Is the East African Community an Optimum Currency Area?

N. Kundan Kishor and John Ssozi

University of Wisconsin-Milwaukee

3. October 2009

Is the East African Community an Optimum Currency Area?

N. Kundan Kishor[1]
University of Wisconsin Milwauke

John Ssozi
University of Wisconsin Milwaukee

September 2009

Abstract

This paper investigates whether the East African Community (EAC) constitutes an optimum currency area (OCA) by estimating the degree and evolution of business cycle synchronization between the EAC countries. We also investigate whether the degree of business cycle synchronization has improved after signing of the EAC treaty in 1999. The degree of business cycle synchronization is estimated using an unobserved components model of structural shocks obtained from a structural VAR model. We then use a time-varying parameter model to estimate the evolution of business cycle synchronization. Our results indicate that the proportion of shocks that is common across different countries is small, implying weak synchronization. However, we also find that the degree of synchronization has improved after signing of the EAC treaty in 1999.

JEL classifications: F33; E32; F15; N17

Keywords: East African Community, Optimum Currency Area, Business Cycle Synchronization, Structural VAR, State-Space Model

[1] Kishor: Department of Economics, Bolton Hall, Box 0413, University of Wisconsin-Milwaukee, Milwaukee, WI-53201 (Email: kishor@uwm.edu), Ssozi: Department of Economics, Bolton Hall, Box 0413, University of Wisconsin-Milwaukee, Milwaukee, WI-53201 (Email: jmssozi@uwm.edu)

1. Introduction

The East African Community (EAC) which was revived by the 1999 Treaty[2] between Kenya, Tanzania and Uganda has not only grown to include Burundi and Rwanda by 2007, it has taken concrete steps towards becoming a monetary union. The 1999 Treaty states that these countries are determined to strengthen their economic, social, cultural, political, technological and other ties for their fast balanced and sustainable development by the establishment of an EAC, with an East African Customs Union and a Common Market as transitional stages to and integral parts thereof, subsequently a Monetary Union and ultimately a Political Federation. The Common Market is set to come into effect by 2010 and subsequently a Monetary Union by 2012. The EAC organs in place by 2009 include the East African Legislative Assembly, the EA Court of Justice, a Secretariat, a Summit of Heads of State and Council of Ministers.

Despite the importance of this initiative and steps already taken, and whereas the political will continues to gain momentum, there is concern that not enough empirical economic research has been done to buttress the initiative. This paper contributes to the existing meager empirical economic research about the viability of the EAC as a monetary union. The paper seeks to find out whether the EAC is an optimum currency area (OCA) by examining the synchronization of structural shocks of the member countries. Since countries in a monetary union employ a single monetary policy, it is important for the success of the union that member countries have synchronized business cycles. This assertion stems from the theory of optimum currency areas, whereby countries under a monetary union share a common monetary policy and therefore can not use national monetary or exchange rate policies to address country-specific shocks (Mundell, 1961 and McKinnon, 1963).

The first strand of empirical research on the suitability of the EAC as an OCA employed a Generalized Purchasing Power Parity (GPPP) model and concluded that the

[2] The Treaty for Establishment of the East African Community was signed on 30th November 1999 and entered into force on 7th July 2000 following its ratification by the original three partner States – Kenya, Uganda and Tanzania. The Republic of Rwanda and the Republic of Burundi acceded to the EAC Treaty on 18th June 2007 and became full Members on 1st July 2007.

EAC is an OCA (Mkenda (2001)). Buigut and Valev (2005, 2006) following Angeloni and Dedola (1999) point out that the GPPP approach does not distinguish shocks from responses, yet movements in macroeconomic variables reflect the combined effects of both. Another limitation to the GPPP approach raised by Xu (2006) is that if the nominal exchange rates and market prices have been controlled by the respective governments, then the movement of long-run real exchange rates may not reflect common trends in market forces as expected in an OCA.

The second strand of literature on the EAC assesses the symmetry of underlying shocks using a structural vector autoregressive technique developed by Blanchard and Quah (1989). Buigut and Valev (2005) use data from 1970 to 2001 and find that only the contemporaneous supply shocks for Kenya and Burundi are positive and significantly correlated. Buigut and Valev (2005) find that for the period 1970-2001 the supply and demand shocks are mostly asymmetric in the EAC, a result which does not support a currency union.

In this paper, we investigate the degree and the evolution of business cycle synchronization in the EAC. In doing so, we go beyond the simple correlation analysis that has been performed before for these countries. Simple correlations cannot account for factors that affect the co-movement of shocks between two economies. Countries are suitable for an optimal currency area if common shocks explain a significant portion of the overall variation in structural shocks. The correlation analysis also does not provide the dynamics of the convergence process, which is very important in our context especially since the EAC treaty was signed in 1999.

To estimate the degree of business cycle synchronization, we estimate a bivariate structural VAR model of output growth and inflation, and obtain structural demand and supply shocks for each country in the region. Then we examine the extent to which the movements in structural shocks are country-specific, that is, idiosyncratic and the extent to which they are common across different countries. We use a dynamic factor model of Stock and Watson (1991) to decompose the movements in demand shock and supply shock into common and individual components. We find that the shares of the common shocks in the EAC are low: the share of common demand shocks is highest in Tanzania at 33.5 percent, while the share of common supply shocks is highest in Rwanda at 36

percent. We also examine the evolution of the synchronization of these structural shocks over time using a time-varying parameter model. Our results indicate that although the share of common shock across different countries is still low, the degree of synchronization has improved since the EAC Treaty came into force in 2000.

