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Optimum Currency Areas and Synchronization of Business Cycles in Sub-Saharan Africa

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This paper investigates the theory of optimum currency areas in Sub-Saharan Africa (SSA). This issue is examined in a context of small open economies of SSA using a structural vector auto-regression (VAR) approach with limited capital mobility and a weak-banking system in Africa. A structural VAR implies long run restrictions of a small open economy model to identify the shocks. Using annual data series for 30 SSA countries from 1960 to 2000, the findings suggest similar terms of trade and trade balance disturbances in the Communauté Financière Africaine (CFA) and non-CFA countries in contrast to the supply and demand shocks which tend to influence the non-CFA zone to a greater extent. The sizes of the disturbances and the speed of adjustment confirm that the CFA and non-CFA countries are suitable of forming a monetary union. The adjustment speed is on average nine to 18 months in the CFA zone and 12 to 24 months in the non-CFA zone. These results also suggest the creation of smaller monetary arrangements in the CFA and non-CFA regions as preliminary steps in creating one monetary union in Africa. The findings support evidence of weaker business cycle synchronization in Sub-Saharan Africa.

Keywords: optimum currency areas theory, African monetary unification, vector auto-regression, size and speed of adjustment

Introduction

The idea for monetary union has been around for a while. The globalization and the internationalization of the world economy push countries to get together and create a monetary unification. But, there are costs and benefits of forming a monetary union. Mundell (1961, 1968) rightly considered as the father of the Optimal Currency Areas (OCA) theory, discussed the conditions for the realization of a monetary unification with a single currency. To achieve an OCA, countries should be economically integrated and have some experiences of flexible exchange rate regime. Factors of production should move freely within the area with stable relative prices. The size of the economy is a key factor. The theory of OCA also requires a single currency with a single central bank without losing reserves and impairing convertibility. This means national central banks have to give up their sovereignty over their own currency. Furthermore, Mundell (1999)[1] underlined seven criteria to realize a monetary union. First, there should be a large transactions area in order to have a low, flat transaction cost. Second, monetary policy should be stable. An unstable monetary policy could result in an unstable real money balances. Third, there should be no controls by the governments of the monetary union. Of course, this

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[1] See Mckinnon (1963) and Kenen (1969) for further discussion on the theory of OCA.

is a difficult task given the political situation in each country member of the union. The fourth feature is the need of a strong central state to avoid the collapse of its currency when the country is invaded. The fifth factor is a central bank committed to stabilize the prices. To achieve this criterion, the central bank has to hold substantial gold reserves and foreign exchange reserves. The sixth feature is a sense of permanence. There should be a belief that the monetary union and the currency are going to be here forever, not just for a limited period of time. Finally, the OCA should provide low interest rates for the single currency to dominate and prevail as a currency bloc. In the end, there should be a Euro bloc, which has already started in the European Monetary Union[2].

Bayoumi and Eichengreen (1992, 1994) empirically investigated the OCA theory in light of a monetary union in Western Europe, Asia and the United States using a structural VAR to identify the incidence of aggregate supply and demand shocks. Countries experiencing symmetric or similar disturbances of aggregate supply and aggregate demand would form a monetary union. Of course, the size of the disturbances and the speed of adjustment will matter. They find that there should be a Northern European bloc, a Northeast Asian bloc and Southeast Asian bloc. The Americas region is less plausible as candidate for a monetary unification but the United States, Canada, and possibly Mexico may get together to form the North American bloc. Moreover, Horváth and Grabowski (1997) found that asymmetric supply disturbances across African countries and symmetric demand shocks across African regions during the 1960-1992 period. These regions include Northern, Western, Eastern, and Southern Africa. Their findings make the African continent to be a less plausible candidate for monetary union but monetary arrangements might be possible at a smaller scale.

Bayoumi and Eichengreen (1997) suggested that economic integration and monetary integration went together. They apply the OCA theory to the European countries by computing an OCA index. The OCA index is driven by the relative size of the country and the degree of economic integration. Eichengreen (1997) argued that Europe was an OCA since European countries experience region-specific shocks and a higher variability of real exchange rates than the United States and Canada. Furthermore, Bayoumi and Eichengreen (1998) showed that the patterns of exchange rate variability and intervention across countries using the theory of OCA. Countries experiencing larger asymmetric shocks are countries with more flexible exchange rates. Bayoumi, Eichengreen, and Mauro (1999) investigated the feasibility of monetary arrangements for ASEAN[3]. They identify gradual steps such as standard economic criteria, higher level of intra-regional trade, and firm political commitment for the ASEAN to achieve a monetary unification.

More importantly, Frankel and Rose (1998) outlined four criteria of forming a potential OCA. The first factor is the extent of trade, that is, the trading intensity with other potential members of the currency union. The degree of openness of potential members of an OCA depends of their economic integration, which leads to low transaction costs and risks associated with different currencies. The second criterion is the similarity of the shocks and the cycles. Countries might experience closer international trade linkages when they do a lot of intra-industry trades which in turn, leads to similar business cycles. The degree of mobility of labor is the third criterion. Factors of production should move freely between regions according to their marginal productivity. The last feature is the system of risk sharing with respect to fiscal transfers. This is known as the balanced

[2] The European Monetary Union, created by the Maastricht treaty (1993), includes currently 27 members.
[3] ASEAN consists of 10 countries, namely, Brunei Darussalam, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

budget or fairness criterion. Countries with a huge budget deficit should not transfer their burdens to countries with a balanced budget or small budget deficit. Frankel and Rose (1998) focused on the former two criteria known as the "Lucas Critique". They consider that international trade and international business cycles are endogenously correlated. That is, trade integration leads to more international trade, which in turn will result in high correlations of business cycles across countries. Countries with the same or close international trading partners will benefit from a monetary unification. The benefits of joining a monetary union have to be higher than the associated costs, namely, transaction costs and loss of monetary independence costs.

