0.0230

	10th	3.3861	14.7782	8.9440	71.4991	1.3926		10th	10.5834	7.4999	3.3286	78.2909	0.2972
	1st	9.6998	21.3434	9.1668	59.7900	0.0000		1st	0.9694	7.0421	1.8986	90.0899	0.0000
Cape	5th	19.1099	15.2681	7.4587	44.9213	13.2421	Niger	5th	5.5598	17.4232	3.0070	73.8087	0.2014
	10th	18.7123	14.7522	7.5020	43.1984	15.8352		10th	5.7147	17.3687	3.2426	73.2789	0.3951
	1st	0.4350	0.0151	2.7352	96.8147	0.0000		1st	9.5678	0.0890	8.2152	82.1280	0.0000
Cote	5th	3.8332	8.9303	7.0587	76.5766	3.6012	Nigeria	5th	18.5154	20.8145	17.3140	34.2510	9.1052
	10th	4.0483	8.9314	7.0429	76.2762	3.7011		10th	19.1292	24.3506	17.9203	30.1265	8.4735
	1st	0.3750	1.6665	1.5442	96.4143	0.0000		1st	0.4558	0.1176	5.5056	93.9209	0.0000
Gambia	5th	3.6147	1.8553	3.7527	75.5719	15.2054	Senegal	5th	2.0556	9.5664	7.6930	79.5932	1.0918
	10th	3.8992	2.3724	3.8227	73.9223	15.9834		10th	2.0728	9.5671	7.7683	79.4418	1.1500
	1st	1.7309	2.5688	11.2270	84.4733	0.0000		1st	4.2388	1.3202	3.7186	90.7224	0.0000
Ghana	5th	27.1508	4.2212	14.0023	52.4787	2.1470	SierraL	5th	5.9670	9.2033	4.4500	79.0287	1.3510
	10th	26.8732	4.7180	14.6811	51.5422	2.1855		10th	6.4460	9.3418	4.6950	78.0213	1.4958
	1st	6.7792	9.3530	6.1441	77.7237	0.0000		1st	0.2269	5.5929	14.9670	79.2132	0.0000
Guinea	5th	13.4239	12.2796	10.2233	56.4644	7.6088	Togo	5th	2.2717	7.3328	41.7835	44.0959	4.5161
	10th	13.3470	12.2609	10.2104	56.1217	8.0599		10th	2.3812	7.3166	41.6024	44.0076	4.6923

Source: Source: Eviews 9.5 Computed Results

Table 4 presents the variability of domestic prices to changes in external, supply, monetary and demand shocks across ECOWAS countries. Results show that the external supply shock (GGDP) predominantly affects prices in Ghana, while external supply (WOP) and domestic supply shocks predominantly influence prices in Guinea and Togo respectively. Interestingly the remaining ECOWAS countries are predominantly affected by a monetary shock. This implies that price adjustments across West African States are largely determined by a monetary phenomenon. Results from the SVAR are consistent with ealier findings of (Fielding, Lee & Shields, 2004; Opoku-Afari & Kinful, 2005; Housa, 2008; Chuku, 2012; Ekong & Onye, 2012; Harvey & Cushing, 2015; Sagiru & Irfan, 2019).

Chapter 3. Table 4: Variability of Domestic Prices to Changes in Supply, Monetary and Demand Shocks

		Price Levels							Price Levels				
		WOP Supply Shock	GGDP Supply Shock	Domestic Supply Shock	Monetary Shock	Demand Shock			WOP Supply Shock	(GGDP) Supply Shock	Domestic Supply Shock	Monetary Shock	Demand Shock
	1st	0.3070	5.6677	7.0734	33.6600	53.2920		1st	0.3418	0.1882	1.2933	45.7539	52.4228
Benin	5th	5.2804	7.4604	7.4818	36.1716	43.6057	GuineaB	5th	5.3724	3.6258	14.3660	43.7125	32.9233
	10th	5.3293	7.4357	7.6586	36.1550	43.4213		10th	5.5073	3.6248	14.5901	43.9026	32.3752
	1st	0.4624	2.5838	0.0281	42.4114	54.5144		1st	16.3964	4.3271	3.2497	21.2170	54.8099
Burkina	5th	1.6919	3.3470	0.9779	37.7153	56.2679	Mali	5th	12.5361	9.6646	4.7918	16.9368	56.0708
	10th	1.7309	3.3620	0.9804	37.6548	56.2719		10th	12.3570	9.9082	4.9653	16.5503	56.2192