2. A Brief Literature Review

Literature on optimum currency areas may be classified under two generations. First generation literature, also known as Mundell I (1963), holds that countries should adopt a single currency only if they exhibit synchronized business cycles or correlated demand and supply shocks. Second generation literature, also known as Mundell II focuses on the degree of risk sharing and financial integration as the key to the success of currency unions irrespective of whether their prior business cycles are synchronized or not. Proponents of Mundell II, such as Krugman (1993), predict that due to strong trade ties a monetary union can induce specialization leading to asymmetric output cycles and shocks. On the other hand Frankel and Rose (1998) predict that economic integration can increase the correlation of business cycles across regions as policy measures get more coordinated between countries. Without prejudice to any prediction, the second generation literature suggests that it is especially those countries with asymmetric shocks that may benefit the most from a monetary union, because as individuals across countries hold claims on each other's productive assets, they can very easily benefit from a boom in another country. Hence income and consumption become insured and highly correlated across countries, even if they have asymmetric idiosyncratic shocks or business cycles. Therefore following Mundell II countries in the EAC do not have to wait until their structural shocks are synchronized but rather work towards increased financial integration and risk-sharing policies. However, financial integration within the EAC is known to be in its infancy. Hence the continued relevance of seeking empirical evidence based on the synchronization of structural shocks.

The rest of the paper is organized as follows: section 3 explains the model and methodology used to extract the structural shocks. Section 4 makes a brief description of data: annual real GDP and inflation. Section 5 reports the estimation equations and discusses the results. Section 6 summaries the main findings and concludes.

3. Model and Methodology

This paper undertakes two tasks: first, it empirically examines the synchronization of structural shocks in the EAC so as to assess the viability of a monetary union. Second, we set out to establish the degree to which the structural shocks can be explained by some unobserved common component, which might in turn account for the synchronization. The first task is accomplished using the Blanchard-Quah technique, while the second goal is achieved using a state-space model.

3.1. Structural VAR to Extract Demand and Supply Shocks

Literature starting with Shapiro and Watson (1988) and later Blanchard and Quah (1989) employed the long-run restrictions founded on neutrality properties in the theory of macroeconomic dynamics to identify permanent and transitory shocks to real GDP. Blanchard and Quah (1989) interpreted the permanent shocks as aggregate supply shocks, and the transitory shocks as aggregate demand shocks. Since then the Blanchard-Quah technique has been widely used to estimate potential GDP and business cycles. DuPasquier et al., (1999) use this technique and interpret the resultant cumulative aggregate demand shocks as a measure of business cycle fluctuation.

Following Buigut and Valev (2005) we execute the Blanchard-Quah technique with a bivariate vector-autoregressive (VAR) model using the log of real GDP and inflation. The log of real GDP is integrated of degree one, while inflation is a covariance stationary series. Our objective is to extract structural demand and supply shocks from this bivariate model. A bivariate model with one non-stationary and the other stationary component provides us a framework to distinguish between supply shocks and demand shocks since the long-run impact of demand shock on output is zero and supply shock is non-zero. According to Bayoumi and Ostry (1997), real GDP and inflation are the most important macroeconomic indicators across Africa. The model is set up as follows:

Let $y_t = (\Delta y_{1t}, y_{2t})'$ (1)

where y_{1t} is the log of real GDP and hence Δy_{1t} is the growth rate of output, and y_{2t} is the inflation. Equation (1) is a vector of stationary variables. The structural model to reflect the dynamics from period *t-1* to *t* is specified as follows:

$$\beta y_t = \gamma_0 + \Gamma_1 y_{t-1} + \varepsilon_t ; \quad \varepsilon \sim i.i.d.(0, \sigma^2) \tag{2}$$

where $\varepsilon_t = (\varepsilon_{dt}, \varepsilon_{st})'$; ε_{dt} are demand shocks and ε_{st} are supply shocks, and they are orthogonal. The reduced form vector autoregressive (VAR) of equation (1) can be represented as follows:

$$y_t = a_0 + A_1 y_{t-1} + u_t \tag{3}$$

where $a_0 = B^{-1}\gamma_0, A_1 = B^{-1}\Gamma_1, u_t = B^{-1}\varepsilon_t$ and A_1 represents the impulse response functions of the shocks to the growth of real GDP and inflation. In order to generate the impulse response functions, we apply the Wold Decomposition Theorem on equation (3) and derive the structural moving average representation of y_t which becomes:

$$y_t = \mu + \Theta(L)\varepsilon_t \tag{4}$$

where μ is a vector of constants and L is a lag operator. Equation (4) is an infinite series. In matrix form equation (4) can be expanded as follows:

$$\begin{bmatrix} \Delta y_{1t} \\ y_{2t} \end{bmatrix} = \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} + \begin{bmatrix} \theta_{11}^{(0)} & \theta_{12}^{(0)} \\ \theta_{21}^{(0)} & \theta_{22}^{(0)} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} + ... \tag{5}$$

Hence the impulse response functions are derived as:

$$\left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{dt}}\right] = \theta_{11}^{(s)}, \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{st}}\right] = \theta_{12}^{(s)}, \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{dt}}\right] = \theta_{21}^{(s)}, \left[\frac{\partial \Delta y_{1t+s}}{\partial \varepsilon_{st}}\right] = \theta_{22}^{(s)} \tag{6}$$

In order to decompose the shocks into demand and supply shocks, we impose the long-run restriction that demand shocks do not affect the level of output in the long-run, while both shocks may affect the price level. This restriction implies that the cumulative effect of demand shocks on real GDP is zero.