Sub-Saharan Africa (SSA) already has two monetary unifications. The first one consists of seven countries in West Africa and six countries in Central Africa plus the Islamic Federal Republic of Comoros. The single currency used is the CFA Franc (CFAF)[4]. The Comoros Franc (CF) is the currency in Comoros Island. The CFA Franc Zone was created in 1946 after the Second World War[5]. The CFA Franc was originally pegged to the French Franc. The French Treasury provides foreign exchange reserves to the CFA Franc Zone and maintains a freely convertibility vis-à-vis the French Franc (FF). However, the CFA Franc is now pegged since 1999 to the Euro, the currency of the European Union[6]. The second currency union in SSA is the Common Monetary Area (CMA) in Southern African, which includes South Africa Republic, Lesotho, Namibia, and Swaziland. Bank notes issued by these countries are freely convertible into the South African Rand.

Bayoumi and Ostry (1997) applied the theory of OCA to SSA countries by investigating the size and correlation of the real disturbances across countries and the level of intra-regional trade. According to the theory of OCA, the benefits of forming a monetary union are lower transaction costs and the elimination of the exchange rate variability while the cost is the loss of monetary sovereignty. Assuming the same speed of adjustment, if countries face similar or symmetric disturbances then they will gain from forming a monetary union. Of course, the benefits depend upon the degree of diversification of their export commodity base. That is, the desirability of monetary unification should decrease with the degree of specialization of production. Other factors such as the poor quality of the data, the complement of the production structure, the poor local and intra-regional transportation and communications networks might explain the asymmetric of African trade disturbances.

A monetary union requires that the participating countries give up their sovereignty over the national currency and monetary policy. A unified monetary system implies some costs and benefits shared by the member countries. The main objective of this paper is to examine whether SSA countries should form one or more monetary arrangements in the light of the theory of an OCA. Another objective is the synchronization of business cycles in SSA countries. The economic integration of SSA countries will tend to raise the inter-linkages of their business cycles.

The remaining of this paper is as followed: The first section discusses the introduction and review literature. The second section contains the methodology and model identification. The data set, the unit root test and empirical results are mentioned in the third section. The last section concludes and draws the policy implications of the study.

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[4] The CFA stands for the "Communauté Financière Africaine" in the West African Economic and Monetary Union (WAEMU) and for the "Coopération Financière en Afrique Centrale" in the Central African Economic and Monetary Union (CAEMC).

[5] See Clement et al. (1996).

[6] The exchange rate is 1 French Franc (FF) for 50 CFAF before the 1994 devaluation and 100 CFAF after and 1 Euro for 655.957 CFAF.

Model and Methodology

The analysis of the theory of an OCA is used to determine potential members of a monetary union. Potential members of an OCA tend to have synchronized business cycles (Bayoumi & Eichengreen, 1992, 1994). Roughly speaking, the partners of synchronization depend upon the mechanism of transmission via common shocks or a weaker form of transmission.

A structural Vector Auto Regression (VAR) framework is used first to assess the possibility of one or more OCAs in SSA countries. This methodology follows Blanchard and Quah (1989).

Consider a small open economy with limited capital mobility. Political instability and weak financial/institutional infrastructure in SSA suggest that it is inappropriate to assume uncovered interest parity. In what follows, one can adapt a small open economy aggregate supply/aggregate demand (AS/AD) model to reflect exogenous capital mobility that may be more appropriate for SSA. The following equations provide the elements of such a model that will provide the restrictions to identify the shocks within a structural VAR framework:

Terms of trade	$h_t = h_{t-1} + \varepsilon_t^h$	(1)
Aggregate Supply	$y_t^s = \breve{y}_t + \theta h_t$	(2)
Evolution of Capacity output	$\breve{y} = \breve{y}_{t-1} + \varepsilon_t^s$	(3)
Trade balance	$nx_t = \eta_1(s_t - p_t) - \eta_2 y_t + z_t \ = 0$	(4)
Trade balance shock	$z_t = z_{t-1} + \varepsilon_t$	(5)
Aggregate Demand (AD)/IS	$y_t^d = d_t - \gamma[i_t - E_t(p_{t+1} - p_t)] - z_t$	(6)
Evolution of autonomous AD	$d_t = d_{t-1} + \varepsilon_t^d$	(7)
Money demand	$m_t^d = p_t + y_t - \lambda i_t$	(8)
Money supply	$m_t^s = m_{t-1}^s + \varepsilon_t^m$	(9)
Goods market equilibrium	$y_t^s = y_t^d = y_t$	(10)
Money market equilibrium	$m_t^s = m_t^d = m_t$	(11)

where h = terms of trade as proxied by the relative price of the primary export commodity; y = real GDP; $\breve{y}$ = capacity output; i = nominal interest rate; s = nominal exchange rate (e.g., CFA Franc per dollar); p = domestic price level; m = money stock; d = autonomous aggregate demand, all variables except the interest rate are in logarithms; E_t is the conditional expectations parameter, and all Greek parameters are positive.

The observed movements in the variables are due to five mutually uncorrelated "structural" shocks with finite variances. These are terms of trade shocks— ε_t^h; aggregate supply shocks— ε_t^s; trade balance shocks— ε_t^z; aggregate demand or real demand shocks— ε_t^d; and money supply shocks— ε_t^m.

Equation (1) is the evolution of the world oil or export commodity price, which is assumed to be exogenous. Equation (2) is an aggregate supply equation, where aggregate supply depends on capacity output and terms of trade (world oil price or export commodity price). Capacity output in equation (3) is a function of the productive capacity of the economy (e.g., capital stock and human capital or employment), and for simplicity, is assumed to be a random walk process. The balance on goods and services (equation (4)) is assumed to be a function of the real exchange rate, $(s_t - p_t)$ and domestic real income. For simplicity, normalize the foreign price level to unity, so that $(s_t - p_t)$ measures the relative price of foreign goods in terms of domestic goods. Although the author labels z_t a trade balance shock, it can capture capital flows

shocks, or exogenous shifts in imports or exports. Equation (5) implies that the exogenous part of the trade balance shocks follow a random walk.

