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Feasibility of Proposed Monetary Unions in the Eastern and Southern Africa Region

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FEASIBILITY OF PROPOSED MONETARY UNIONS IN THE EASTERN AND SOUTHERN AFRICA REGION

BY

STEVEN K. BUIGUT

A Dissertation Submitted in Partial Fulfillment
of the Requirements for the Degree
of
Doctor of Philosophy
in the
Andrew Young School of Policy Studies
of
Georgia State University

GEORGIA STATE UNIVERSITY
2006

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ACCEPTANCE

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ABSTRACT

FEASIBILITY OF PROPOSED MONETARY UNIONS IN THE EASTERN AND SOUTHERN AFRICA REGION

By

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December 2006

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Major Department: Economics

The dissertation assesses the suitability of countries in the Eastern and Southern Africa region for a monetary union. Using VAR techniques the symmetry of the underlying structural shocks is analyzed. The results indicate that supply and demand shocks are generally asymmetric, which does not lend strong support for forming a region-wide currency union at the moment. Although economic shocks are not highly correlated across the entire region, we tentatively identify three sub-regional clusters of countries that may benefit from a currency union. We find some tentative evidence that some, though not all, sub-regions may benefit from a link to the Euro. However, the speed and magnitude of adjustment to shocks is similar across the countries. Therefore, further integration of the economies might lead to more favorable conditions for a monetary union.

Using a Barro-Gordon type model, it is shown that forming a monetary union yields net benefits if output shocks are similar across member countries and if one or

more countries in the union can serve as anchors. In addition it is shown that the opportunistic objectives of one country's policymakers are kept in check at the union level by other members with disparate objectives. Hence monetary union can improve the monetary policy for its members if the pressures on the individual central banks are dissimilar. Calibrating the model to evaluate the proposed monetary union in the East African Community, it is found that central bank uncertainty would be a significant aspect in the net welfare effect of monetary union. An examination of the EAC countries also shows a fair degree of linkages. Intra-regional trade is substantial. The benefits from reduced transaction costs and exchange rate uncertainty would be substantial and growing. Though symmetry of shocks is still low, implementation of a protocol on factor mobility under discussion would help improve labor mobility. However though some progress has been made there is still need for more convergence before monetary union could be implemented.

Essay One: Is The Proposed East African Monetary Union an Optimal Currency Area? A Structural Vector Autoregression Analysis

Introduction

The treaty of 1999 to revive the defunct East African Community (EAC) ratified by Kenya, Uganda, and Tanzania[1] came into force in July 2000 with the objective of fostering a closer co-operation in political, economic, social, and cultural fields. To achieve this, an East Africa Customs Union protocol was signed in March 2004. A Common Market, a Monetary Union, and ultimately a Political Federation of East Africa states is planned. Though the question of a monetary union has been discussed in the political arena there has been no corresponding empirical study on the economic viability of such a union. To fill this gap this article assesses whether the political force driving the EAC towards a monetary union has economic basis.

As Mundell (1961) and McKinnon (1963) describe, the member countries of a monetary union have a common monetary policy and therefore they cannot use monetary and exchange rate policies to react to country-specific shocks. The loss of independent monetary and exchange rate policy is problematic if the member countries experience asymmetric shocks so that different members need different policies at the same time. This is even worse if adjustment to shocks is hampered by downward wage rigidity, immobile labor, and the absence of agreements for fiscal transfers between member countries. In addition, fiscal policy, which is the only stabilization tool available, is hindered by high government debts, which are typical in developing countries including the ones studied here. Thus, this paper investigates the feasibility of a monetary union in the East African Community by focusing on the

[1] The old EAC collapsed in 1977 and was officially dissolved in 1983. Rwanda and Burundi have applied to join the new community and are included in the study.

symmetry of the underlying shocks across the member economies as a precondition for forming an optimal currency area (OCA).[2]

A monetary union can have important benefits. By eliminating currency conversion costs and exchange rate risks between the member states it can spur intra-regional trade (Rose and Stanley 2005). It is also possible that the supranational monetary authority could achieve a greater credibility for setting prudent monetary policy compared to the central banks of the individual countries (see Guillaume and Stasavage 2000). Expectations of financial stability contribute to financial deepening, greater investment, and faster economic growth. Such institutional credibility gains are particularly important in developing countries with relatively short history of independent policy making. Finally, a monetary union reduces the need to maintain large liquid foreign exchange reserves that can be redirected to generate greater returns.

The methodology used here follows Bayoumi and Eichengreen (1992) who are among the first to identify the underlying structural shocks using the Vector Autoregression (VAR) technique developed by Blanchard and Quah (1989). They measure the incidence of asymmetric demand and supply shocks across members of the former European Community (EC) and compare them with the ones prevailing in the United States. Since then, a large literature has applied this methodology or a related approach to different compositions of country groups in Europe. More recently a number of studies have used the same approach to investigate the situation in Central and Eastern European Countries (CEECs) and East Asia. Fidrmuc and

[2] Introduced by Mundell (1961), an OCA is defined as an optimal geographic domain of a single currency, or of several currencies, whose exchange rates are irrevocably pegged and might be unified (Mongelli 2002). Optimality is defined in terms of several OCA properties, including the mobility of labor, wage and price flexibility, diversification in production and fiscal integration, among others. Sharing the above properties reduces the cost of abandoning exchange rate adjustments within the currency area.

Korhonen (2001) and Frenkel and Nickel (2002) use VAR to assess the similarity of shocks between the countries of the Euro area and the CEECs. Studies that have applied the approach to East Asia (e.g., Yuen and Ling 2001; Zhang, Sato, and McAleer 2004) identify tentative groupings of East Asian economies with potential for monetary union.

Although there are a number of economic blocks considering monetary union like the African Monetary Zone (WAMZ),[3] the Southern African Development Community (SADC),[4] and the EAC, application of this methodology in Africa has been limited. Fielding and Shields (2001) modify the Blanchard and Quah methodology in order to estimate a structural VAR for a small open economy. They identify and compare economic shocks to different members of the two CFA monetary unions, the West African Economic and Monetary Union (UEMOA)[5] and the region of the Central Bank of Equatorial Africa (BEAC).[6] Their results indicate that if the policy response to inflation shocks is immediate and inflation is all that matters then one currency would suffice. However, the pattern of output shocks suggests a need to redraw the internal boundaries of the Franc zone. Using a model of government financing needs, Debrun, Masson, and Pattillo (2005) find that fiscal heterogeneity is critical in shaping regional currency union in the ECOWAS[7] region. A study by Khamfula and Huizinga (2004) investigates the desirability of a monetary union among the countries of the SADC to gauge which countries are suited to enter a South Africa Monetary Union. They employ a Generalized Auto-Regressive Conditional Heteroscedasticity model to assess the share of the variation in real

[3] Gambia, Ghana, Guinea, Nigeria, and Sierra Leone.

[4] Angola, Botswana, D.R. Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Swaziland, South Africa, Tanzania, Zambia, and Zimbabwe. Note: Seychelles pulled out 2004.

[5] Benin, Burkina Faso, Cote d'Ivoire, Guinea-Bissau, Senegal, Togo, Mali, and Niger.

[6] Cameroon, Chad, Congo, Central Africa R., Equatorial Guinea, and Gabon.

[7] ECOWAS includes the WAMZ, UEMOA, Cape Verde and Liberia.

exchange rates vis-à-vis South Africa that can be explained by the divergence in monetary and fiscal policies. The results from this model indicate low degrees of symmetry of the real exchange rate shocks across most of these countries.

There is, however, a glaring paucity of empirical work for the East African Community. A lone study, Mkenda (2001), employs a Generalized Purchasing Power Parity (GPPP) model to analyze the suitability of the EAC for a monetary union. The results from Mkenda's study indicate that the real exchange rates between the EAC countries are cointegrated during the period from 1980 to 1998, suggesting that the EAC is an optimum currency area. The limitation of this approach is that movements in macroeconomic variables reflect the combined effects of shocks and responses (Angeloni and Dedola 1999). Hence this methodology does not distinguish disturbances from responses. The identification scheme due to Blanchard and Quah (1989) is one way to achieve this distinction. This study is the first to assess the similarity of underlying shocks in the EAC based on the VAR approach. The rest of the paper is structured as follows: Section 2 provides a description of several key features of the economies studied here, Section 3 introduces the empirical methodology, Section 4 presents the estimation results, and Section 5 concludes.