	1st	0.1254	1.7563	10.1147	12.2690	75.7346		1st	0.0049	0.3923	0.6841	36.4946	62.4241
Cape	5th	9.3632	2.1387	8.3518	20.4892	59.6570	Niger	5th	1.5649	1.3097	2.7006	31.7139	62.7110
	10th	9.2187	2.8594	8.9506	21.2066	57.7647		10th	1.6308	1.3403	2.7844	31.7657	62.4787
	1st	2.4974	0.1156	3.1435	27.1575	67.0861		1st	0.0003	5.7244	0.0108	21.1767	73.0878
Cote	5th	2.1142	1.4042	4.3095	33.5065	58.6656	Nigeria	5th	7.9414	21.5340	11.7248	25.6710	33.1288
	10th	2.3184	1.7006	4.6872	33.1210	58.1728		10th	9.6768	22.1565	16.8236	21.3860	29.9571
	1st	8.3162	0.1787	1.5259	14.8930	75.0862		1st	0.9051	0.7264	1.4694	49.5037	47.3955
Gambia	5th	6.1069	7.6227	1.9263	21.5776	62.7665	Senegal	5th	3.5272	4.2140	9.1955	44.7537	38.3096
	10th	6.1338	8.3917	2.0395	22.2357	61.1994		10th	3.6072	4.2894	9.2344	44.5307	38.3384
	1st	1.0010	5.6543	1.9736	0.6152	90.7559		1st	6.4476	1.1521	4.7782	1.0937	86.5285
Ghana	5th	7.4633	13.8931	8.9084	1.3687	68.3664	Sierra	5th	20.2166	7.3587	5.8659	39.0196	27.5391
	10th	7.7732	14.2211	8.9065	1.3836	67.7156		10th	20.3174	7.8100	5.8686	39.2429	26.7611
	1st	18.0552	16.9082	4.7428	3.2215	57.0722		1st	1.9146	1.5214	6.6510	9.1415	80.7715
Guinea	5th	19.5574	14.1661	9.4716	4.8269	51.9779	Togo	5th	2.1355	1.2982	32.5658	18.0134	45.9871
	10th	19.4891	14.2276	9.5789	4.8986	51.8057		10th	2.1678	1.3836	33.0745	17.8183	45.5557