Equation (6) is a conventional aggregate demand (IS) equation where aggregate spending depends on the expected real interest rate and the exogenously given level of the trade balance. The autonomous portion of aggregate demand—d_t, is assumed to follow a random walk in equation (7). Equation (8) is a conventional money demand equation with unitary income elasticity. Equation (9) is the evolution of money supply, which for simplicity, is assumed to follow a random walk. Finally, the model is closed by postulation of goods and money market equilibrium relationships (equations (10) and (11)).

In order to solve the model, eliminate the interest rate from equation (6) using equation (8) to get:

$$p_t = (\frac{\lambda\gamma}{1+\lambda\gamma})E_t p_{t+1}(\frac{\lambda}{1+\lambda\gamma})(d_t - z_t) + (\frac{1}{1+\lambda\gamma})m_t - (\frac{1+\lambda}{1+\lambda\gamma})y_t \tag{12}$$

This is a first order expectational difference equation in the price level. Note that for finite values of the parameters, and assuming that $\lambda\gamma \neq 1$, the forward-looking solution is convergent. With rational expectations, and given the stochastic processes for the exogenous variables in equations (1), (3), (5), (7), and (9), the forward looking solution for the price level is given by:

$$p_t = m_t + \lambda(d_t - z_t) - (1+\lambda)y_t \tag{13}$$

From equation (13), Equilibrium real money balances are:

$$m_t - p_t = \lambda(z_t - d_t) + (1+\lambda)y_t \tag{14}$$

The equilibrium real exchange rate, which is compatible with trade balance, is obtained using equation (4):

$$s_t - p_t = \frac{\eta_2}{\eta_1} y_t - \frac{1}{\eta_1} z_t \tag{15}$$

It can be shown that the long run impact of the structural shocks on the endogenous variables has a peculiar triangular structure[7]. In order to show the long run impact of the five structural shocks $\varepsilon_t = [\varepsilon_t^h, \varepsilon_t^s, \varepsilon_t^z, \varepsilon_t^d, \varepsilon_t^m]$ on the system of endogenous variables $\mathrm{X}_t = [h_t, y_t, (s_t - p_t)(m_t - p_t), p_t]'$, there is need to express the solution to the model in first differences:

$$\Delta h_t = \varepsilon_t^h \tag{16}$$

$$\Delta y_t = \theta\varepsilon_t^h + \varepsilon_t^s \tag{17}$$

$$\Delta(s_t - p_t) = (\frac{\eta_2}{\eta_1})(\theta_t^h + \varepsilon_t^s) - (\frac{1}{\eta_1})\varepsilon_t^z \tag{18}$$

$$\Delta(m_t - p_t) = \lambda(\varepsilon_t^z - \varepsilon_t^d) + (1+\lambda)(\theta\varepsilon_t^h + \varepsilon_t^s) \tag{19}$$

$$\Delta p_t = \lambda(\varepsilon_t^d - \varepsilon_t^z) - (1+\lambda)(\theta\varepsilon_t^h + \varepsilon_t^s) + \varepsilon_t^m \tag{20}$$

Note that although endogenous variables have unit roots, all are difference stationary. The long-run impact of the structural shocks on the endogenous variables is triangular. Specifically, all shocks except terms of trade shocks have no long-term effect on the oil price or the relative price of primary commodity. Real demand, trade balance, and monetary shocks have no long-run impact on output. Real demand and monetary shocks have no long-run impact on the real exchange rate, and monetary shocks have no long-run effect on real money balances.

[7] See Sissoko and Dibooglu (2006) for similar aggregate demand/aggregate supply triangular long run impact structures.

Given the model structure above, the long-run effects of the shocks of the endogenous variables are given by:

$$\begin{vmatrix} \Delta h_t \\ \Delta y_t \\ \Delta(s_t - p_t) \\ \Delta(m_t - p_t) \\ \Delta p_t \end{vmatrix} = \begin{vmatrix} a_{11} & 0 & 0 & 0 & 0 \\ a_{21} & a_{22}(1) & 0 & 0 & 0 \\ a_{31}(1) & a_{32}(1) & a_{33}(1) & 0 & 0 \\ a_{41}(1) & a_{42}(1) & a_{43}(1) & a_{44}(1) & 0 \\ a_{51}(1) & a_{52}(1) & a_{53}(1) & a_{54}(1) & a_{55}(1) \end{vmatrix} \begin{vmatrix} \varepsilon_t^h \\ \varepsilon_t^s \\ \varepsilon_t^z \\ \varepsilon_t^d \\ \varepsilon_t^m \end{vmatrix} \quad (21)$$

where $a_{ij}(1)$ represents the cumulative long-run effect of shock j on variable i. The zero entries in equation (21) provide the 10 (long-run) restrictions needed to identify the shocks.

Empirical Results

The study covers 30 SSA countries from both the CFA Franc and the non-CFA Franc zones. The CFA countries covered in the study include Benin, Burkina Faso, Cameroon, Central African Republic, Chad, Congo, Côte D'Ivoire, Gabon, Mali, Niger, Senegal, and Togo. The non-FCFA countries are Botswana, Burundi, Ethiopia, Gambia, Ghana, Kenya, Lesotho, Madagascar, Malawi, Mauritius, Nigeria, Rwanda, South African Republic, Swaziland, Tanzania, Uganda, Zambia, and Zimbabwe[8].

The data used in the sample consist of 40 annual observations from 1960 to 2000 taken from the International Financial Statistics (IFS) CD-ROM published by the International Monetary Fund (IMF). The data set includes the following series: terms of trade; output; real exchange rates; real money balances; and price level[9].

The proper specification of the VAR requires testing for times series properties of the data. The variables are tested for unit roots using the Augmented Dickey-Fuller (ADF) and Kwiathowski-Phillips-Schmitt-Shin (KPSS) test statistics[10]. The ADF test statistics show the null hypothesis of a unit root cannot be rejected at the log level for the data for most of the series in question at five percent significance level. The ADF test statistics also indicate that the variables are stationary in the first differences at the five percent significance level. This makes the use of a VAR appropriate. Moreover, the KPSS test statistics confirm the results of the ADF test. That is, the acceptance of the null hypothesis of the KPSS test makes the use of a VAR in first differences appropriate.