In other words $\theta_{11}(1) = \sum_{s=0}^{\infty} \theta_{11}^{(s)} = 0$, hence the long-run impact matrix which is used to identify the B matrix in a structural VAR is as follows:

$$\Theta(1) = \begin{bmatrix} 0 & \theta_{12}(1) \\ \theta_{21}(1) & \theta_{22}(1) \end{bmatrix} \tag{7}$$

The shocks are derived from equation (4) as follows:

$$\varepsilon_t = (y_t - \mu)\theta(1)^{-1} \tag{8}$$

Equation (8) shows output and inflation as a function of the demand and supply shocks.

3.2. A State-Space Model to Measure the Importance of Common Shocks

The usual approach in the OCA literature is to compute the contemporaneous correlation coefficients of the shocks between economies. Following Mundell I, countries which are a good fit for a currency union should have significant positive correlation coefficients. However, this approach is fraught with limitations. First, simple correlations cannot account for factors that affect the co-movement of shocks between two economies. Countries are suitable for an optimal currency area if the idiosyncratic components of their structural shocks are correlated for smooth monetary policy action. Earlier papers on the EAC monetary union by Mkenda (2001) and Buigut and Valev (2005) do not address the issue of the possibility of a common factor to influence the pattern of economic activity. The correlation analysis also does not provide the dynamics of the convergence process, which is very important in our context especially since the EAC treaty was signed in 1999. In addition, the correlation coefficient is very sensitive to the periods chosen.

We therefore move to decompose each country's demand and supply shocks (C_{it}) into two unobserved components, namely, a common component (K_t) and an idiosyncratic component (I_{it}) using a state-space model. The following two assumptions are made: both the common and country specific components are subject to stochastic shocks, and they are orthogonal. The measurement equation which describes the relationship between observed data and the unobserved state variables is specified in equation (9).

$$C_{it} = \delta_i K_t + I_{it} \tag{9}$$

where δ_i is the degree to which a country's shocks are determined by some unobserved common component (shock). The state-space representation of the measurement equation is set up as follows:

$$\begin{bmatrix} C_{B,t} \\ C_{K,t} \\ C_{R,t} \\ C_{T,t} \\ C_{U,t} \end{bmatrix} = \begin{bmatrix} \delta_B & 1 & 0 & 0 & 0 & 0 \\ \delta_K & 0 & 1 & 0 & 0 & 0 \\ \delta_R & 0 & 0 & 1 & 0 & 0 \\ \delta_T & 0 & 0 & 0 & 1 & 0 \\ \delta_U & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} K_t \\ I_{B,t} \\ I_{K,t} \\ I_{R,t} \\ I_{T,t} \\ I_{U,t} \end{bmatrix} \tag{10}$$

Following Xu (2006) we model the transition equations which describe the dynamics of state variables from period $t-1$ to period t to take a form of random shocks as specified in equation (11).

$$\begin{aligned} K_t &= \eta_t ; \eta_t \sim i.i.d.N(0, \sigma^2_{\eta,t}) \\ I_{it} &= \varepsilon_{it} ; \varepsilon_{it} \sim i.i.d.N(0, \sigma^2_{\varepsilon_i,t}) \end{aligned} \tag{11}$$

where η_t and ε_{it} are the common and idiosyncratic stochastic shocks respectively.

The state-space representation of the transition equations is set up as follows:

$$\begin{bmatrix} K_t \\ I_{B,t} \\ I_{K,t} \\ I_{R,t} \\ I_{T,t} \\ I_{U,t} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \eta_t \\ \varepsilon_{B,t} \\ \varepsilon_{K,t} \\ \varepsilon_{R,t} \\ \varepsilon_{T,t} \\ \varepsilon_{U,t} \end{bmatrix} \tag{12}$$

Since shocks are independent, the variance-covariance matrix for the shocks is specified as follows:

$$E(\eta\varepsilon') = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & \sigma_B^2 & 0 & 0 & 0 & 0 \\ 0 & 0 & \sigma_K^2 & 0 & 0 & 0 \\ 0 & 0 & 0 & \sigma_R^2 & 0 & 0 \\ 0 & 0 & 0 & 0 & \sigma_T^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & \sigma_U^2 \end{bmatrix} \tag{13}$$

The variance of the common shocks is normalized to unity, while for identification all shocks are assumed to be orthogonal. The state-space model outlined in equations (9)-(13) is estimated using the Kalman filter to obtain the model coefficients. A detailed description of the Kalman filter can be found in Clark (1989) and Stock and Watson (1991).

Using the estimated coefficients we determine the importance of the common component to each country's structural shocks. This finding enables us to explain the extent to which the co-movement of the cyclical component of output depends on the some unobserved common component. Since the coefficients δ_i measure the extent to which shocks are explained by an unobserved common component, while σ_i^2 gives the variance of country-specific shocks to the unobserved state vector variables, then following Xu (2006) the proportion of the variance of the shocks that should be allocated to the common unobserved component can be computed as $\delta_i^2/(\delta_i^2+\sigma_i^2)$.

4. Data

Our dataset consists of annual real GDP and inflation for the period between 1970 and 2007. The data were drawn from the IMF's International Financial Statistics and the World Bank's World Development Indicators and supplemented by data from UN databases. We separate the sample period into two sub-periods: before the EAC 1999 Treaty and after. The first handicap we have is lack of high frequency data on the EAC countries. The second limitation is that we have very few post-1999 EAC Treaty data points. However, we have seven years of data after the signing of EAC Treaty and will help us in examining whether the degree of synchronization in the business cycles has improved after 1999 or not.