Descriptive Analytics

Table 1 shows that in broad terms the structure of the EA economies is similar with agriculture contributing a large part of GDP and exports. Kenya has a relatively larger manufacturing sector and exports more manufactures. Manufactures dominate the region's imports and all the countries are oil importers. These structural similarities would suggest also similarity of economic shocks.

However, although all the EA countries export primary commodities, reliance on specific commodities varies. Kenya's top two exports, tea and horticulture, comprise 36% of its total exports, whereas Tanzania relies on gold (43.7% of exports) and fish (11.9% of exports). Uganda depends on coffee and fish (35% of exports), Burundi on coffee (69.5% of exports) and tea (20.3% of exports), and coffee forms the bulk (25%) of Rwanda's exports (IMF 2003/2004). Heavy reliance on a narrow range of exports shows a limited ability to cope with shocks. The differences in primary commodity exports across the countries suggest that they are affected by different economic shocks. These primary products are however prone to very high price volatility, raising the cost of exchange rate volatility risk. One currency may thus offer substantial benefits in eliminating volatility risk in trade.

Table 1. Structure of the Economy for East African Countries (2001)

Share of GDP (percentage)	Burundi	Kenya	Rwanda	Tanzania	Uganda
Agriculture	50	19	41	45	36
Manufacturing	..	13	10	7	10
Services	31	63	38	39	43
Share of Exports (percentage)					
Food	91	59	..	70	69
Agric. Raw materials	8	9	..	13	15
Manufactures	0	21	..	15	7
Imports (percentage)					
Food	23	14	..	16	12
Fuels	12	22	..	8	16
Manufactures	60	60	..	72	67

Source: World Development Indicators (2003). Note: (..) not available.

Large trade volumes between the countries might contribute to more similar economic conditions despite the differences in specialization. Table 2 shows the intra-region trade and trade with major developed countries. Intra-regional trade is not insignificant. For example, the EA region absorbs 20% of Kenya's exports, with Uganda being the single most important destination for its goods. Uganda, Rwanda, and Burundi source a substantial portion of their imports from EA, especially from

Kenya. In addition unrecorded (informal) trade between these countries is substantial. Estimates show that informal trade between Tanzania and its neighbors was over 57% of recorded trade (Ackello-Ogutu and Echessa 1998) during the same period. Including informal trade, intra-region trade compares favorably with trade with Euro-bloc, and exceeds that with U.K. or U.S. Improvements in infrastructure are expected to significantly increase intra-regional trade (Longo and Sekkat 2004). High trade links with the Euro-bloc suggest that pegging a common EAC currency to the euro, as is the case with the CFA zone, might be beneficial. We explore the feasibility of this option in the following sections.

Table 2. Trade Relations of East African Countries (2003): Exports (Imports) as Percentage of Total Exports (Imports)

	Burundi	Kenya	Rwanda	Tanzania	Uganda
Burundi		0.8[a]; 0.0[b]	0.5; 0.7	1.7; 0.0	1.9; 0.0
Kenya	0.1; 14.4		0.1; 23.3	4.6; 5.0	14.7; 26.0
Rwanda	5.6; 0.5	3.1; 0.0		0.5; 0.0	3.9; 0.0
Tanzania	0.1; 11.7	4.2; 1.1	0.0; 1.4		1.1; 0.8
Uganda	2.0; 5.9	12.6; 2.1	0.3; 6.3	1.0; 0.3	
East Africa	7.8; 32.5	19.9; 3.2	0.5; 31.0	6.2; 5.2	19.7; 26.9
U.S.A	1.6; 2.1	9.4; 5.2	1.7; 2.4	2.5; 3.1	2.4; 5.7
U.K.	16.3; 0.8	12.5; 7.4	0.3; 1.6	5.2; 4.4	6.4; 6.3
Euro-bloc	12.0; 28.4	19.0; 15.3	10.0; 22.4	24.6; 22.4	21.5; 14.9
Total	100.0	100.0	100.0	100.0	100.0

Source: Calculated from the Direction of Trade statistics (2004) published by the IMF. Note: [a (b)]; 0.8% (0%) of Kenya's exports (imports) go to (come from) Burundi.

Asymmetry of economic shocks is less of a problem for the feasibility of a monetary union if labor is mobile between the countries, if wages are flexible, or if the countries can engage in effective independent or common stabilization fiscal policies. Though there are no statistics on cross-country labor flows in the region, traditionally labor mobility is considered to be high, with Kenya and Uganda being major sending countries to destinations such as South Africa and Botswana (Adepoju 2001). The indication, however, is that the region does not yet have a free flow of

labor. Currently mobility is undermined by security concerns and high unemployment in these countries (ECA 2004). Using spending on education as a measure of the potential for human development and labor mobility, they find that spending on education has had low priority.[8] Article 104 of the EAC treaty envisions free movement of labor and right of establishment of residence as one of the goals of the community. The community has established a committee to look into implementation of this objective through harmonization of labor laws, travel documents, and education policies among others. A common language and many cross-border communities also suggest possibilities for more mobility in the future.

It is hard to generalize on wage flexibility due to the dual nature of the labor market. There tends to be less flexibility in the formal sector than in the informal sector. The three core countries have minimum wage laws though with varying degrees of enforceability. The formal sector in Kenya has a strong union structure that over the last few years succeeded in raising real wages after an extended period in which inflation eroded real wage (IMF 2003). However there is a large informal sector not covered by unions and minimum wage laws. High labor growth and unemployment is another source of downward pressure on wages. Due to its socialist leaning past, Tanzania's wage structure has previously been set by government, though reforms are underway to allow for more market determined wage structure and bargaining.

Table 3 shows the kind of fiscal burden the countries face. All of them still need to improve on their public debt management. Kenya relies less on foreign aid and has the least external debt as percentage of GNI. However this advantage is compromised by its relatively higher domestic debt (35% of total debt). This will

[8] Kenya seems to be better placed with an adult literacy level of 84%. The other countries have literacy levels ranging from only 50% in Burundi, 68% in Rwanda and Uganda to 76% in Tanzania (Source: WDI, 2003).

hinder fiscal response to shocks, or any form of fiscal transfers between the EAC countries.

Synchronicity of shocks thus becomes crucial since the alternative ways of adjustment related to wage flexibility, labor mobility, and intra-regional transfers are limited at the moment.

Table 3. Debt and Aid Dependency (Percentage) Indicators for East African Countries (2001)

Debt & Aid	Kenya	Burundi	Rwanda	Tanzania	Uganda
Total external debt/Exports	192.9	1842.7	787.3	451.0	552.6
Total External debt/GNI	51.9	156.8	76.3	71.9	67.4
Total debt service/Exports	15.4	39.8	11.3	10.3	7.4
Domestic debt/Total debt	35	8.3	13.2	-	7.7
Aid per capita	15	19	33	36	34
Aid as percentage of GNI	4.0	19.3	17.3	13.3	14.1
Aid as percentage of cross capital formation	31.1	274.3	92.7	77.7	40.5

Source: Global Development Finance, (2003); World Development Indicators (2003).

Methodology and Data

Methodology

The aim of the remainder of the paper is to identify and compare macroeconomic shocks to the East African countries and to those of the EMU countries, the U.K., and the U.S. We focus on shocks to aggregate output growth and inflation using a VAR model. These are the two most important macro economic indicators across Africa (Bayoumi and Ostry 1997). A VAR is a statistical method that allows us to estimate how an unpredictable disturbance affects other variables in the economy. In the VAR we assume that the changes in the log of real output (Δy_t) and price level (Δp_t) result from two types of shocks: demand and supply shocks.