Table 1 shows the mean of the annual average growth rate of output and inflation across the CFA and non-CFA countries for the full period of the data. The non-CFA countries have grown on average faster than the CFA countries during the period of 1960 to 2000. The ratio is 1 to 2 in favor of the non-CFA countries with Botswana leading with a growth rate of output of 9.1% in the non-CFA zone compared with only 6.0% for the Republic of Congo in the CFA zone. However, the CFA countries outperform the non-CFA countries with an annual average inflation rate of 6.7% against 13.1% for the latter. The inflation variability is somewhat smaller across the CFA countries than across the non-CFA countries.

More importantly, SSA countries seem to lag behind other regions of the world in terms of output growth

[8] This sample covers the bulk of SSA except for the Comoros Islands in the CFA group and Angola, Equatorial Guinea, Guinée, Guinea Bissau, Liberia, Mozambique, Sierra Leone, Somalia, Sudan, and Democratic Republic of Congo (i.e., former Zaire) in the non-CFA group. These dropped from the study because of insufficient data.

[9] See Sissoko and Dibooglu (2006) for a detailed explanation about the construction of the data.

[10] These results are available from the author upon request.

performance, even though they might have an edge in the area of inflation. Bayoumi and Eichengreen (1994) found that the average annual growth rates of output and inflation were respectively 3.3% and 7.2% for Western European Countries during the 1960-1990 period against 6.0% and 8.4% for East Asia and 3.1% and 4.9% for the Americas including the United States and Canada. The output and inflation variability is somewhat higher across SSA countries than across the countries of the regions of the world considered above[11].

Table 1

Annual Average of Output and Inflation Growth Rates—1960 to 2000

	Growth		Inflation	
	Mean	Std. Deviation	Mean	Std. Deviation
		CFA countries		
Benin	0.031	0.047	0.108	0.098
Burkina Faso	0.018	0.077	0.048	0.073
Cameroon	0.019	0.055	0.071	0.068
C.A.R*	0.016	0.106	0.058	0.068
Chad	0.046	0.141	0.053	0.067
Congo	0.030	0.589	0.111	0.102
Cote D'Ivoire	0.027	0.084	0.065	0.062
Gabon	-0.014	0.214	0.063	0.080
Mali	0.022	0.096	0.101	0.091
Niger	-0.005	0.260	0.059	0.091
Senegal	0.016	0.058	0.086	0.108
Togo	-0.015	0.096	0.048	0.135
Average	0.015	0.140	0.067	0.080
		Non-CFA countries		
Botswana	0.091	0.069	0.121	0.072
Burundi	-0.006	0.238	0.114	0.093
Ethiopia	0.028	0.044	0.062	0.077
Gambia	0.020	0.256	0.090	0.103
Ghana	0.037	0.083	0.240	0.216
Kenya	0.060	0.157	0.096	0.080
Lesotho	0.028	0.085	0.129	0.053
Madagascar	0.017	0.035	0.126	0.092
Malawi	0.060	0.084	0.207	0.256
Mauritius	0.044	0.070	0.100	0.098
Nigeria	0.038	0.302	0.157	0.147
Rwanda	0.026	0.134	0.106	0.102
South Africa	0.030	0.027	0.087	0.046
Swaziland	0.054	0.083	0.100	0.051
Tanzania	0.049	0.087	0.173	0.082
Uganda	0.078	0.178	0.232	0.330
Zambia	0.034	0.136	0.233	0.284
Zimbabwe	-0.020	0.158	0.117	0.102
Average	0.035	0.117	0.131	0.120

Note. *Central African Republic; Source: IFS CD ROM and Author's own computations.

[11] See Bayoumi and Eichengreen (1992) for similar comparative findings between the European countries and the U.S. regions.

Correlation of Supply and Demand Disturbances

Table 2 is the country codes used for the CFA and non-CFA countries. Table 3 displays the results of the correlations of supply shocks above the diagonal and the correlations of demand disturbances below the diagonal. The supply correlation coefficients within the CFA countries and between the CFA and the non-CFA countries do not suggest a clear regional pattern among these countries. Indeed, most of the supply correlations are insignificant within the CFA countries. The non-CFA countries have more significant positive supply correlations than the CFA countries, but still do not show any clear geographical pattern. The correlations of supply shocks between Gambia, Ghana, Malawi, Nigeria, and Uganda are positive and significant suggesting a regional pattern. One possible explanation is perhaps the differences in the economic structures within the CFA and non-CFA countries. These results are similar with the findings of Bayoumi and Eichengreen (1994) that the supply correlations within Europe and the Americas do not feature a clear geographic pattern in contrast to the ones of Asia.

Table 2

Country Codes for CFA and Non-CFA Countries

Country	Country code
CFA countries	
Benin	BE
Burkina Faso	BF
Central African Republic	CA
Cameroon	CR
Congo	CO
Cote D'ivoire	CI
Gabon	GA
Mali	MI
Niger	NI
Senegal	SE
Togo	TO
Non-CFA countries	
Botswana	BO
Burundi	BU
Ethiopia	ET
Gambia	GM
Ghana	GH
Kenya	KE
Lesotho	LE
Madagascar	MA
Malawi	MW
Mauritius	MU
Nigeria	NG
Rwanda	RW
South African republic	SA
Swaziland	SW
Tanzania	TA
Uganda	UG
Zambia	ZA
Zimbabwe	ZI