Table 1 summarizes average statistics of real GDP growth and inflation. The EAC Development Strategy 2001-2005 stipulated that partner states shall work towards closer macroeconomic convergence on the following economic parameters: real GDP growth rate of at least 7 percent; inflation of less than 5 percent; lower ratio of current account deficit; reduction of fiscal deficit to less than 5 percent; maintaining reserves at least 6 months equivalent of normal imports; scaling up the ratio of domestic savings to GDP of at least 20 percent; undertake debt reduction initiatives and maintaining the fiscal burden of serving the external obligations to less than 15 percent.

After the 1999 Treaty, whereas on an average of eight years (2000-2007) none of the EAC countries achieved the 7 percent target of real GDP growth, they were not far off the target, while Tanzania and Uganda lowered inflation substantially to an average of 5.39 and 5.05 percent respectively almost matching the convergence parameter of 5

percent. Using each country's share of total real GDP in the EAC as the weight, we computed the EAC regional growth is a weighted average. The average regional EAC growth rate increased by about 53 percent between the sub-sample periods of 1970-1999 and 2000-2007. Of the five EAC countries, Kenya has the dominant share of total regional GDP, about 42 percent, while Burundi has the least share of approximately 2.9 percent. Between 2000 and 2007 all EAC countries controlled inflation to an average of less than 10 percent, with Uganda having the highest drop in the rate at which the general price level rose.

Table 1: EAC indicators

Country	Real GDP growth		Share of Real GDP in the EAC		Inflation	
	1970-1999	2000-2007	1970-1999	2000-2007	1970-1999	2000-2007
EAC target*	-	7	-	-	-	5
Burundi	1.75	2.48	4.73	2.93	10.62	9.44
Kenya	3.82	3.94	44.37	41.56	13.07	9.21
Rwanda	2.40	5.62	10.71	8.90	11.49	7.00
Tanzania	3.12	6.35	21.28	22.59	21.45	5.39
Uganda	2.96	5.54	18.91	24.02	71.29	5.05
EAC	3.26	4.98	100	100		

*EAC convergence parameters (2001-2005)

In Table 2 (Panel 1) we report simple correlations of output growth between the EAC countries during the two sub-periods. Before 1999 the correlations of output growth are mostly negative and when positive they are less than 30 percent. All growth correlations with Uganda are negative. The lack of synchronization with Uganda's growth can be explained by history. While other EAC countries enjoyed relative political tranquility in the 1970s, 80s and early 90s, Uganda degenerated during the Amin regime (1970-1979), Asian entrepreneurs were expelled from the country and industries and plantations closed. The immediate post-Amin years were marked by coups and counter coups until the Museveni regime at the beginning of 1986. In a lapse of six years (1979-1986) Uganda had four presidents. The Museveni administration also did not immediately restore peace to the whole country. For a period of almost 21 years (1986-2006) northern Uganda has suffered a civil war and has largely been unproductive. These political events might explain why Uganda does not seem to fit with the rest. While the genocide in Rwanda and Burundi also dealt a huge blow to the economy, it

was short lived and the aftermath saw a massive inflow of foreign aid which quickly revived the economy.

On the other hand, after the 1999 EAC Treaty we observe the opposite, growth correlations are mostly both positive and high, and when negative they are low with the exception of Uganda and Rwanda. Correlations of inflation before 1999 are mostly positive, again with the exception of Uganda, but after 1999 all of them become strongly positive with the exception of Rwanda which has a very small negative correlation of 2 percent. During the pre-1999 sub-sample period Uganda had a very high inflation averaging to 71 percent. On average, correlations of both output growth and inflation are increasing over the sub-periods, suggesting that they are sensitive to the periods chosen, and perhaps the 1999 Treaty has engendered more synchronization. It further suggests the need for a more robust technique to examine the nature of business cycle synchronization in the EAC.

Table 2: Simple correlations of output growth, and inflation, between the EAC countries

Panel 1:correlations of output growth between the EAC countries						Panel 2: correlations of inflation between the EAC countries				
	Burundi	Kenya	Rwanda	Tanzania	Uganda	Burundi	Kenya	Rwanda	Tanzania	Uganda
Burundi		0.48	0.46	0.35	0.24		0.28	-0.02	0.06	0.55
Kenya	0.28		-0.13	0.27	0.71	0.07		0.78	0.40	0.82
Rwanda	0.12	0.16		-0.07	-0.45	0.48	0.32		0.03	0.65
Tanzania	-0.10	-0.08	0.14		0.25	-0.09	0.26	0.19		0.33
Uganda	-0.21	-0.20	-0.22	-0.12		-0.41	-0.24	-0.39	0.37	

Lower triangles: correlation for 1970-1999; Upper triangles: correlations for 2000-2007.

5. Estimation Results

5.1. Correlation Analysis Using Structural Shocks

Simple correlation analysis is not very informative. In order to extract the structural shocks we estimated the VAR for each country, using 2 lags based on the AIC and BIC lag length criteria. Unit root tests were carried out on the log of real GDP and inflation using the Augmented Dickey-Fuller test for Burundi, Kenya and Rwanda. Due to the high persistence in the time series data of Tanzania and Uganda, we used the Ng-Perron test. The log of real GDP was found to be I(1), while inflation was I(0) for each

country.[3] The log of real GDP was therefore first-differenced before it could be used in a VAR model.