When $\left[X_t \equiv \begin{matrix} \Delta y_t \\ \Delta p_t \end{matrix} \right]$ is stationary, this process can be represented by an infinite moving average representation,

$$X_t = \mathrm{A}_0 \varepsilon_t + \mathrm{A}_1 \varepsilon_{t-1} + \mathrm{A}_2 \varepsilon_{t-2} + ... = \sum_{i=0}^{\infty} L^i A_i \varepsilon_{t-i} \tag{1.1}$$

where L is the lag operator, $\mathbf{A}_i$ are 2x2 matrices representing the impulse response functions of the shocks to the elements of the vector X_t, i.e., these transmit the effects of the shocks to the variables, and ε_{dt} and ε_{st} are independent white noise demand and supply disturbances, normalized so that Var(ε_t)=I. Because ε_{dt} and ε_{st} are not observed, to identify this model we estimate a finite version VAR(p) with a lag length (p) chosen such that the residuals approximate white noise. Tests show that the optimal lag length is two. Thus we estimate:

$$X_t = K + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + e_t , \tag{1.2}$$

The vector of residuals (e_t) obtained in (1.2) is a composite of demand and supply shocks. We need to decompose these residuals into the pure structural demand and supply shocks (ε_{dt} and ε_{st}). Appendix A describes how to achieve that in technical terms. The identification method is based on the Aggregate Demand-Aggregate Supply (AD-AS) framework due to Blanchard and Quah (1989) and Bayoumi and Eichengreen (1992). In this framework, the short-run aggregate supply curve is upward sloping due to sticky wages. A higher price level lowers the real wage, inducing higher employment and raising output. In the long-run real wages adjust to price changes so that the long-run aggregate supply curve is vertical at the full employment level of output. The aggregate demand curve is downward sloping both in the short and the long-run to reflect the assumption that lower prices boost demand. Supply shocks, such as those originating from changes in technology, have

long-run permanent effects on the full employment level of output. They reduce prices and increase output. On the other hand, the effect of a permanent shock to the aggregate demand is a short-term rise in output that gradually returns to its initial level as the real wage adjusts. The long-term effect is only a permanent increase in prices. In that framework, we have enough information to obtain an impulse response function ($\mathbf{A}_0$) and recover the structural shocks. Two series of exogenous shocks are obtained for each country and the correlations of these shocks are computed.

Data

The main data source used in this study is the IMF's *International Financial Statistics*. This is supplemented by comparable figures from the World Bank's *World Development Indicators* and the African Development Bank *Country Statistics*. Annual data for the five Eastern African countries, the U.K., the U.S. and the EMU countries[9] cover the sample period from 1970 to 2001. Real GDP growth is used to measure changes in output, while changes in the implicit GDP deflator represent price changes, both rebased to 100 in 1995 for all countries. For each country we use the first difference of the natural logs of real GDP and the implicit GDP deflator for estimation. Although they are available, it is worth noting that the quality of reported data by these countries, specifically Rwanda and Burundi during the civil unrest in these countries, is questionable, particularly in the period from 1994 to 1998. Thus, we re-estimate[10] some of our results excluding these two countries.

[9] To represent EMU we select the core countries of Germany, France and Italy, and in addition we use a GDP-weighted aggregate of all EMU countries.

[10] We carry out a stability test using Chow's forecast test due to limiting post-war sub sample size. We find a significant war-effect for level data for both Rwanda and Burundi, but only Rwanda for first differenced data. We report results based on the full sample and discuss the effect on the results when we use pre-war data (up to 1993) for these countries. We exclude these two countries in the sub-period analysis.

Results

Identifying Supply and Demand Shocks

The time series properties of the variables were investigated using the Augmented Dickey-Fuller test and it was found that both variables are I(1). Therefore the first differences of the variables are used to ensure stationarity. Tests for stability show that the eigenvalues of (F) in (A6) all lie inside the unit root circle (see Appendix B). The VAR is thus covariance stationary. For estimation of the empirical two-variable VAR the number of lags is set to two in all cases since both the SBIC and AIC statistics indicate that all models have an optimal lag length of one or two. From the estimated VAR the underlying supply and demand shocks were recovered as described in Appendix A.

The sizes of the underlying demand and supply shocks constrained to be of unit variance are graphed in Figure 1. The shocks vary from country to country in magnitude. Tanzania has experienced the widest swings in demand shocks, while Rwanda has the widest range in supply shocks.

Figure 1. Demand and Supply Shocks, EAC, 1973 to 2001

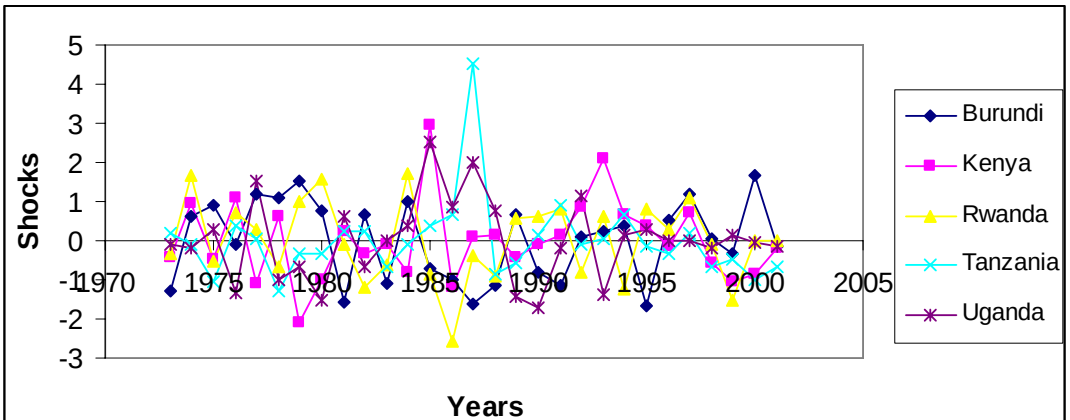

Figure 1a. Demand Shocks, EAC, 1973-2001

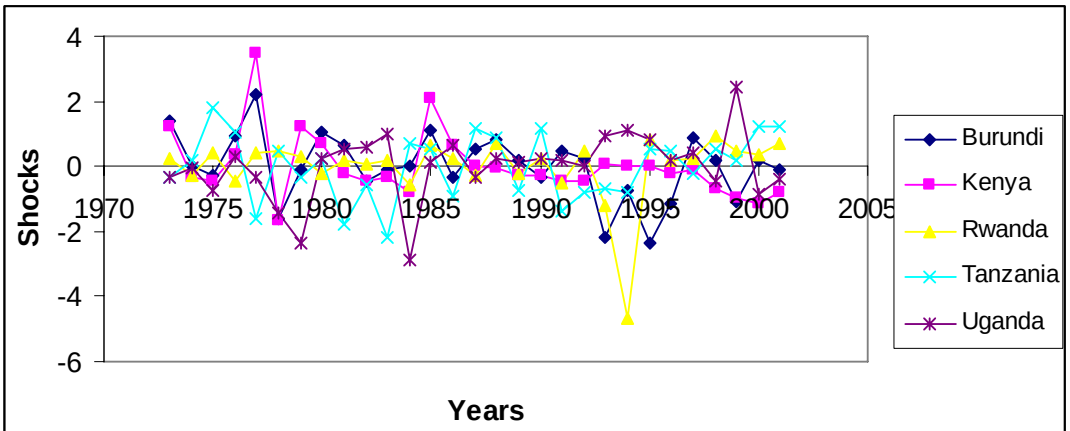

Figure 1b. Supply Shocks, EAC, 1973-2001

The larger the size of the shocks the more difficult it is to maintain a fixed exchange rate. This is particularly true of the supply shocks that may require more painful adjustments. The graphs indicate that the shocks are relatively equally distributed between negative and positive shocks. The demand shocks however were larger during the mid-eighties for all countries with the exception of Burundi. Demand shocks though seem to have declined after the later part of eighties for all countries.

Generally the supply shocks experienced by the countries show more pronounced and more frequent peaks and troughs than the demand disturbances, and there are no indications of a tendency of these shocks to converge. The mid nineties were especially turbulent years for Rwanda, and to a lesser extend Burundi, due to civil war in those countries. Large negative shocks are evident during this period. Uganda experienced similar large negative shocks during the early eighties for the same reason. Kenya experienced large positive shocks in the mid seventies due to a boom in coffee prices – a primary export commodity for that country.