Table 3

Correlation of Supply and Demand Shocks

	CFA countries												Non-CFA countries																	
	BE	BF	CA	CR	CD	CO	CI	GA	MI	NI	SE	TO	BO	BU	ET	GM	GH	KE	LE	MA	MW	MU	NG	RW	SA	SW	TA	UG	ZA	ZI
BE	---	-0.22	-0.07	0.08	0.06	-0.07	-0.03	-0.22	-0.10	-0.07	-0.03	-0.11	-0.08	-0.01	-0.03	-0.31	-0.29	-0.09	-0.11	-0.07	-0.08	0.01	-0.16	0.12	-0.10	0.05	-0.04	-0.07	0.18	0.06
BF	**0.30**	---	-0.05	0.18	0.18	0.12	0.23	0.05	0.18	-0.17	0.16	-0.24	-0.01	0.07	-0.03	-0.27	0.06	-0.16	-0.11	0.02	-0.22	0.00	-0.10	-0.07	0.10	0.06	-0.03	-0.03	-0.03	**0.44**
CA	**0.42**	0.17	---	-0.23	-0.32	-32	0.06	-0.14	0.14	-0.05	-0.21	0.12	-0.02	0.01	-0.07	0.26	-0.07	0.20	-0.01	-0.30	0.09	0.16	-0.32	-0.35	-0.18	-0.07	0.01	0.00	**0.33**	0.22
CR	**0.29**	**0.38**	**0.34**	---	**0.29**	-0.00	0.21	0.09	0.04	-0.08	-0.01	-0.05	0.19	0.56	-0.04	-0.35	-0.12	-0.09	0.19	-0.40	-0.17	**0.28**	-0.23	-0.25	**0.43**	-0.07	0.22	-0.07	0.19	0.01
CD	0.07	**0.27**	0.24	0.17	---	-0.41	-0.19	-0.11	-0.38	0.03	0.07	-0.33	0.08	-0.20	-0.09	-0.33	-0.12	-0.15	0.20	0.06	-0.10	0.06	-0.25	0.05	**0.28**	0.03	0.17	-0.20	-0.14	0.15
CO	0.**36**	**0.46**	**0.36**	0.13	0.09	---	0.10	**0.86**	0.10	-0.00	-0.08	**0.49**	0.04	-0.12	0.01	0.08	-0.16	0.32	0.26	-0.14	0.11	-0.12	0.01	-0.27	-0.12	0.10	0.01	0.06	0.14	-0.03
CI	-0.00	**0.27**	0.01	-0.04	-0.24	0.23	---	0.05	**0.37**	-0.19	-0.15	-0.05	0.22	0.03	-0.08	0.08	0.09	0.13	-0.03	-0.21	-0.08	0.10	0.13	-0.29	0.09	0.10	0.13	-0.05	0.36	0.16
GA	**0.54**	**0.50**	0.51	**0.43**	0.20	**0.43**	0.06	---	**0.27**	-0.13	0.19	-0.03	0.06	0.22	0.18	0.02	0.47	-0.01	-0.11	-0.02	-0.14	-0.10	0.15	0.18	-0.05	-0.08	-0.20	**0.37**	-0.11	0.14
MI	**0.46**	**0.42**	**0.46**	**0.40**	**0.43**	0.25	0.11	**0.66**	---	0.01	0.03	0.21	0.12	**0.33**	-0.06	-0.01	0.17	-0.04	-0.12	0.02	0.07	0.08	0.08	-0.15	-0.01	0.07	-0.19	0.22	-0.06	0.25
NI	**0.43**	**0.48**	**0.33**	0.19	**0.32**	0.32	0.15	**0.49**	**0.58**	---	-0.05	0.07	-0.35	-0.08	-0.01	-0.14	-0.01	-0.26	-0.05	**0.39**	-0.10	-0.14	0.15	-0.02	**0.30**	-0.03	-0.06	**0.34**	-0.19	0.17
SE	**0.41**	**0.68**	**0.49**	0.**41**	0.25	0.52	0.17	**0.72**	**0.68**	**0.60**	---	-0.20	-0.20	0.11	0.14	-0.25	0.06	-0.08	-0.34	0.11	0.04	0.03	-0.07	0.38	0.20	0.25	-0.16	-0.13	-0.07	0.00
TO	0.12	0.17	-0.05	0.07	0.14	**0.28**	0.10	0.07	**0.31**	0.16	**0.31**	---	**0.27**	-0.06	0.02	**0.29**	-0.04	0.22	0.01	0.11	-0.07	-0.05	0.18	-0.15	0.05	-0.08	0.02	0.24	-0.04	-0.03
BO	-0.37	**0.26**	0.11	-0.04	0.42	0.11	0.01	-0.16	-0.10	0.02	-0.01	0.22	---	-0.08	0.10	0.03	0.17	0.30	0.18	-0.10	0.05	0.21	-0.00	0.12	-0.08	**0.26**	0.08	0.16	-0.02	-0.10
BU	0.03	0.01	0.25	0.20	0.42	-0.08	-0.00	-0.03	0.35	0.25	0.23	**0.33**	0.11	---	-0.49	0.08	0.04	-0.16	0.02	-0.22	0.11	0.19	-0.13	0.01	-0.34	0.20	-0.36	-0.00	-0.08	0.17