A structural VAR was estimated with the long-run restriction that demand shocks have no effect on the level of real GDP. Table 3 (Panel 1) reports correlations of the demand shocks between each pair of countries in the two sub-sample periods. Demand shocks correlations in the pre-1999 EAC Treaty period are mostly negative with the exception of Kenya and Burundi, and Uganda and Rwanda. The results indicate that the correlations are positive in the post-Treaty sub-sample period between Burundi, Kenya and Rwanda. Demand shock correlations with Uganda become highly negative, with the exception of the correlation with Tanzania. Table 3 (Panel 2) reports correlations of supply shocks. Buigut and Valev (2005) used a sample of 1970-2001 and found that only contemporaneous supply shocks for Kenya and Burundi are positive and significant. For our pre-Treaty sample we find a positive correlation not only between Kenya and Burundi, but also between Kenya and Uganda. Again we observe that Burundi, Kenya and Rwanda attain positive supply shock correlations in the post-Treaty period. Burundi has positive correlations with all the other EAC countries in the post-Treaty period. While the prior positive supply shock correlation between Kenya and Uganda turns negative. We observe some consistence in the correlations between three countries, namely, Burundi, Kenya and Rwanda.

Table 3: Correlations of business cycles in the EAC

Panel 1: Demand shocks' correlations from the Blanchard-Quah Technique						Panel 2: Supply shocks' correlations from the Blanchard-Quah Technique				
	Burundi	Kenya	Rwanda	Tanzania	Uganda	Burundi	Kenya	Rwanda	Tanzania	Uganda
Burundi		0.67	0.75	0.05	-0.71		0.01	0.27	0.22	0.54
Kenya	0.32		0.37	-0.34	-0.70	0.17		0.14	-0.21	-0.32
Rwanda	-0.10	-0.19		0.09	-0.80	-0.20	-0.32		-0.65	0.56
Tanzania	-0.11	-0.23	0.05		0.36	0.12	-0.03	0.11		-0.36
Uganda	0.02	-0.24	0.18	0.30		-0.11	0.23	-0.11	-0.07	

Lower triangles: correlation for 1970-1999; Upper triangles: correlations for 2000-2007; Positive (negative) values indicate symmetry (asymmetry).

[3] The detailed results of unit root tests are available upon request.

While the contemporaneous correlation coefficients are positive and sometimes significant between Burundi, Kenya and Rwanda, we may not easily conclude that a monetary union is suitable for these countries. One limitation to such simple correlation coefficients is that the existence of an unobserved shock or component which is common to all economies in a region, for instance Africa or all developing countries or world business cycles, may lead to highly correlated shocks. If this is the case, then these correlations would not be reflecting synchronization of EAC-specific common shocks, which is the basis for viability of a monetary union. In addition such simple contemporaneous correlations tend to be sensitive to the chosen periods (Xu, 2006). We therefore compute the proportion of variance of the demand and supply shocks for each country that is explained by the common shocks.

5.2. Estimation of the State-Space Model

The state-space model specified by equations (9) to (13) is estimated for the entire sample period from 1970 to 2007, and the hyper-parameters of the estimated model are reported in Table 4. Ideally a state-space model for each sub-sample period should be estimated to take into account the pre- and post-1999 Treaty years; however we have very few data points for the post-Treaty period.

Table 4: Estimated coefficients of the unobserved components model

Panel 1: Demand shock model				Panel 2: Supply shock model			
Standard deviations		Common component		Standard deviations		Common component	
σ_B	1.010 (0.126)	δ_B	-0.092 (0.257)	σ_B	0.998 (0.128)	δ_B	-0.164 (0.314)
σ_K	0.936 (0.146)	δ_K	-0.422 (0.261)	σ_K	0.939 (0.136)	δ_K	0.381 (0.248)
σ_R	0.855 (0.148)	δ_R	0.491 (0.242)	σ_R	0.808 (0.301)	δ_R	0.608 (0.409)
σ_T	0.800 (0.177)	δ_T	0.568 (0.259)	σ_T	0.982 (0.129)	δ_T	-0.229 (0.277)
σ_U	0.885 (0.156)	δ_U	0.498 (0.259)	σ_U	0.883 (0.217)	δ_U	0.497 (0.373)
Likelihood value is -108.577601				Likelihood value is -114.868455			

Note: Standard errors are in parenthesis

The estimated coefficients in Table 4 help us to compute the proportion of each country's structural shocks that is explained by the common component. Table 5 presents the proportion of the variance of country-specific shocks that is explained by some unobserved common component, which is the basis for evaluating the suitability of an OCA. Demand shocks represent short-run innovations of business cycles, while supply shocks reflect the long-run variations.

Table 5: Variance decomposition (decimal percentage)

	Share of Common Component: Demand shock (%)	Share of Common Component: Supply shock (%)
Burundi	0.8236	2.6164
Kenya	16.9005	14.1053
Rwanda	24.8148	36.0913
Tanzania	33.4868	5.1663
Uganda	24.0639	24.0393

The results in Table 5 are very important because, for instance, the simple correlation coefficients of demand shocks between Burundi, Kenya and Rwanda are high and positive, but the degrees of the countries-specific common shocks are very low. Burundi which has 67 percent and 75 percent simple correlations of demand shocks with Kenya and Rwanda respectively in the second sub-sample, yet its demand shocks has only a 0.8 percent share of the common shocks. Tanzania has the highest share of the common demand shocks which is only 33.5 percent, while Kenya, Rwanda and Uganda lie between 16 percent and 25 percent. Hence the empirical economic evidence to support the plausibility of a currency union in the EAC is weak.