Correlations of Supply and Demand Shocks across EA Countries

Tables 4 and 5 report the correlation coefficients of the identified supply and demand shocks among the East African countries. We also compare these shocks with those of selected EU countries and the U.S. The more symmetric the shocks as indicated by positive correlations, the more feasible it becomes for a group of countries to establish a monetary union. We look first at the supply shocks in Table 4 as these are more critical since they are more likely to be invariant to demand management policies (Bayoumi and Eichengreen 1994). Generally the contemporaneous EA supply shocks are asymmetric and, if positive, the correlations are small which reflects the differences in the core export commodities as discussed in Section 2. Only the supply shocks for Kenya and Burundi are positive and significantly correlated. The correlations of lagged shocks are only slightly better. Specifically, Tanzania's lagged shocks show more symmetry with EA shocks. The supply shocks experienced by Kenya and Burundi are positively and significantly correlated with those of Tanzania lagged one period, suggesting that supply shocks in Tanzania are transmitted to these countries. Supply shocks are also correlated with a lag between Burundi and Rwanda.

The demand shocks for the EA countries in Table 5 are also generally asymmetric. The contemporaneous demand shocks experienced by Rwanda and Burundi are positively and significantly correlated to the shocks faced by Uganda and Tanzania. Though insignificant, the contemporaneous demand shocks faced by Kenya are positively correlated with those of other EA countries, except with Burundi. But this correlation is also positive when lagged. We attribute this to the fact that Kenya relies substantially on these markets. The other correlations are asymmetric.

Table 4. Correlations of Supply Shocks, 1973 to 2001

	Bur	Ken	Rwa	Tan	Uga	U.K.	U.S.	Fra	Ger	Ita	Euro
Burundi	1.00										
Kenya	***0.54	1.00									
Rwandi	0.15	0.01	1.00								
Tanzania	-0.12	-0.29	0.23	1.00							
Uganda	-0.18	-0.01	-0.17	-0.31	1.00						
U.K.	0.11	-0.08	0.18	-0.16	0.07	1.00					
U.S.	-0.06	-0.01	0.10	0.12	0.15	0.28	1.00				
France	*0.35	0.12	0.05	0.13	-0.10	**0.38	**0.39	1.00			
Germany	0.03	-0.06	-0.28	-0.09	-0.01	0.22	0.12	0.24	1.00		
Italy	*0.32	0.14	-0.13	0.11	-0.14	0.14	-0.07	***0.69	0.29	1.00	
Euro-bloc	0.21	0.00	-0.17	-0.08	-0.13	**0.32	0.21	**0.38	***0.91	**0.40	1.00
L.burundi	0.11	-0.08	**0.39	-0.09	-0.02	0.19	-0.04	0.07	-0.35	-0.07	-0.17
L.kenya	-0.11	-0.11	-0.03	-0.10	0.00	0.20	-0.04	0.01	-0.24	0.17	-0.12
L.rwanda	0.25	-0.16	0.03	-0.02	-0.15	0.08	0.06	0.05	0.10	-0.05	0.18
L.tanzania	**0.44	*0.37	0.18	0.00	0.22	0.11	0.12	0.28	0.28	0.23	0.30
L.uganda	-0.28	-0.41	-0.18	-0.08	0.00	0.20	-0.19	0.03	0.16	-0.09	-0.04
L.U.K.	-0.02	0.00	0.29	-0.14	-0.07	0.10	0.02	0.00	-0.11	-0.29	0.02
L.U.S.	0.18	*0.35	0.17	-0.36	0.14	0.27	-0.04	0.04	0.03	0.00	0.06
L.france	0.07	0.19	**0.47	0.01	-0.01	-0.08	-0.40	-0.07	-0.35	0.02	-0.27
L.germany	0.15	0.27	0.05	-0.13	-0.08	0.00	-0.24	0.00	0.02	0.06	-0.01
L.italy	0.21	*0.31	**0.46	0.09	-0.27	-0.28	-0.53	-0.24	-0.48	-0.07	-0.45
L.Euro	0.30	*0.35	0.17	-0.20	-0.10	-0.04	-0.32	-0.05	-0.04	0.00	0.01

Notes: *** (**, *) Indicates statistical significance at 1% (5%, 10%) level. The prefix L. indicates supply shocks lagged one period. Contemporaneous supply shocks are not prefixed. Positive (negative) values indicate symmetry (asymmetry).

Table 5. Correlations of Demand Shocks, 1973 to 2001

	Bur	Ken	Rwa	Tan	Uga	U.K.	U.S.	Fra	Ger	Ita	Euro
Burundi	1.00										
Kenya	-0.24	1.00									
Rwanda	*0.31	0.00	1.00								
Tanzania	-0.44	0.16	-0.07	1.00							
Uganda	-0.31	0.16	-0.41	**0.40	1.00						
U.K.	-0.07	-0.03	-0.46	0.08	0.23	1.00					
U.S.	0.09	-0.01	0.02	-0.17	0.03	***0.50	1.00				
France	0.09	0.22	-0.15	-0.28	-0.26	-0.04	-0.09	1.00			
Germany	-0.12	-0.11	0.10	-0.12	-0.35	-0.36	-0.46	**0.40	1.00		
Italy	-0.19	-0.03	0.18	-0.06	-0.47	-0.22	-0.39	0.13	*0.33	1.00	
Euro-bloc	-0.03	-0.25	0.14	-0.38	-0.41	-0.18	-0.14	***0.49	***0.67	0.22	1.00
Lburundi	0.04	0.04	0.11	-0.25	-0.23	0.07	0.17	0.02	0.17	0.13	0.15
Lkenya	0.02	-0.14	-0.38	-0.02	0.13	0.26	-0.04	0.13	0.11	0.03	-0.12
Lrwanda	0.11	0.18	-0.04	-0.34	0.07	-0.17	-0.01	0.07	0.27	0.07	0.07
LTanzania	-0.38	0.15	-0.32	0.04	**0.38	0.24	0.02	0.13	-0.19	-0.10	0.05
Luganda	-0.06	0.15	-0.38	-0.01	0.08	**0.45	0.16	0.29	-0.36	-0.24	0.00
LU.K.	0.05	-0.15	*0.32	0.04	-0.15	-0.10	0.13	0.03	0.05	-0.05	*0.33
LU.S.	*0.34	-0.12	*0.34	-0.02	-0.12	-0.08	-0.17	-0.03	0.05	0.03	0.26
Lfrance	0.21	-0.31	0.07	-0.09	-0.13	0.26	0.15	0.11	-0.02	0.13	-0.13
Lgermany	-0.04	-0.08	0.06	0.02	0.14	-0.31	-0.02	0.03	0.02	0.06	-0.22
Litaly	-0.08	0.10	0.08	0.12	0.07	-0.39	-0.12	0.26	*0.33	0.07	0.05
LEuro	0.00	-0.27	0.16	0.03	-0.06	-0.31	-0.16	-0.10	0.19	0.13	0.05

Notes: *** (**, *) Indicates statistical significance at 1% (5%, 10%) level. The prefix L. indicates demand shocks lagged one period. Contemporaneous demand shocks are not prefixed. Positive (negative) values indicate symmetry (asymmetry).

Overall, most of the correlation values are either low or asymmetric and do not show much support for a monetary union in contrast to the findings of Mkenda

(2001). The correlations for EA countries seem much more asymmetric compared to the correlations for CFA zone obtained by Fielding and Shields (2001) and more comparable to those found for the SADC by Khamfula and Huizinga (2004). Using pre-war data (up to 1993) for Rwanda and Burundi does not improve the symmetry of supply shocks with other EA countries, while the demand shock correlations show more positive, though still mostly non-significant, values for Burundi only. Analyses of shocks during the sub-periods 1970 to 1985 and 1986 to 2001 do not show any indication of increased symmetry in the correlation coefficients between the two periods. Though some of the correlations obtained for the two periods are positive, none of them are significant. The values obtained for the latter period do not show any distinct improvement over the earlier period. This sub-periods analysis excludes Rwanda and Burundi.

Finally, Tables 4 and 5 do not suggest a clear choice of an external anchor currency between the U.S. dollar and the Euro. Although the EU is the largest destination of EA exports, this does not show up much in the correlation of contemporaneous shocks. Contemporaneous supply and demand shocks for EA are mostly asymmetric with those of the hard currencies considered. However, the lagged U.S. and Euro-bloc supply shocks show more positive correlations with the shocks to Kenya, Burundi, and Rwanda. This seems to indicate that shocks to these countries get transmitted to EA with a lag. Lagged U.K. shocks however still show asymmetry with the EA supply shocks. Overall, although very tentative, the evidence from the supply shocks correlations seems to be marginally in favor of the Euro.