ET	-0.31	0.21	0.05	-0.17	-0.02	-0.17	0.25	-0.23	-0.15	0.08	-0.04	0.06	**0.38**	0.10	---	0.07	0.26	0.02	0.01	0.15	0.20	-0.31	-0.05	0.21	0.28	-0.17	-0.07	0.10	0.13	-0.18
GM	-0.07	0.02	-0.42	-0.24	-0.28	0.06	-0.02	-0.03	-0.30	-0.23	-0.13	0.02	0.03	-0.51	0.19	---	0.27	0.21	0.23	-0.14	0.28	**0.36**	0.20	0.00	-0.45	0.09	0.16	0.09	-0.07	-0.20
GH	0.05	**0.38**	-0.04	-0.16	0.25	0.12	0.12	0.19	**0.30**	0.21	**0.26**	0.16	0.35	-0.04	0.26	0.25	---	-0.15	-0.24	0.04	0.08	-0.02	**0.30**	0.03	-0.09	0.15	0.18	**0.33**	-0.11	0.17
KE	-0.23	0.19	-0.23	-0.20	-0.19	0.16	0.07	-0.24	-0.23	-0.13	-0.01	-0.13	0.12	-0.20	0.31	**0.37**	0.14	---	0.14	0.09	0.07	0.15	0.01	0.17	**0.26**	0.05	0.12	**0.37**	0.19	0.02
LE	-0.23	-0.23	-0.23	0.01	-0.00	-0.21	0.03	-0.03	0.00	-0.18	-0.25	-0.24	0.19	-0.27	0.01	0.03	-0.03	0.21	---	-0.19	0.21	0.10	-0.16	0.10	-0.24	0.17	0.11	-0.11	-0.02	-0.07
MA	-0.13	**0.30**	0.13	0.08	0.22	**0.32**	-0.16	0.28	**0.27**	**0.32**	**0.38**	0.11	**0.27**	0.22	-0.07	-0.18	0.31	-0.08	-0.38	---	0.01	-0.37	**0.45**	**0.41**	-0.03	-0.05	-0.06	**0.33**	-0.35	0.18
MW	-0.19	**0.27**	-0.06	-0.01	0.03	0.42	0.23	-0.10	0.01	0.19	0.16	-0.02	0.17	0.04	0.11	-0.25	0.18	0.16	-0.08	-0.04	---	-0.01	-0.04	0.09	-0.10	0.11	-0.09	-0.09	0.03	-0.16
MU	0.06	**0.29**	0.19	0.12	0.21	-0.02	0.02	0.28	**0.31**	-0.07	0.14	0.15	0.03	-0.06	0.12	-0.21	**0.28**	-0.06	0.08	**0.45**	0.15	---	-0.08	-0.17	-0.12	-0.10	0.10	-0.04	0.09	-0.01
NG	-0.20	0.15	0.18	-0.03	-0.01	0.20	-0.00	0.03	0.07	0.18	0.09	0.02	0.26	-0.02	**0.35**	-0.07	**0.26**	0.13	0.09	**0.40**	**0.37**	-0.01	---	0.15	-0.06	-0.17	-0.08	**0.33**	-0.15	0.02
RW	-0.09	**0.44**	0.08	-0.17	0.05	0.13	**0.38**	-0.01	0.22	0.06	0.18	0.12	0.14	0.05	**0.43**	0.06	0.17	0.13	-0.00	-0.10	0.24	0.25	0.10	---	-0.27	**0.32**	-0.27	0.10	-0.21	-0.13
SA	0.03	0.14	0.11	-0.02	0.09	0.02	-0.00	0.29	0.14	0.08	0.02	-0.17	0.09	-0.27	-0.21	-0.02	**0.41**	-0.08	0.22	0.08	-0.03	0.16	0.07	-0.02	---	-0.26	-0.05	-0.15	-0.01	-0.04
SW	-0.30	0.25	0.01	-0.13	-0.00	0.18	0.20	-0.14	-0.01	-0.01	-0.05	0.15	**0.31**	0.08	**0.30**	0.03	**0.40**	0.24	-0.11	**0.34**	**0.52**	**0.27**	**0.44**	**0.27**	**0.28**	---	0.01	-0.25	-0.12	-0.19
TA	-0.25	0.01	-0.50	0.23	-0.12	-0.13	0.01	-0.10	-0.25	-0.19	-0.11	-0.05	-0.00	-0.11	0.18	**0.26**	-0.08	0.09	**0.27**	0.06	0.06	-0.16	0.08	0.13	-0.05	0.05	---	0.00	0.42	-0.05
UG	-0.20	-0.07	-0.04	-0.00	-0.05	0.15	0.23	-0.16	-0.2	-0.24	-0.04	0.11	0.22	-0.05	-0.06	0.18	0.14	0.10	-0.02	-0.02	0.20	-0.12	-0.04	-0.15	0.07	0.15	-0.03	---	-0.09	**0.40**
ZA	-0.13	-0.25	-0.27	0.09	-0.16	-0.08	-0.05	-0.22	-0.31	-0.35	-0.30	0.18	0.10	-0.15	**0.26**	**0.39**	0.02	0.01	0.15	-0.05	0.04	-0.09	0.21	-0.12	-0.20	0.09	**0.42**	0.25	---	0.08
ZI	-0.13	0.08	0.06	-0.11	-0.02	-0.12	0.23	-0.07	0.06	0.02	0.15	0.11	0.07	0.13	0.20	-0.12	-0.04	0.09	-0.03	0.02	-0.16	-0.22	0.15	**0.46**	-0.21	0.10	0.07	-0.08	0.07	---