5.3. A Time-Varying Parameter Model to Estimate the Evolution of Business Cycle Synchronization

The empirical results in the previous section indicate that the simple demand correlation coefficients substantially improved in the post-1999 EAC Treaty sub-sample period (2000-2007). We therefore investigate how the synchronization of the demand shocks has evolved over the past years by estimating a time varying parameter model. Since there is no anchor country in the EAC, such as Germany in the European Union, estimating the evolution of business cycle synchronization becomes a tricky issue. As a result, we take the simple approach of using the estimated common component as anchor

and estimate the time-varying nature of the business cycle synchronization by regressing the common component of demand shock on demand shocks of each country. The transitory demand shocks reflect the evolution of business cycle synchronization from year to year. We follow a parsimonious strategy in modeling the nature of time-variation by allowing the coefficients to follow a random walk. We set up state-space model to estimate the time varying parameters as follows: let the measurement equation be specified as follows:

$$y_t = \alpha' x_t + \upsilon_t, \tag{14}$$

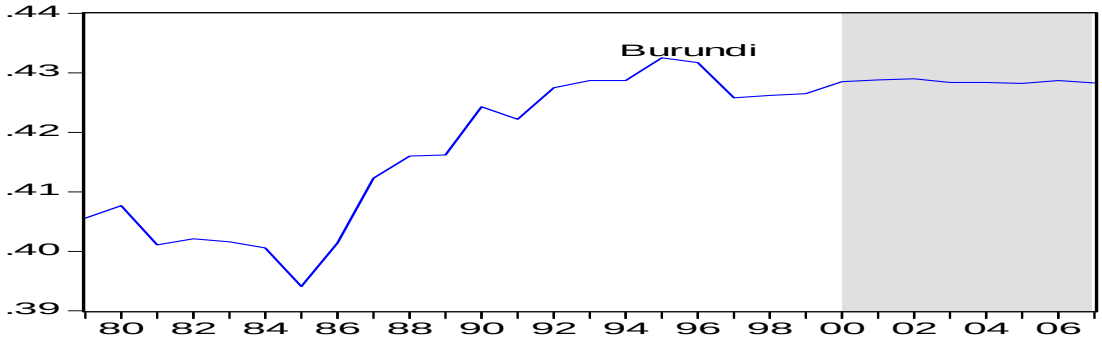
where y_t is a time series of common shocks derived from estimating equations (9) to (13), x_t is the vector of the country demand shocks, and $\upsilon_t \sim NID(0,1)$. α measures the relationship between individual country's demand shocks with common shock, and we allow this coefficient to vary with time to capture the evolution of business cycle synchronization in the EAC countries. The state equation follows a random walk process:

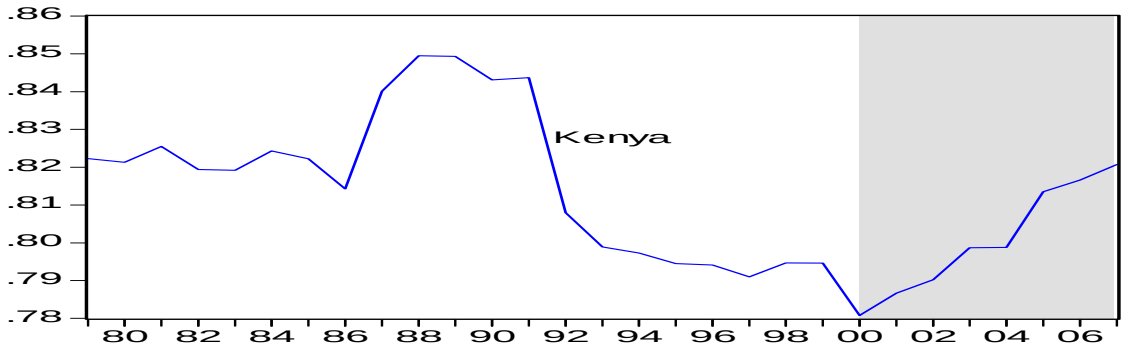
$$\alpha_t = \alpha_{t-1} + \varepsilon_t,$$

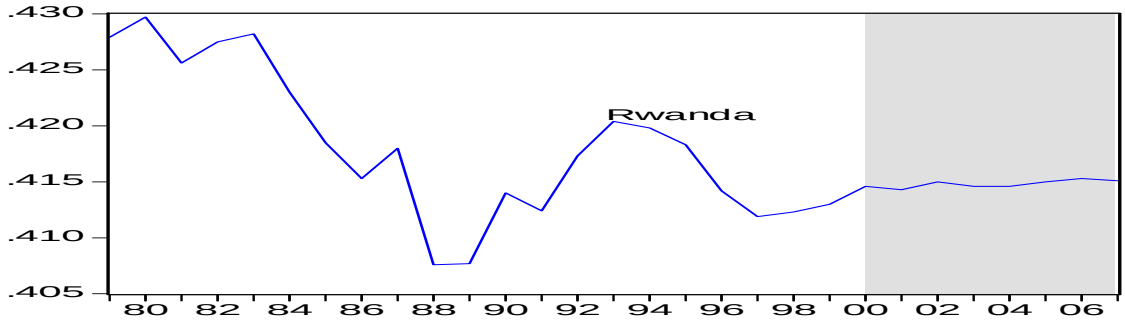
where $\varepsilon_t \sim NID(0, Q)$. (15)