Impulse Response

In addition to isolating the underlying disturbances, it is beneficial to compare the response of the economies to the shocks in terms of the magnitude and speed of adjustment. This can be done by looking at the impulse response functions. The larger the size of the shock, the more disruptive its effects will be on the economy. Similarly, the slower is the adjustment after disturbances, the larger will be the cost of maintaining a single currency.

Figure 2 shows the impulse response functions of output and the price level to a positive one unit demand and supply shock for EA. The impulse response functions for prices in Figure 2(a) indicate that the over-identifying restriction is satisfied for all countries—except Tanzania. The accumulated effect of supply shocks on prices is negative for all countries except for Tanzania which exhibits a small but positive effect. As shown in Figure 2(b) an expansionary supply shock induces positive long-run output effects for all the countries, while demand shocks produce a gradual increase in prices over time as predicted by the AD-AS model (Figure 2c). The response functions for the EA countries seem not to differ much. The bulk of the adjustment of output to a supply shock occurs within the first three to four years for all the countries. Though this seems to be slightly faster time of adjustment than found for the EEC core countries by Bayoumi and Eichengreen (1992), the accumulated long-run effect for EA is larger, around 0.03 to 0.08, compared to around 0.025 for EEC.

The adjustment of prices to supply shocks is also within the first three years and of a similar absolute magnitude (less than 0.1) for four countries but much larger (exceeding 0.6) for Uganda. These long-run effects are however more similar for the

EA countries relative to those found for the CFA zone. The same is true of adjustments of prices to demand shocks. Overall, Figure 2(c) suggests that the speeds of adjustment, as well as the long-run effect, are similar across countries with the exception of Uganda. From these results it would seem that all the countries (except for Uganda) have similar magnitude and speed of adjustment to the shocks, tentatively pointing to a possibility of sustaining a monetary union.

Figure 2. Impulse Response Functions

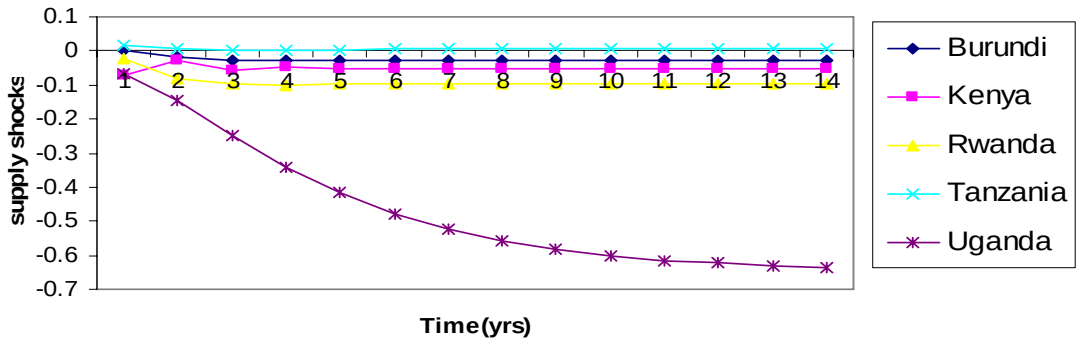

Figure 2a. Impulse response functions for the price level to a positive supply shock

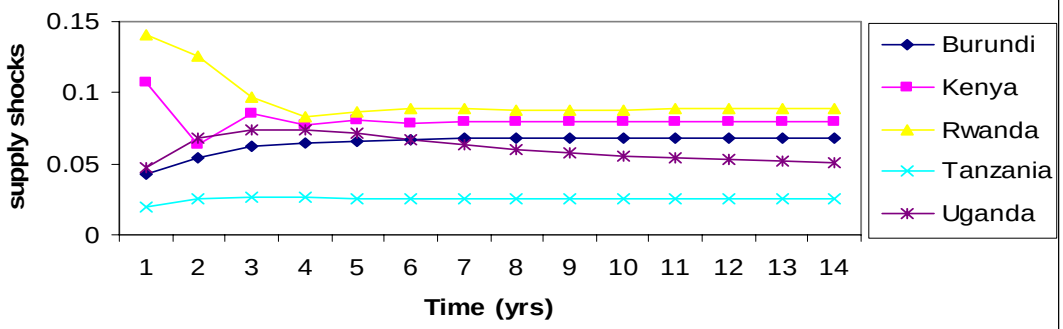

Figure 2b. Impulse response functions of the output level to a positive supply shock.

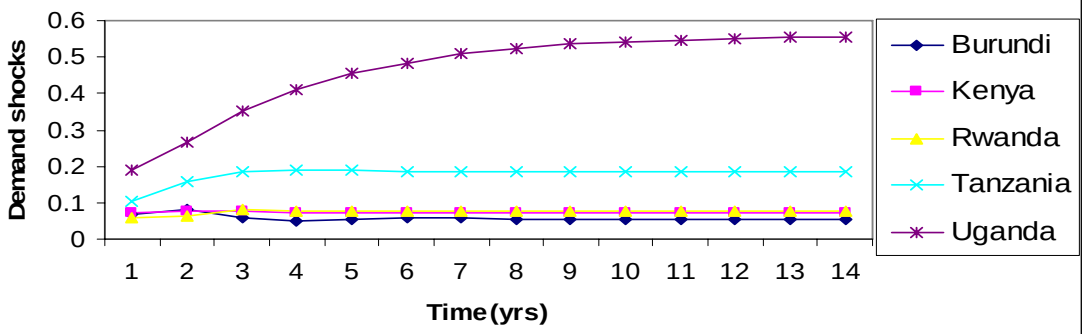

Figure 2c. Impulse response functions of the price level to a postive demand shock

Variance Decomposition

The forecast error variance shows the contribution of each shock to the movements in the two variables of the vector $X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix}$. This gives an indication of which shocks are the more predominant accounting for the variability in vector X_t. This is important because differences in the cause of variability in the countries could be indicative of underlying differences in transmission mechanism and policy strategies of the EA countries, which would be obstacles to regional monetary integration.

Table 6. Variance Decomposition: Proportion of Real Output and Price Variability Due to Demand Shocks.

	Burundi		Kenya		Rwanda		Tanzania		Uganda	
Horizon (Years)	Output	Price	Output	Price	Output	Price	Output	Price	Output	Price
1	0.119	0.818	0.097	0.507	0.0245	0.879	0.072	0.979	0.022	0.890
2	0.193	0.799	0.085	0.433	0.0458	0.464	0.079	0.980	0.023	0.790
3	0.199	0.770	0.083	0.407	0.0661	0.472	0.094	0.980	0.038	0.695
4	0.199	0.793	0.084	0.432	0.0658	0.463	0.120	0.975	0.047	0.765
5	0.201	0.785	0.084	0.410	0.0669	0.475	0.135	0.982	0.055	0.767
6	0.200	0.771	0.083	0.407	0.0665	0.473	0.130	0.980	0.057	0.586

Notes: The values indicate the proportion of the forecast error variance in real output and price level due to demand shocks. The proportion due to supply shock is found by simply subtracting from one.

Table 6 shows the proportion of variability of the log of real output due to demand shocks at one to six year time horizon. The proportion due to supply shocks is found by subtracting from unity. The supply shocks account for most of the variability of real output in all the East African countries. The supply shocks account for over 80% of all the variability at the six-year horizon. This corresponds to results obtained for East Asia (Zhang, Sato, and McAleer 2004) for the sample period prior to the crises, and is more uniform than those indicated for the European Union by Ballabriga, Sebastian, and Valles (1999). In contrast, variance decomposition of the price level indicates that demand shocks account for different proportions of the price level variability across the economies. Demand shocks contribute a much higher proportion of the variation in the price level relative to its contribution to the variability of real output. However the proportions differ markedly among the EA countries, ranging from over ninety percent in Tanzania to around forty in Kenya. Thus, although there are indications that structural supply shocks contribute to output changes in the East African countries in the same way, the contribution to changes in the price level is quite variable.