Source: Source: Eviews 9.5 Computed Results

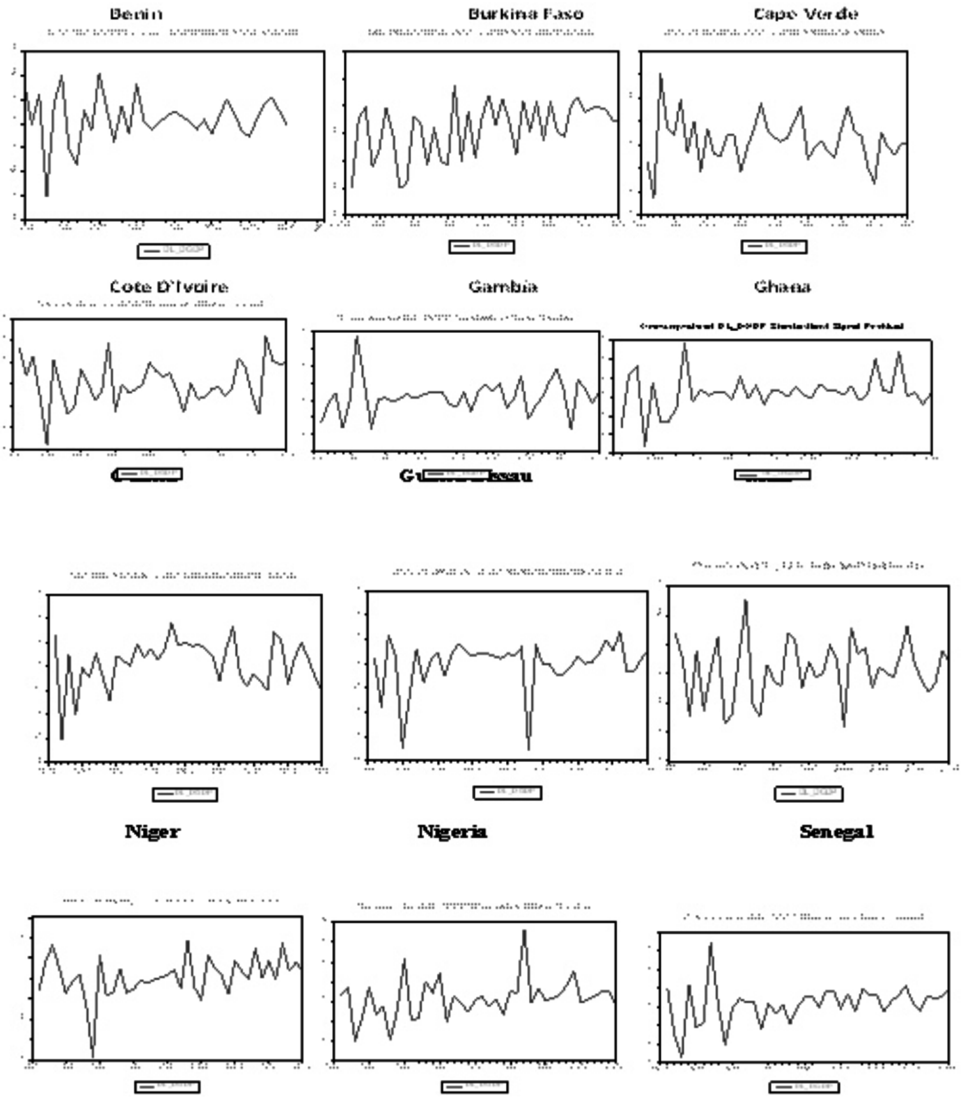
Chapter 4. State Space-VAR Analyses for ECOWAS Countries

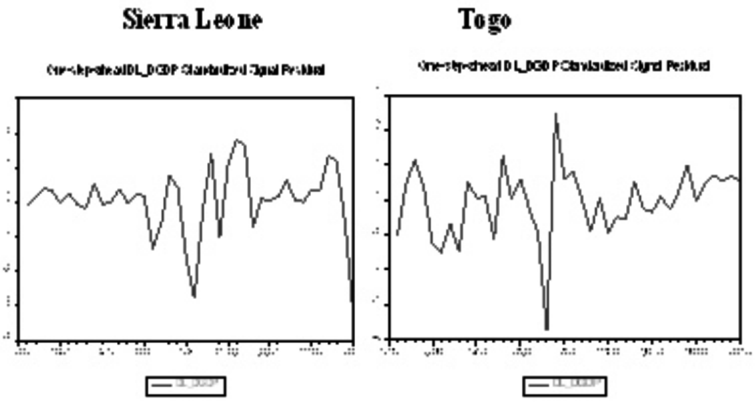
The impulse response function (IRF) has often been used to tract the size and speed at which economies adjust to external and domestic shocks (see, Bayoumi & Eichengreen, 1994; Liu, 2012). However, the IRF employed in literature derived from the SVAR model has a static effect. On the contrary, IRF derived from the state- space VAR estimations have a dynamic effect because it considers every point in time over the entire sample period. Thus, Kamil's (2010) approach is used to trace one-period ahead response of each country's GDP to an external shock (global GDP); and the one-period ahead response of each country's domestic price (INF) to a domestic shock (monetary) of each ECOWAS economy.

State Space VAR Analysis of External Shock

Figure 1 measures the dynamic effect of a one-standard ahead response of domestic real GDP to global GDP over time for each West African State. Global GDP as an external shock is chosen because the variance decomposition shows that it affects all ECOWAS countries. The responses display negative and positive trend values. The effect of the supply shock peter's-out in the last years of some economies like Benin, Nigeria, Senegal and Togo. Specifically, the effect of the supply shock is dissimilar across ECOWAS economies and exhibit different magnitudes, time paths and different speeds of adjustments. For instance, the adjustment time for Benin and Senegal starts from 1990, while that of Nigeria and Togo start from 2000 and 2005 respectively. Apart from these few economies, the adjustment time for the remaining ECOWAS economies apparently is very slow (longer years) and with some not even converging to zero like Cote D'Ivoire and Sierra Leon. Hence, ECOWAS economies take longer periods to adjust to external shocks. Certainly, the different convergence time paths will generate policy inconsistencies among West African states hence, making it difficult for ECOWAS members to comply with both the primary and secondary macroeconomic convergence criteria as desired.