Notes. Correlations of supply disturbances are above the diagonal and correlations of demand disturbances are below the diagonal. Bold words in this table mean positively significant coefficients at the 5 percent level, At 5%, the critical value of the correlation coefficient, *r* is 0.26. Source: IFS CD ROM and Author's own computations.

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Table 4

Shock Sizes and Adjustment Speed in the CFA and Non-CFA Countries

	CFA countries									
Countries	ε_t^h		ε_t^s		ε_t^z		ε_t^d		ε_t^m	
	SS	AS	SS	AS	SS	AS	SS	AS	SS	AS
Benin	0.26	0.87	0.04	1.83	0.70	0.38	0.32	2.76	0.10	2.10
Burkina Faso	0.20	1.35	0.06	0.93	0.72	2.43	0.10	2.44	0.05	0.81
Cameroon	0.29	0.25	0.07	3.79	0.61	2.54	0.19	0.97	0.14	0.24
Central African Republic	0.29	0.41	0.11	0.07	0.65	3.26	0.11	2.73	0.06	0.30
Chad	0.28	0.34	0.36	2.30	0.68	0.08	0.11	0.25	0.77	0.38
Congo	0.24	0.12	0.11	3.69	0.69	0.81	0.16	0.38	0.06	0.56
Cote D'Ivoire	0.29	0.10	0.06	1.76	0.69	2.22	0.09	0.76	0.04	2.39
Gabon	0.25	2.22	0.14	0.22	0.69	1.29	0.10	0.52	0.06	3.84
Mali	0.25	0.40	0.10	3.75	0.67	1.20	0.18	0.07	.08	3.10
Niger	0.16	0.86	0.20	0.10	0.60	1.21	0.13	1.89	0.07	0.11
Senegal	0.26	1.40	0.08	0.09	0.66	2.38	0.10	3.79	0.08	3.00
Togo	0.28	2.54	0.06	3.21	0.61	0.26	0.29	0.17	0.11	0.77
Average CFA	0.25	0.91	0.12	1.81	0.66	1.51	0.16	1.39	0.14	1.47
Countries	Non-CFA countries									
Botswana	0.20	1.74	0.06	3.59	0.61	0.58	0.11	0.51	0.02	1.10
Burundi	0.27	3.58	0.28	0.80	0.64	0.44	0.23	1.17	0.09	3.02
Ethiopia	0.31	2.07	0.04	2.64	0.76	2.10	0.15	1.06	0.04	2.45
Gambia	0.24	1.43	0.23	3.00	0.74	0.79	0.37	2.96	0.07	2.86
Ghana	0.40	0.72	0.09	2.16	0.75	2.57	0.11	1.20	0.16	2.52
Kenya	0.27	1.26	0.14	0.64	0.72	1.81	0.13	0.76	0.25	0.20
Lesotho	0.13	1.03	0.07	2.12	0.65	1.84	0.08	1.70	0.02	0.96
Madagascar	0.26	1.71	0.04	3.11	0.70	3.16	0.11	1.88	0.11	2.23
Malawi	0.29	0.76	0.07	1.31	0.61	1.84	0.19	1.99	0.14	2.30
Mauritius	0.31	1.62	0.08	0.51	0.66	0.80	0.20	2.79	0.11	1.57
Nigeria	0.60	1.15	0.28	1.69	0.62	2.78	0.25	0.40	0.13	1.83
Rwanda	0.36	0.97	0.11	1.15	0.60	1.36	0.15	3.89	0.05	0.82
South African Republic	0.15	0.58	0.11	0.13	0.67	1.72	0.07	1.18	0.03	0.69
Swaziland	0.18	0.76	0.07	0.23	0.67	3.83	0.11	1.24	0.05	2.45
Tanzania	0.42	1.62	0.08	0.51	0.71	0.80	0.13	2.79	0.09	1.57
Uganda	0.52	1.71	0.15	1.41	0.57	1.31	0.26	1.18	0.27	3.41
Zambia	0.47	2.48	0.16	0.50	0.74	0.95	0.18	0.97	0.18	1.06
Zimbabwe	0.22	0.71	0.10	0.45	0.68	0.79	0.79	3.40	0.05	0.02
Average non-CFA	0.31	1.66	0.12	1.91	0.67	1.64	0.20	1.74	0.10	1.91

Notes. SS = Shock Size; AS = Adjustment Speed. Source: IFS CD ROM and Author's own computations.

The demand disturbances exhibit significant positive coefficients within the CFA countries and the Non-CFA countries with a clear geographic pattern. However, the correlations between the CFA and the Non-CFA countries show a number of significant positive coefficients but with no clear regional pattern. The CFA countries except Congo and Côte D'Ivoire might be good candidates for monetary union. The correlations of demand shocks between Burundi, Ghana, Malawi, Mauritius and Mali also suggest a coherent regional pattern. In the non-CFA countries, the best clear geographical pattern consists of Swaziland, Botswana, Ethiopia, Ghana, Madagascar, Malawi, Mauritius, Nigeria, Rwanda, and South Africa. The demand

disturbances are highly correlated within the CFA countries. These results are also similar with the findings of Bayoumi and Eichengreen (1994) in their study about the prospects of monetary unification around the world.

Size of Disturbances and Speeds of Adjustment and Synchronization of Business Cycles

Besides the level of correlation between countries, the size of the shocks and the speeds of adjustment are also important in defining a monetary unification. Bayoumi and Eichengreen (1994) identified three criteria to define an optimum currency area. Related to the country's macro-economic disturbances, these criteria are: the size of shocks; the cross-country correlation; and the speed of adjustment. Countries are relatively highly correlated with similarly sized shocks and speeds of adjustment are suitable to form a monetary union. The results of the sizes of the disturbances and the speeds of adjustments are given in Table 4.

The size of the shock is measured by the standard deviation of each disturbance. Larger sized disturbances are costly to the economy to offset the shocks. On average, the non-CFA countries experience a larger terms of trade shock than the CFA countries. CFA and non-CFA countries face similar sized supply shocks on average with the largest disturbance in Chad for the CFA countries and Nigeria and Burundi for the non-CFA countries. Moreover, the CFA and non-CFA also display similarly sized trade balances disturbances on average. Burkina Faso in the CFA zone and Burundi in the non-CFA zone are the two countries with the largest trade balance shocks. The size of the monetary shocks is smaller on average in the CFA countries than in the non-CFA countries. As one should expect, this is the discipline effect of the fixed exchange rate regime. However, the CFA countries display on average larger demand shocks than the non-CFA countries with Central African Republic in the CFA zone and Uganda in the non-CFA experiencing the largest demand disturbances. Overall, even though the CFA and non-CFA countries face similarly sized disturbances, the trade balance shocks are far the largest shocks on average for both the CFA and non-CFA countries. Indeed, trade balance disturbances represent on average twice the terms of trade shock size, five times the size of supply shocks, three times the size of monetary shocks and four to six times the size of demand shocks.

A simple measure of the speed of adjustment is the ratio of the impulse responses function in a chosen year, say the third year divided by its long run level[12]. A low value of the speed of adjustment indicates a relatively slow adjustment while a high value indicates a large amount of adjustment. Note that there are high costs to the economy associated with a relatively slow adjustment. The non-CFA countries have on average faster adjustment speed in terms of trade, supply, and trade balance, monetary and demand shocks than the CFA countries. Indeed, only one third of the terms of trade adjustment occur within three years, while the adjustment of terms of trade shocks is two thirds in the non-CFA countries. The fastest adjustment in terms of trade happens in Togo for the CFA countries and Burundi for the non-CFA countries where all the adjustments occur within three years. Three fourths of the adjustment of supply shocks occurs on average within three years in the non-CFA countries. In the CFA countries, in contrast, the change or adjustment is only two thirds. Cameroon and Botswana in the CFA and non-CFA countries respectively achieve the fastest supply shock adjustment. The adjustment speed in trade balance disturbances within three years is respectively half and two thirds for the CFA and non-CFA countries. The non-CFA countries achieve two thirds of the adjustment in monetary shocks within three years while the change is only half in the CFA countries. Finally, 75% of the adjustments of demand disturbances occur on average within three years in the non-CFA countries. In contrast, the change is only half in the CFA countries. Gabon and Uganda in the CFA and non-CFA countries

[12] The choice of the third year is somewhat arbitrary but the use of other years (e.g., two or four) gives similar results.

respectively achieve all the adjustment of demand shocks within three years faster than anyone else in their respective bloc.