Conclusion

This paper uses a two variable VAR model to identify supply and demand shocks for East African countries in order to determine whether these countries are good candidates for a monetary union. The correlation results indicate that contemporaneous shocks among the EA countries are mostly asymmetric. Only the contemporaneous supply shocks for Kenya and Burundi are positive and significantly correlated, while the lagged values are not much better. The correlations of demand shocks show only a weak symmetry related to trade patterns. The correlation results

therefore do not show strong support for a currency union at the moment but indicate that more integration may improve the symmetry of shocks. The impulse response functions for the EA countries follow a similar pattern, with the exception of Uganda. The bulk of the adjustment of output to a supply shock occurs within the first three to four years and the long-run magnitudes are close. The adjustment of prices to supply shocks is also within the first three years. Although the magnitude of the response is much larger in Uganda and the adjustment takes relatively longer, overall these results show some support for monetary union among the EA countries. However, the variance decomposition shows mixed results. The proportions of variability of real output accounted for by supply shocks are similar for all the EA countries. Demand shocks, however, contribute markedly different proportions of the variation in price level. Evidence in favor of linking an EA currency to an external anchor is weak. However, the evidence from the lagged supply shock correlations seem to be in favor of the Euro as anchor currency over the U.S. dollar and Sterling pound.

The effect of further trade integration as envisioned by the EAC treaty could result in more or less symmetry in national business cycles. As Krugman (1993) argues, it is possible that the economies become more specialized and their cycles less similar. If, however, intra-regional trade shocks predominate, business cycles may become more symmetric as evidenced by Frankel and Rose (1998). Thus countries that may appear to be poor candidates for inclusion in a monetary union may turn out to be suitable candidates after joining the union if the union spurs trade. De Grauwe (2003) supports this second view suggesting that though concentration may occur, deeper integration reduces the importance of national borders increasing the likelihood that clusters of economic activity will transgress national borders. Which

effect would actually dominate in the case of EA is an open question, suggesting the need for a gradual approach to monetary union.

It is worth noting that the process of integration is going on, significant being the signing of the customs union treaty earlier in 2004, and the political will, a factor that has been stressed by Feldstein (1997) as the major motivation for the European monetary union, seems to be present to carry this through.

Essay Two: Eastern and Southern Africa Monetary Integration: A Structural Vector Autoregression Analysis

Introduction

The map of Africa is layered with a complex network of regional organizations. Many countries belong to a multiplicity of customs unions, development associations or other multi-country institutions that have various objectives and envision various degrees of integration.[11] Some countries also use a common currency. For example, the West African Economic and Monetary Union (UEMOA) and the Central African Economic and Monetary Community (CEMAC) use the CFA franc, previously pegged to the French franc and now to the euro. In the Southern Africa, the Common Monetary Area (CMA)[12] uses the South African Rand. In recent years, with the launching of the euro, a number of regional integration groupings in the Eastern and Southern Africa (ESA) have started to seriously consider monetary union, a few of them even setting tentative timetables for the process. For example, the revived East African Community (EAC)[13] is targeting monetary union and ultimately a Federation. In 2004 they concluded a customs union treaty, and in the same year the committee on fast tracking the East African federation submitted its recommendations which propose a currency union by year 2009 and a Federation by 2013.[14] These recommendations are now to be debated by member countries.

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[11] Masson and Pattillo (2005) survey the existing proposed monetary integration initiatives and attempts to forecast the likely trends in the future exchange rate arrangements.

[12] The CMA is a monetary arrangement that uses the South African Rand as a common currency though each member country (Lesotho, Swaziland, and Namibia) issues its own currency at par with the Rand. Botswana opted out in 1976, but remains linked to the Rand through a currency basket where the Rand weighs 60-70 %.

[13] The EAC consisting of Kenya, Uganda and Tanzania used a common currency until 1966 when the East African Currency Board collapsed. Each country then introduced its own currency in 1967. The old EAC finally collapsed in 1977, and was revived in 1999.

[14] See http://www.eac.int/fasttrack/news_2004_12_speech-wako.htm, Internet; accessed December, 2005.

The Southern African Development Community (SADC) has monetary union in the cards too, with a Central Bank Governors meeting in February 2005[15] proposing 2016 for a SADC common currency. The Common Market for Eastern and Southern Africa (COMESA)[16] also has a monetary union objective with its own time table to achieve this. Indeed, these proposed monetary zones are fostered as building blocks for an eventual African Monetary Union, an ideal of the African Union (Masson and Pattillo 2005). However, the effect of overlapping membership is viewed by the Economic Commission for Africa (ECA 2004) as a stumbling block to integration due to confusion arising from differences in rules of origin, wasteful duplication of effort and counterproductive competition among countries and institutions.

The goal of this paper is inform these deliberations by sorting out what groupings of countries appear to be good candidates for monetary unions. We focus on ESA since a number of countries in West Africa are already in similar monetary arrangements and have been studied by the previous literature. Particularly, Fielding and Shields (2001) apply the methodology used in this paper to the two CFA monetary unions (UEMOA and CEMAC). Using a model of government financing needs, Debrun, Masson, and Pattillo (2005) considers the possibility of extending the UEMOA to include countries in the proposed West Africa Monetary Zone. Benassy-Quere and Coupet (2005) address the same question using cluster analysis. However, the proposed monetary unions in Eastern and Southern Africa have not received much research attention despite the apparent policy drive in that direction. Furthermore, there has been no research on the possibility of forming currency union(s) linked to

[15] See Business Report, March 1, 2005 at http://www.busrep.co.za; accessed December 2005. The SADC currently has 13 members.

[16] The 20 member COMESA has the objective of establishing a common market and monetary union by 2025. The newest member, Libya, joined in June 2005 and is not included in the analysis.

some hard currency, e.g., the euro, the dollar, or the British pound. We examine these options.

The methodology used here follows Bayoumi and Eichengreen (1992) who were among the first to identify the underlying structural shocks using the Vector Autoregression (VAR) technique developed by Blanchard and Quah (1989). Since then, a large literature has applied this methodology or a related approach to different compositions of country groups in Europe. More recently, Zhang, Sato, and McAleer (2004) and Fidrmuc and Korhonen (2001) among others, have used the same approach to investigate the situation in Central and Eastern Europe and East Asia respectively. Application of this methodology to Africa has been limited to Fielding and Shields (2004) who identify and compare economic shocks to different members of the two CFA monetary unions in West Africa. They conclude that the pattern of output shocks suggests a need to redraw the internal boundaries of the Franc zone.

Alternative methodologies applied to Eastern and Southern Africa provide mixed results. A study by Khamfula and Huizinga (2004) using a GARCH model investigates which countries of SADC are suited to enter a South Africa Monetary Union. Their results indicate low degrees of symmetry of the real exchange rate shocks across most of these countries, suggesting that a monetary union would amass high costs relative to benefits. Bayoumi and Ostry (1997) regresses real growth on its first two lags to decompose shocks. Their results indicate that asymmetry of shocks prevails while the few significant correlations of shocks they find do not involve contiguous states. Masson and Pattillo (2005) raise serious doubts about a full African monetary union due to economic disparities and poor linkages, but view the selective expansion of existing monetary unions as a more promising strategy. Grandes (2003) concludes that the CMA and Botswana form an optimal currency area using a

Generalized Purchasing Power Parity model. Mkenda (2001) employs the same model to analyze the suitability of the EAC for a monetary union. The study found that the real exchange rates between the EAC countries are cointegrated during the period from 1980 to 1998, suggesting that the EAC is an optimum currency area. The limitation of this approach is that it does not distinguish disturbances from responses since movements in macroeconomic variables reflect the combined effects of shocks and responses (Angeloni and Dedola 1999). The identification scheme due to Blanchard and Quah (1989) used here makes this distinction.

The Case for an Optimum Currency Area: An Initial Assessment.