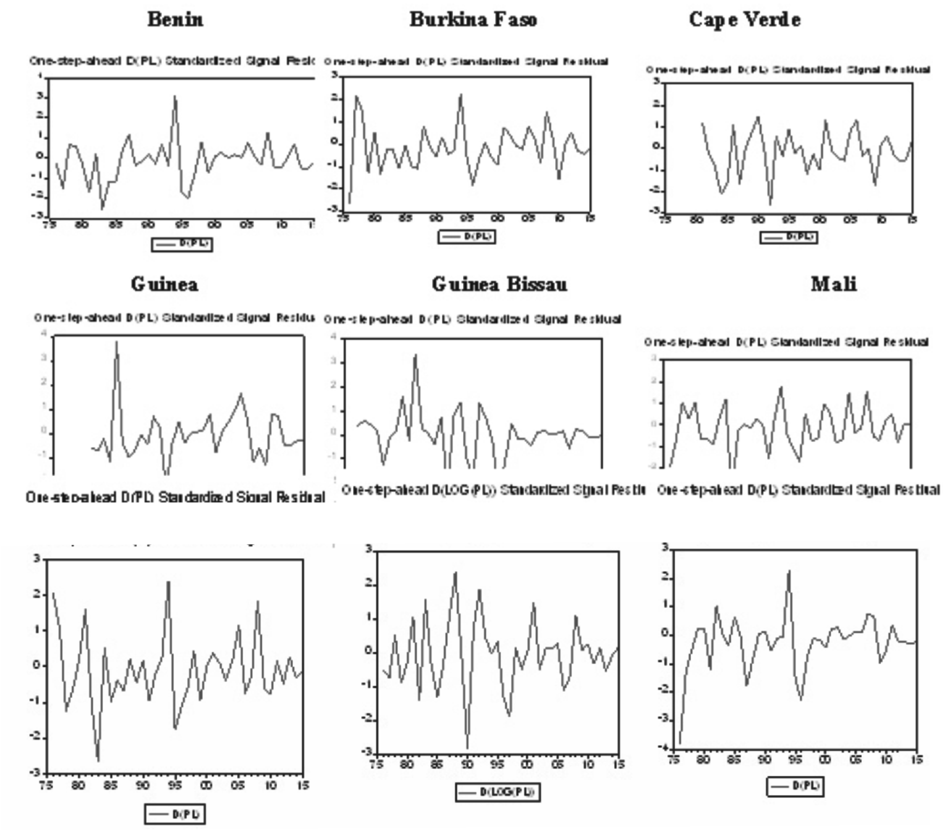
Figure 1: Response of ECOWAS Countries to External Supply Shock (Global GDP)





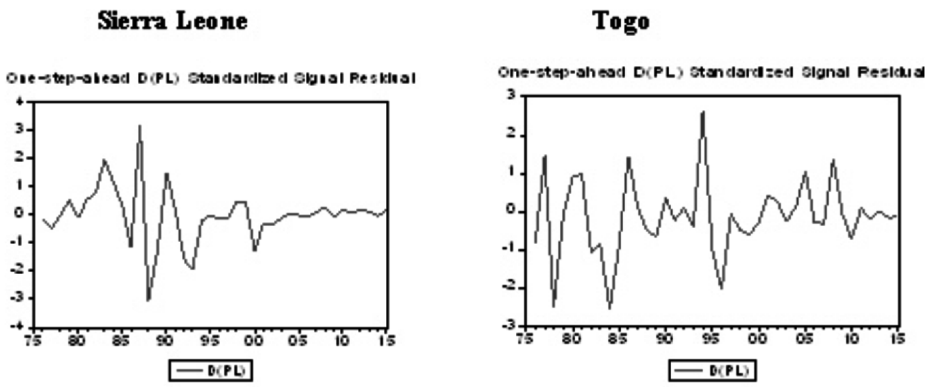
Source: Graph derived from State Space VAR estimates using Eviews 9.5.
State Space VAR Analysis of Domestic Shock