The non-CFA countries face on average faster adjustment speed of real shocks within three years than the CFA countries. In the CFA countries, only one third of the adjustment of real disturbances occurs within three years in contrast to the non-CFA where the adjustment is one half. In contrast, the adjustment speed of nominal disturbances is faster on average in the CFA countries than in the non-CFA countries. Indeed, three fourths of the nominal adjustment speed occurs within three years in the CFA countries while the adjustment is only one half for the non-CFA countries. Bayoumi and Eichengreen (1994) investigated the speed of adjustment in west Europe, East Asia, and the Americas including Canada and the United States. Within two years, they found that Asia had the fastest adjustment of all the change of output and prices, followed by the Americas and Europe where only 80% and 50% of the adjustment was completed respectively.

Overall, the CFA and non-CFA countries experience similarly sized disturbances and almost same speed of adjustment for the different shocks. However, there is no clear geographical pattern for the correlations between CFA and non-CFA countries. Nevertheless, this may be an indication of a partial synchronization of business cycles in SSA. Countries facing the similar shock sizes with the same speed of adjustment of the disturbances might get together to form a monetary union with less opportunity costs.

Concluding Remarks

The Theory of Optimum Currency Area (OCA) is applied to SSA countries to indentify feasible monetary arrangements. This study focuses on the correlations of aggregate supply and demand disturbances, the sizes of the disturbances and the speed of adjustment as the necessary conditions of forming a monetary union. Countries with high disturbance correlations, with same shock sizes and same speed of adjustment may be a strong evidence for currency unification. The results of the supply disturbances do not show a strong evidence of common currency area in the CFA and non-CFA countries. The correlations of supply shocks between the CFA and non-CFA countries do suggest a clear regional pattern among these countries. The results, however, favor smaller SSA blocs, such as the one between South African Republic, Cameroon, Cote D'Ivoire, and Niger. In contrast, the correlations of demand shocks feature significantly positive coefficients among the CFA countries, the non-CFA countries and between the CFA and non-CFA countries. These results suggest a clear geographical pattern within the CFA and non-CFA countries or between the CFA and non-CFA countries. The results of the supply and demand disturbances are very similar to the findings of Horvath and Grabowski (1997) about African regions.

Notwithstanding their economic structure disparity, CFA and non-CFA countries experience on average similarly sized disturbances. These results hold for the different shocks considered in the study, namely, terms of trade, supply, demand, monetary and trade balances disturbances and real and nominal shocks. CFA and non-CFA countries also feature on average similar speed of adjustment within three years after experiencing macroeconomic disturbances. These results may suggest a possible partial synchronization of business cycles in Sub-Saharan African countries. The management of the exchange rate policy and monetary policy will be much easier even though there is loss of monetary sovereignty. Further studies may investigate the level of intra-regional trade within the CFA and non-CFA countries and between the CFA and the non-CFA countries. It will be interesting to check the findings of intra-regional trade disturbances in SSA countries in the light of the theory of OCA.

References

Bayoumi, T., & Eichengreen, B. (1992, January). Shocking aspects of European monetary unification (pp. 1-39). NBER, Working Paper No. 3949.

Bayoumi, T., & Eichengreen, B. (1994, September). One money and many? Analysing the prospects for monetary unification in various parts of the world. *Princeton Studies in International Finance, 76,* 1-44.

Bayoumi, T., & Eichengreen, B. (1997). Ever closer to heaven? An optimum-currency-area index for European countries. *European Economic Review, 4,* 761-770.

Bayoumi, T., & Ostry J. D. (1997). Shocks and trade flows within sub-Saharan Africa: Implications for optimum currency arrangement. *Journal of African Economies, 6*(3), 412-444.

Bayoumi, T., Eichengreen, B., & Mauro, P. (1999). On regional monetary arrangements for ASEAN (pp. 1-30). Working Paper.

Blanchard, O., & Quah, D. (1989, September). The dynamic effects of aggregate demand and supply disturbances. *American Economic Review, 79,* 655-673.

Clément, J. A. P., Mueller, J., Cosse, S., & Le Dem, J. (1996, May). Aftermath of the CFA franc devaluation. International Monetary Fund, Occasional Paper 138.

Dickey, D. D., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica, 49,* 1057-1072.

Frankel, J. A., & Rose, A. K. (1998, July). The endogeneity of the optimum currency area criteria. *The Economic Journal, 108,* 1009-1025.

Horváth, J., & Grabowski, R. (1997, March). Prospects of African integration in light of the theory of optimum currency areas. *Journal of Economic Integration, 12*(1), 1-25.

International Monetary Fund. (1999). *Direction of trade statistics yearbook (various years)*. Washington, D. C..

International Monetary Fund. (2001, June). *International financial statistics, CD-ROM*. Washington, D. C..

Kenen, P. B. (1969). The theory of optimum currency areas: An eclectic view. In R. Mundell, & A. Swoboda (Eds.), *Monetary Problems of the International Economy*. Chicago: University of Chicago Press.

McKinnon, R. I. (1963). Optimum currency area. *American Economic Review, 53,* 717-724.

Mundell, R. A. (1961). A theory of optimal currency areas. *The American Economic Review, 51*(3), 657-665.

Mundell, R. A. (1968). A theory of optimum currency areas. *International Economics*. New York: Macmillan.

Mundell, R. A. (1999) The euro: How important*? Cato Journal, 18*(3), 441-444.

Sissoko, Y., & Dibooglu, S. (2006). The exchange rate system and macroeconomic fluctuations in sub-Saharan Africa. *Economic Systems, 30*(2), 1-16.