Countries with a similar economic structure can be expected to have similar business cycles and therefore might be suitable for a monetary union. However, this does not appear to be the case for the countries we study in this paper. In particular, except for South Africa, all countries have one or two products forming a high proportion of their total output and exports (Table 7). Furthermore, different countries specialize in different primary or semi-processed products. Only a few countries specialize in similar products e.g., coffee and fish for the East African countries and oil for Egypt and Sudan. On those grounds, it is unlikely that the shocks experienced by various countries would be symmetric. Table 7 indicates that the ESA countries trade mostly with developed countries, especially Western Europe, while intra-region trade is low. This limits the potential benefits from reduced currency transaction costs and reduced exchange rate uncertainty. However, a single currency linked to the euro may lead to substantial gains for these countries.[17] A few countries show relatively

[17] Political interferences in monetary affairs, which is widespread in Africa, are prime causes of harmful monetary uncertainty. Several authors such as Guillaume and Stasavage (2000) make an argument for monetary union on this ground, that a monetary union acting as an agent of monetary and

large intra-ESA trade. South Africa, the biggest and most developed economy in the ESA, is an important market for the Southern cone countries such as Malawi, Zambia, and Mozambique. The East African region also shows higher trade links, with Kenya exporting a substantial portion of its products to its neighbors.

Table 7. Trade Relations of ESA Countries as Percentage of Exports (Imports) of Goods, (2003)

		US	W-Europe	Africa	ESA	Major traded commodities
Burundi	Exports	1.63	60.53	9.07	8.19	Coffee (76.8)
	Imports	2.12	32.16	44.03	40.86	Petroleum oils (23)
Comoros	Exports	11.77	73.19	0.95	0.69	Vanilla (74.9), cloves (11.6)
	Imports	0.56	41.62	22.56	21.62	Vehicles & parts (19.8)
Egypt	Exports	13.35	54.22	4.52	2.01	Petroleum (28.6)
	Imports	13.65	19.39	2.59	1.23	Cereals (6.8)
Ethiopia	Exports	5.07	31.85	18.46	2.43	Coffee (36.0), vegetables (21.6)
	Imports	17.03	20.59	2.51	1.99	Cereals (15.1)
Kenya	Exports	9.43	32.90	37.46	32.02	Petroleum oils (19.1), Tea (19.0)
	Imports	5.14	23.84	14.02	13.06	Petroleum (22.7)
Madagascar	Exports	29.23	50.48	8.03	7.62	Clothing (27.5), Vanilla (24.7)
	Imports	2.27	23.84	14.56	11.40	Petroleum (10)
Mauritius	Exports	17.55	67.35	10.01	9.60	Clothing (51), Cane/beet sugar (16.3)
	Imports	2.62	29.49	17.01	16.12	Petroleum (9.6)
Malawi	Exports	13.47	33.29	34.21	31.90	Tobacco (49.3), Cane(beet) sugar (23.1)
	Imports	2.97	12.64	69.55	65.60	Petroleum (11.5)
Mozambique	Exports	0.80	52.81	21.71	16.59	Unwrought aluminum (69.6)
	Imports	3.87	14.48	27.50	26.76	Petroleum (9.4)
Rwanda	Exports	1.73	11.07	2.95	1.82	Coffee (27.8), Tea (23.8)
	Imports	2.44	25.38	38.33	35.71	Petroleum (15.8)
SACCA[a]	Exports	2.97	93.32	2.58	1.75	Not available
	Imports	16.02	45.27	0.45	0.63	Not available
S. Africa	Exports	12.38	40.90	14.46	7.34	Platinum (10.1), Cars/trucks (7.5)
	Imports	8.25	45.64	4.45	1.74	Petroleum (11.1)
Seychelles	Exports	0.81	95.56	0.47	0.43	Fish (83.1)
	Imports	0.86	39.18	14.22	14.16	Fishing vessels & parts (5)
Sudan	Exports	0.26	12.79	4.39	3.72	Crude oil (80)
	Imports	0.64	23.90	7.98	7.47	Vehicles & parts (8.3)
Tanzania	Exports	2.51	31.47	19.72	15.90	Gold (36.1), Fish (9.4)
	Imports	3.22	22.61	23.80	23.34	Petroleum (18.6)
Uganda	Exports	2.39	40.41	36.07	30.65	Coffee (22.4), Fish (14.2)
	Imports	5.70	19.33	35.72	35.53	Petroleum (13.6)
Zambia	Exports	0.65	43.50	45.62	39.61	Tobacco (32.9), Nickel (17.4)
	Imports	2.10	15.05	67.66	54.06	Vehicles & parts (9.3)

Note: [a]SACU countries excluding South Africa.
Sources: IMFs DOTS (2004) and United Nations International Trade Centre http://www.intracen.org/menus/countries.htm; accessed December 2005.

Estimates by Ackello-Ogutu and Echessa (1998) also show that unrecorded trade in this sub-region is high; in some cases over 50% of recorded trade. The stronger trade

possibly fiscal restraint could produce large gains for its members from increased macroeconomic stability.

links may contribute to greater similarity of economic fluctuations and to potentially greater benefits of a monetary union among these groups of countries.

In the traditional optimum currency area (OCA) theory introduced by Mundell (1961), the cost of a monetary union is the country's inability to use monetary policy to react to country-specific shocks. However, this cost is lower if the member economies can adjust to shocks via labor mobility between countries and/or if wages are flexible. Labor mobility in Sub-Saharan Africa is considered high traditionally (Benassy-Quere and Coupet 2005; Masson and Pattillo 2005), though data on international migration in Sub-Saharan Africa remain fragmentary and incomplete. Adepoju (2001) outlines major migration configurations in the region. The main recipient countries in the recent past have been South Africa and Botswana, whereas the sending countries include Kenya and Uganda. Mobility is however undermined by security concerns and high unemployment (ECA 2004), resulting in reluctance to implement regional initiatives on free movements of persons.

The dual nature of the labor markets in Sub-Sahara Africa makes it hard to generalize on wage flexibility. Most countries have minimum wage legislations in the formal sector. However, the informal sector, considered to be highly flexible, is dominant in the region. Most countries have a large and growing labor force that puts downward pressure on real wages. There are however important differences among countries. For example, Ethiopia has high unemployment, and appears to have downward inflexibility of wages. Some countries also show a union impact on wages e.g., South Africa (Schultz and Mwabu 1997) and Kenya (IMF 2003). However, Teal (2000) finds that though there is a union impact, unemployment in South Africa has an impact on wages identical to that found in OECD countries.

Finally we should point out that a scheme for compensatory fiscal transfer across differentially affected regions is not a viable option in ESA. Most of the countries are aid-dependent. Only four of them: South Africa and the three tiny economies of Botswana, Mauritius, and Seychelles are classified as middle income countries.

Methodology

The aim is to identify and compare macroeconomic shocks to different Eastern and Southern African countries. We focus on shocks to aggregate output growth and inflation. To recover the underlying shocks we use the VAR identification scheme due to Blanchard and Quah (1989) and Bayoumi and Eichengreen (1992). The identification scheme is based on the Aggregate Demand-Aggregate Supply (AD-AS) framework. In this framework, the short-run aggregate supply curve is upward slopping due to sticky wages. A higher price level lowers the real wage, inducing higher employment and raising output. However, in the long-run real wages adjust to price changes so that the long-run aggregate supply curve is vertical at the full employment level of output. The aggregate demand curve is downward sloping both in the short and the long-run to reflect the assumption that lower prices boost demand. Supply shocks such as those originating from changes in technology, have long-run permanent effects on the full employment level of output. A positive supply shock reduces price and increases output. Conversely, the effect of a positive shock to aggregate demand is a short-term increase in output that gradually returns to its initial level as the real wage adjusts. The long-term effect is only a permanent increase in prices. Thus, both supply and demand shocks have long-run effects on the level of prices though in opposite directions.