Figure 2 presents the dynamic effect of a one-standard ahead response of domestic price to monetary shock over time for each West African State. The monetary shock is chosen among the domestic shocks because adopting a common policy is imperative and tends to reduce the cost of forming a monetary union when these policies become more synchronised. Also, results derived from the variance decomposition indicate that price adjustments across West African States are largely determined by a monetary phenomenon. This also explains the high cost of losing their monetary policy autonomy, if their convergence paths are different and slow. The graphs show that the responses of domestic prices exhibit a dissimilar pattern and are distributed between low negative and high positive magnitudes. The speed of adjustment of domestic prices to monetary shocks is slow and varies across most ECOWAS economies. Ghana, Guinea Bissau and Sierra Leone adjust to monetary shocks faster than other countries because monetary disturbances start normalising to a zero from 2001 upwards, while for Guinea, Senegal and Togo, the disturbances normalise to zero from 2012 upward. While monetary disturbances in other ECOWAS economies start normalising almost at the last few years of investigation, the disturbances in Cape Verde and Gambia oscillate with time. The variations in monetary shock and slow speeds of adjustments to monetary shocks for ECOWAS economies tentatively indicates that a common monetary policy across the region may not be ideal. The smaller the size of monetary disturbances and high speed of adjustments, the faster the policy synchronization process among West African countries, which for now exists only in theory.



Chapter 5.

Figure 2: Response of ECOWAS Countries to Monetary Shock



Source: Graph derived from State Space VAR estimates using Eviews 9.5.

V. CONCLUSION and RECOMMENDATIONS

This study builds on the optimum currency area theory, to identify the predominant shocks affecting ECOWAS countries using the SVAR model, particularly the S- SVAR model to analyse the dynamic evolution of shocks resonating across West Africa. The SVAR model shows that global GDP and monetary shocks predominantly affect ECOAWS countries. The S-SVAR model results clearly indicates that the identified shocks across West Africa are asymmetric and oscillate irregularly after a time lag of one year and with some countries finding it difficult to converge even in the long run. The policy implication here is that the different convergence time paths and longer convergence periods will generate policy inconsistencies among West African States, leading to a high cost of forming a monetary union. Thus, a monetary union is not feasible in West Africa for now.

For ECOWAS shocks to be symmetric thus, making them potential candidates for a monetary union, members should be given ample time to satisfy the requisite conditions of an optimal currency area and their policies need to be timely and quick to respond to the different shocks before they start manifesting. This will cushion the effect of the shocks and also shorten the duration of their impact before their sizes and ripple effects get bigger.

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APPENDIX

Appendix 1. Unit Root Test Result

Series	Augmented Dickey Fuller (ADF) Test		Phillips Perron (PP) Test		
Trend and Intercept. Test Critical Values 1% = -4.2050; 5% = -3.5298; 10% = -3.1946					
	Levels	1st Difference	Levels	1st Difference	Order
Benin					
WOP	-1.869	-5.547	-1.874	-5.572	(I)
GGDP	-2.351	-4.886	-2.443	-4.895	(I)
DGDP	-2.902	-7.240	-2.908	-7.212	(I)
REER	-1.886	-6.555	-1.929	-6.554	(I)
INF	-2.539	-9.054	-2.559	-8.935	(I)
Cape Verde					
DGDP	-1.471	-4.211	-1.966	-4.699	(I)
REER	-1.349	-5.291	-1.345	-5.339	(I)
INF	-3.171	-7.716	-3.177	-7.547	(I)
Gambia					
DGDP	-1.245	-7.026	-1.383	-7.498	(I)
REER	-2.684	-6.576	-2.694	-6.570	(I)
INF	-3.241	-8.304	-3.231	-8.240	(I)
Guinea					
DGDP	-1.410	-8.477	-1.419	-8.105	(I)
REER	-2.221	-8.735	-2.223	-5.944	(I)
INF	-2.878	-7.727	-2.888	-7.727	(I)
Mali					
DGDP	-3.045	-4.592	-3.045	-7.646	(I)
REER	-2.059	-7.235	-2.068	-7.233	(I)
INF	-3.322	-6.832	-11.232	-7.727	(I)
Nigeria					
DGDP	-1.215	-4.687	-1.267	-4.687	(I)
REER	-2.696	-4.803	-2.917	-4.813	(I)
INF	-3.359	-6.515	-3.424	-6.860	(I)
Seirra Leone					
DGDP	-2.410	-3.481	-4.015	**correlogram**	(I)
REER	-2.433	-5.757	-2.437	-6.214	(I)
INF	-3.391	-6.854	-3.413	8.309	(I)
Burkina Faso					
DGDP	-1.349	-6.177	-1.413	-6.179	(I)
REER	-2.025	-7.215	-2.025	-7.252	(I)
INF	-2.315	-8.114	-3.412	-11.298	(I)
Cote D'Ivoire					
DGDP	-2.011	-4.904	-2.262	-4.974	(I)
REER	-2.579	-6.546	-2.590	-6.546	(I)
INF	-3.134	-0.723	3.151	-8.208	(I)
GHANA					
DGDP	-1.498	-4.393	-2.141	-4.443	(I)
REER	-2.326	-3.807	-2.688	-4.203	(I)
INF	-3.126	-11.244	-3.134	-11.000	(I)
Guinea Bissau					
DGDP	-3.049	-8.294	-3.092	-8.250	(I)
REER	-1.887	-4.177	-1.887	-5.247	(I)
INF	-2.275	-2.174	-2.787	-9.405	(I)
Niger					
DGDP	-0.386	-6.043	-0.465	-6.049	(I)
REER	-1.668	-6.553	-1.677	-6.540	(I)
INF	-3.212	-8.449	-3.132	-8.248	(I)