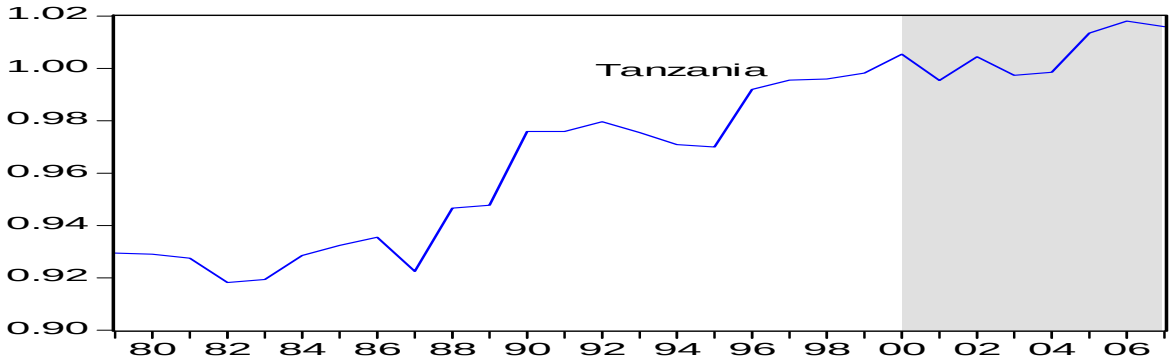
The time varying coefficients for equations (14) and (15) are estimated for the demand shocks, and the results are reported in Fig.1 below. We observe that after the year 2000 when the EAC Treaty came into effect, business cycles become less volatile and improve as in the case of Kenya and Tanzania. These results can be attributed to increased policy coordination through the EAC Development Strategy 2001-2005.

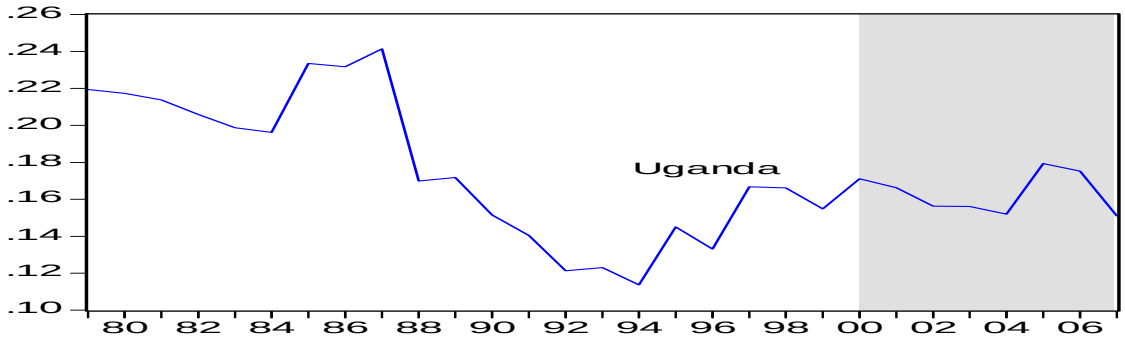
Fig.1 Synchronization of demand shocks overtime











Since countries in a monetary union will be employing uniform monetary policies, it is crucial that country specific shocks are highly synchronized with the common region

shocks. The synchronization of country-specific demand shocks with the common regional shocks has been impressively strengthening from year to year in the cases of Kenya and Tanzania since 2000, the two biggest countries in the EAC. Burundi and Rwanda, the countries with the lowest shares of real GDP in the EAC of 2.93 and 8.9 percent respectively, do not show much time variation, though the degree of synchronization has not declined either. Uganda's synchronization appears to have been improving but still low and volatile. In all, there is evidence of improved synchronization since the 1999 EAC Treaty, but it is still weak with regard to Uganda and idiosyncratic with regard to Burundi and Rwanda.

The apparent improvement in business cycle synchronization during the post-1999 EAC Treaty sub-sample period can be explained by three of factors, namely, reduction in the dissimilarities of economic structures, increase in intraregional trade and improved political climate. Since the launching of the EAC (2000) along with The Second East African Community Development Strategy 2001-2005, while economic disparities have not been completely leveled out, economic structures reflected by growth rate of real GDP and inflation have got closer (Table 1). Increase in intraregional trade has also strengthened regional common shocks by enhancing competitiveness through increased production, trade and investment. The value of merchandise exports within the EAC bloc increased by 96 percent between 1999 and 2005 (African Development Indicators, 2007). This increase in the EAC intraregional trade has been fueled by domestic liberalization and tariff preferences granted in the EAC (Castro, Kraus and Rocha, 2004). Francois and Wignaraja (2008) provide evidence to the notion that due to a reduction in trade costs and service barriers, initiatives of economic integration boost regional trade and incomes without substantive adverse terms of trade effects much better than a spider web of bilateral agreements. However, the value of merchandise exports within the EAC bloc as a percentage of total EAC exports has grown by only 0.6 of a percentage point between 1999 and 2005 (African Development Indicators, 2007).

The economic factors not withstanding, the economic problems of many African countries are strongly linked to their political climate: civil conflicts (wars), corruption and low quality democracy. These socio-political factors have contributed to undisciplined fiscal policies, poor infrastructures and low investment, and hence low

economic growth and intraregional trade in Africa. This can partly explain why the EAC countries which have been relatively politically more stable in the region, namely Kenya and Tanzania, reflect stronger post-EAC synchronization (Fig.1). The post-EAC Treaty years have seen substantial reduction in civil strife of the 1990s.

6. Concluding Remarks

This paper investigates whether five eastern African countries constitute an optimal currency area, and whether the degree of business cycle synchronization has increased between these countries after the signing of the EAC treaty in 1999. To achieve our objective, we have performed three main tasks: first, using a structural VAR model we have examined the synchronization of structural shocks in the EAC. Second, using a state-space model we have measured the degree to which these shocks are explained by some unobserved common shock. Third, we set up a time-varying parameter model to estimate the evolution of synchronization with the common demand shocks over time.