Source: Author's computation using Eviews 9.5

Chapter 8.

Appendix 2. SVAR lag length selection criteria/serial correlationtest

Country	Lag Length	LM - Test
Benin	1	21.34(0.6737)
Burkina Faso	1	26.54(0.6068)
Cape verde	2	7.89(0.99000)
Cote D'Ivoire	2	22.59(0.6014)
Gambia	2	34.06(0.1066)
Guinea	1	25.03(0.4609)
Guinea Bissau	1	26.2390.3956)
Ghana	3	19.91(0.7515)
Mali	3	23.05(0.5673)
Niger	1	26.55(0.3785)
Nigeria	2	13.76(0.9657)
Senegal	2	26.37(0.3879)
Sierra Leone	3	22.98(0.6079)
Togo	1	35.09(0.0865)

(*) represent the probability Values of the LM test

Source: Author's computation using Eviews 9.5

Appendix 3. Eigen value stability

Eigen Value	Modulus	Eigen Value	Modulus	Eigen Value	Modulus	Eigen Value	Modulus
Benin		Gambia		Ghana		**Sierra Leone**	
0.554278 +0.353482i	0.657399	-0.042733-0.754932i	0.75614	0.007801+0.711052i	0.7111	-0.016393-0.750291i	0.75047
0.554278 -0.353482i	0.657399	-0.042733+0.754932i	0.75614	0.007801-0.711052i	0.7111	-0.016393+0.750291i	0.75047
0.119947 +0.566748i	0.579302	0.567346 +0.311451i	0.64721	0.694142	0.6941	0.547701 -0.416176i	0.68788
0.119947 -0.566748i	0.579302	0.567346 -0.311451i	0.64721	-0.586702-0.160775i	0.6083	0.547701 +0.416176i	0.68788
-0.559105	0.559105	-0.367462+0.488236i	0.61107	-0.586702+0.160775i	0.6083	0.336884 -0.494706i	0.598519
-0.202457 +0.474967i	0.516307	-0.367462-0.488236i	0.61107	0.495932-0.276168i	0.5676	0.336884 +0.494706i	0.598519
-0.202457 -0.474967i	0.516307	0.075410 -0.565875i	0.5693	0.495932+0.276168i	0.5676	-0.39503	0.39503
-0.422600 +0.135493i	0.44379	0.075410 +0.565875i	0.5693	-0.063951+0.224422i	0.2334	-0.182076-0.340505i	0.38613
-0.422600 -0.135493i	0.44379	-0.328337	0.32834	-0.063951-0.224422i	0.2334	-0.182076+0.340505i	0.38613
0.0542	0.0542	-0.242365	0.24237	0.202611	0.2026	0.234024	0.234024
Burkina Faso		**Guinea Bissau**		**Togo**		Nigeria	
-0.343063 -0.454031i	0.569067	-0.010830+0.631864i	0.63196	0.083682+0.720029i	0.7249	0.808062 +0.308190i	0.864839
-0.343063 +0.454031i	0.569067	-0.010830-0.631864i	0.63196	0.083682-0.720029i	0.7249	0.808062 -0.308190i	0.864839
0.519176	0.519176	-0.200146-0.576269i	0.61004	0.549376+0.261341i	0.6084	0.560399 +0.607904i	0.826798
0.065931 -0.512690i	0.516822	-0.200146+0.576269i	0.61004	0.549376-0.261341i	0.6084	0.560399 -0.607904i	0.826798
0.065931 +0.512690i	0.516822	-0.59974	0.59974	-0.521351-0.123648i	0.5358	-0.180669+0.804581i	0.824635
-0.222273 -0.458397i	0.509444	0.403724 -0.385867i	0.55847	-0.521351+0.123648i	0.5358	-0.180669-0.804581i	0.824635
-0.222273 +0.458397i	0.509444	0.403724 +0.385867i	0.55847	-0.166271-0.482588i	0.5104	-0.567353+0.567183i	0.802238
0.311860 -0.391729i	0.500708	-0.201655	0.20166	-0.166271+0.482588i	0.5104	-0.567353-0.567183i	0.802238
0.311860 +0.391729i	0.500708	0.024226 +0.171096i	0.1728	-0.006645+0.283191i	0.2833	0.255006 +0.733190i	0.77627
-0.341224	0.341224	0.024226 -0.171096i	0.1728	-0.006645-0.283191i	0.2833	0.255006 -0.733190i	0.77627
Cape verde		**Mali**		**Guinea**		Senegal	
-0.690945 +0.313652i	0.761616	-0.144745+0.773235i	0.78666	-0.136603+0.641655i	0.656	-0.379520-0.490034i	0.619815
-0.690945 -0.313652i	0.761616	-0.144745-0.773235i	0.78666	-0.136603-0.641655i	0.656	-0.379520+0.490034i	0.619815
0.319485 +0.656406i	0.730027	-0.432826+0.498445i	0.66014	-0.579897 +0.247470i	0.6305	0.609	0.609
0.319485 -0.656406i	0.730027	-0.432826-0.498445i	0.66014	-0.579897 -0.247470i	0.6305	0.155809 +0.564269i	0.585191
0.667121	0.667121	0.061592 -0.462672i	0.46675	0.358516-0.424664i	0.556	0.155809 -0.564269i	0.585191
-0.108838 -0.613419i	0.623	0.061592 +0.462672i	0.46675	0.358516+0.424664i	0.556	-0.039477 -0.497978i	0.49954
-0.108838 +0.613419i	0.623	0.344943 +0.261037i	0.43258	0.153256-0.365128i	0.396	-0.039477 +0.497978i	0.49954
-0.612532	0.612532	0.344943 -0.261037i	0.43258	0.153256+0.365128i	0.396	-0.271949	0.271949
0.232740 -0.144067i	0.273721	-0.36125	0.36125	0.019941+0.160729i	0.162	-0.013770+0.091512i	0.092542
0.232740 +0.144067i	0.273721	-0.055964	0.05596	0.019941-0.160729i	0.162	-0.013770-0.091512i	0.092542
Cote D'Ivoire		Niger					
-0.544820 +0.462679i	0.714773	0.012491 +0.686613i	0.68673				
-0.544820 -0.462679i	0.714773	0.012491 -0.686613i	0.68673				
0.129163 +0.632396i	0.645452	0.615408 +0.165390i	0.63725				
0.129163 -0.632396i	0.645452	0.615408 -0.165390i	0.63725				
0.491089 -0.227585i	0.541261	-0.418547 -0.384687i	0.56848				
0.491089 +0.227585i	0.541261	-0.418547 +0.384687i	0.56848				
-0.112022 +0.446895i	0.460721	-0.105397 +0.461391i	0.47264				
-0.112022 -0.446895i	0.460721	-0.105397 -0.461391i	0.47264				
0.418008	0.418008	-0.46545	0.46545				
-0.20296	0.20296	-0.214165	0.21416				

Source: Author's computation using Eviews 9.5