The unobserved components model is based on the notion that co-movements in macroeconomic variables have a common element that represents the general state of the economy and can be captured by a single underlying unobserved variable. If the economies face symmetric and common shocks, then formation of a currency union will be beneficial. On the other hand, if asymmetric and country specific shocks are dominant in these countries, then the benefits of a currency union will be minimal.

We find that the shares of the common shocks in the EAC are low: the share of common demand shocks is highest in Tanzania at 33.5 percent, while the share of common supply shocks is highest in Rwanda at 36 percent. We also examine the evolution of the synchronization of these structural shocks over time using a time-varying parameter model. We find that business cycles have become more synchronized after 2000. Our results indicate that although the share of common shock across different countries is still low, the degree of synchronization has improved since the EAC Treaty came into force in 2000.

This paper has provided empirical evidence concerning the EAC as a plausible OCA. Future research will seek to investigate policy measures that can enhance

synchronization of business cycles to make the initiative a success. It may be pointed out that as Uganda explores its potential as an exporter of oil; its synchronizations are likely to change. At the same time if unionization induces specialization as Krugman (1993) suggested, the modest synchronizations we have observed may dwindle. However our third finding is more in line with Frankel and Rose (1998) that unionization might lead to higher synchronization due to higher interdependence and policy coordination. The second generation literature on optimum currency areas suggests that the success of the EAC monetary union will depend on the extent of risk-sharing through financial integration. Plans are underway to integrate the major capital markets in the EAC, namely the Dar es Salaam stock exchange, the Nairobi stock exchange and the Uganda securities exchange, plus the stock exchange in Burundi. The region will need more cross-border investment and trade, more efficient exchange and payment systems and access to economic information.

References

1. Angeloni, I. and Dedola, L. (1999). "From the ERM to the Euro: New Evidence On Economic and Policy Convergence among EU Countries", European Central Bank, Working Paper No.4, Frankfurt.

2. African Development Indicators (2007), The World Bank.

3. Bayoumi, T., and Ostry, J.D. (1997). "Macroeconomic shocks and trade flows within sub-Saharan Africa: Implications for Optimum Currency Arrangements", Journal of African Economies, 6(3), 412-444.

4. Blanchard, O.J. and Quah, D., (1989). "The Dynamic Effects of Aggregate Demand and Supply Disturbances", The American Economic Review 79, pp.655-673.

5. Buigut, S.K. and Valev, N.T. (2005). "Is the Proposed East African Monetary Union an Optimal Currency Area? A Structural Vector Autoregression Analysis", World Development Vol.33, No.12, pp. 2119-2133.

6 Buigut, S.K. and Valev, N.T. (2006). "Eastern and Southern Africa Monetary Integration: A Structural Vector Autoregression Analysis", Review of Development Economics, Vol.10, No.4, pp.586-603

7. Castro, L., Kraus, C., and Rocha M. (2004). "Regional Trade Integration in East Africa: Trade and Revenue Impacts of the Planned East African Community Customs Union", African Regional Working Paper Series No. 72.

8. Clark, P.K. (1989). "Trend Reversion in Real Output and Unemployment", Journal of Econometrics 40, pp. 15-32.

9. DuPasquier, C., Van Eyden and Ground (2006). "A Survey of Alternative Methodologies for Estimating Potential Output and the Output Gap", Journal of Macroeconomics, 21(3); 577-595.

10. East African Community Treaty (1999).

11. Francois, J. F. and Wignaraja, G. (2008). "Economic Implications of Asian Integration", Global Economy Journal, Vol. 8, Issue 3, Article 1.

12. Frankel, J. A., and Rose, A. K. (1998). "The Endogeniety of the Optimum Currency Area Criterion", Economic Journal, 108, 1009-1025.

13. Hodrick, R. and Prescott, E. C. (1997), "Postwar U.S. Business Cycles: An Empirical Investigation", Journal of Money, Credit, and Banking.

14. Krugman, P. (1993). Lesson of Massachusetts for EMU;
In: Giavazzi, F., Torres, F. (eds.), "The Transition to Economic and Monetary Union in Europe",
Cambridge University Press, New York, pp. 241-261.

15. Maza, A. and Villaverde, J. (2007). "A State-Space Approach to the Analysis of Economic Shocks in Spain", Journal of Policy Modeling, 29, 55-63.

16. McKinnon, R. (1963). "Optimum Currency Areas",
American Economic Review, 53(4) pp.717-725

17. Mkenda, B.K. (2001). "Is East Africa An Optimum Currency Area?",
Working Papers in Economics, No. 41,
School of Economics and Commercial Law, Goteborg University.

18. Mundell, R.A. (1961). A theory of optimum currency areas",
The American Economic Review, 51(4), pp. 657-665.

19. Shapiro, M.D., and Watson, M.W. (1988). "Sources of Business Cycles Fluctuations", in: S. Fischer (eds.). NBER Macroeconomics Annual,
The MIT Press, 1988.

20. Stock, J. and Watson, M. (1991). "A Probability Model of the Coincident Economic Indictors", In Leading Economic Indictors: New Approaches and Forecasting Records, ed. Lahiri, K. and Moore, G.H.
Cambridge Univeristy Press 63-89.

21. The Second East African Community Development Strategy 2001-2005.

22. Xu, X. (2006). "A currency union for Hong Kong and Mainland China?",
Journal of International Money and Finance, 25, pp. 894-911.