Identification of Supply and Demand Shocks

We assume that fluctuations in real output $\{y_t\}$ and the price level $\{p_t\}$ are the result of two underlying types of shocks: supply and demand shocks. Assume also that the variables are unit root, so that the vector $X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix}$ is stationary. The joint process of two variables (changes in GDP and the price level) can be represented by an infinite moving average representation of a vector of the two variables and an equal number of structural shocks. Let ε_t be the vector of demand and supply shocks, ($\varepsilon_{dt,}\ \varepsilon_{st}$). Formally, the bivariate moving average of X_t can be represented as:

$$X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} = \sum_{i=0}^{\infty} L^i A_i \varepsilon_{t-i} \qquad (2.1)$$

where Δy_t and Δp_t represent changes in the log of output and prices, L is the lag operator, A_i represents the impulse response function of the shocks to the elements of the vector X_t, and $\varepsilon_{dt,}\ \varepsilon_{st}$ are independent white noise supply and demand shocks normalized so that $Var(\varepsilon_t)=I$. To decompose the shocks, the AD-AS framework assumes that demand shocks do not have any effect on output in the long-run. Thus, the cumulative effect of demand shocks on the change of the log of output (Δy_t) must be zero:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \qquad (2.2)$$

The supply side and demand side shocks can be recovered from estimating a finite order VAR. The optimal lag length (p) is chosen such that its residuals approximate white noise. Each element of vector X_t is regressed on lagged values of all the elements of X_t:

$$X_t = K + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + ... + \Phi_p X_{t-p} + e_t, \tag{2.3}$$

where K denotes a vector of constants, Φ_is are the coefficients from the estimating equation and e_t is a vector of the residuals $\begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix}$. The vector e_t is a composite of demand and supply shocks. If the process is covariance stationary we can take expectations of (3) to calculate the mean μ of the process:

$$\mu = K + \Phi_1 \mu + \Phi_2 \mu + ... + \Phi_p \mu \tag{2.4}$$

Subtracting (2.4) from (2.3) gives (2.3) in terms of deviations from the mean:

$$X_t - \mu = \Phi_1 (X_{t-1} - \mu) + \Phi_2 (X_{t-2} - \mu) + ... + \Phi_p (X_{t-p} - \mu) + e_t \tag{2.5}$$

The VAR(p) in (5) can be represented as a VAR(1) process. To do this, define:

$$\xi_t \equiv \begin{bmatrix} X_t - \mu \\ X_{t-1} - \mu \\ . \\ . \\ X_{t-p+1} - \mu \end{bmatrix}, F \equiv \begin{bmatrix} \Phi_1 \, \Phi_2 .....\Phi_p \\ I_2 \;\; 0 \; .... \\ . \\ . \\ 0..... \quad I_2 \;\; 0 \end{bmatrix}, V_t \equiv \begin{bmatrix} e_t \\ 0 \\ . \\ . \\ 0 \end{bmatrix} \tag{2.5a}$$

Then (2.5) can be written as VAR(1):

$$\xi_t = F\xi_{t-1} + V_t \tag{2.6}$$

and recursive substitution of (6) implies that:

$$\xi_{t+s} = V_{t+s} + FV_{t+s-1} + F^2 V_{t+s-2} + ... + F^{s-1} V_{t+1} + F^s \xi_t \tag{2.7}$$

If the eigenvalues of F all lie inside the unit root circle, then $F^s \to 0$ as $s \to \infty$ and the VAR is covariance stationary ((Hamilton 1994). The first two rows of (2.7) then give the vector moving average (∞) representation of X_t :

$$X_t = \mu + e_t + C_1 e_{t-1} + C_2 e_{t-2} + C_3 e_{t-3} + C_3 e_{t-3} + C_4 e_{t-4}. \tag{2.8}$$

where $C_j = F_{11}^{(j)}$ and $F_{11}^{(j)}$ denotes the upper left block of F^j which is the matrix F raised to the jth power. Equations (2.1) and (2.8) yield the relationship between the estimated residuals (e_t) and the structural shocks (ε_t):

$$e_t = A_0\varepsilon_t \tag{2.9}$$

Therefore we need to know the elements of A_0 to calculate the underlying structural supply and demand shocks. The variance-covariance matrix of residuals $E(e_t e_t') = A_0 E(\varepsilon_t \varepsilon_t') A_0'$ and the C_is are known from estimation. To recover the four elements of A_0 in the two-by-two case we need four restrictions.[18] Two are simple normalizations which define the variances of $\varepsilon_{dt,}$ and ε_{st} (usually to one). Since $\varepsilon_{dt,}$ and ε_{st} are deemed to be pure shocks, a third restriction applied is to assume that demand and supply shocks are orthogonal so that $E(\varepsilon_{dt}\,\varepsilon_{st}) = 0$ (Bayoumi and Eichengreen 1992). The term $E(\varepsilon_t \varepsilon_t')$ then drops out as I_2, and we have $E(e_t e_t') = \Omega = A_0 A_0'$. The variance-covariance matrix of residuals Ω is a known symmetric matrix. From this we obtain the following three restrictions:

$$Var(e_{yt}) = a_{11}(0)^2 + a_{12}(0)^2 \tag{2.10a}$$

$$Var(e_{pt}) = a_{21}(0)^2 + a_{22}(0)^2 \tag{2.10b}$$

$$\mathrm{cov}(e_{yt} e_{pt}) = E(e_{yt} e_{pt}) = a_{11}(0)a_{21}(0) + a_{12}(0)a_{22}(0) \tag{2.10c}$$

The final restriction is to impose the condition that demand shocks have no long term effects on output as in (2.2). In terms of the VAR this implies:

$$\sum_{i=0}^{\infty} \begin{bmatrix} c_{11i} & c_{12i} \\ c_{21i} & c_{22i} \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} 0 & * \\ * & * \end{bmatrix} \tag{2.11}$$

[18] Four equations to solve for four unknowns.

These restrictions allow the matrix A_0 to be uniquely defined and hence the demand and supply shocks to be identified. Two series of exogenous shocks are obtained and the correlations of these shocks computed for the East African countries.

Data

The main data source used in this study is the World Bank's *World Development Indicators,* and the IMFs *International Financial Statistics*. Annual data for 21 Eastern and Southern Africa countries are used. For most of these countries the data cover the sample period from 1971 to 2002. For Ethiopia, Tanzania, and Uganda, the data are from 1970 to 2001, whereas for the Comoros, Mauritius, Mozambique, and Namibia the data are for the period 1980 to 2002. Real GDP growth is used to measure changes in output, while changes in the implicit GDP deflator represent price changes. For each country we use the first difference of the natural logs of real GDP and the implicit GDP deflator for estimation. Although they are available, it is worth noting that the quality of reported data by some countries, particularly Uganda, Sudan, Rwanda, and Burundi may have been affected by civil unrest —Uganda throughout most of the early eighties, Rwanda and Burundi in the early nineties and Sudan through most of the data period. The data for Zimbabwe proved unstable and this country is not included in the analysis. Data for several countries of interest within the region: Djibouti, Somalia, Angola, Congo D. R., and Eritrea are either not available or the series are too short to be used for any meaningful analysis. The data for EMU countries, the U.K., and the U.S. span the period 1970 to 2001. We consider a GDP-weighted aggregate of all EMU countries as well as a few core countries individually: Germany, France, and Italy.

Empirical Results

The time series properties of the variables were investigated using the Augmented Dickey-Fuller test and it was found that both variables are I(1). Therefore the first differences of the variables are used to ensure stationarity. Tests for stability show that the eigenvalues of (F) in (6) all lie inside the unit root circle (except for Zimbabwe, which is not included in the study). The VAR is thus covariance stationary. For estimation of the empirical two-variable VAR the number of lags is set to two in all cases since both the SBIC and AIC statistics indicate that all models have an optimal lag length of one or two. From the estimated VAR the underlying supply and demand shocks were recovered as described in Section 3.

Correlations of Supply and Demand Shocks

Tables 8, 9, 10, and 11 report the correlation coefficients of the identified supply and demand shocks among the Eastern and Southern African countries with positive and statistically significant correlations highlighted. Positive correlations are considered symmetric and if negative they are considered asymmetric. The more symmetric the shocks, the more feasible it becomes for a group of countries to establish a monetary union. The tables contain a large number of correlations for all pairs of countries.

We look first at the supply shocks. These are more critical since they are more likely to be invariant to demand management policies. The correlations of contemporaneous and lagged supply shocks in Tables 8 and 9 are generally small and asymmetry seems to prevail. There are a few positive and significant correlations. Even then, unlike in Bayoumi and Ostry (1997), a weak pattern is discernible. South Africa, the major economy in the southern tip, shows some significant correlation in

the supply shocks it faces with those faced by its neighboring states of Lesotho, Swaziland, and Mozambique. South Africa is a significant market for these countries. We also find a few positive and significant pair-wise correlations among contiguous states in the Eastern and North Eastern region e.g., Sudan, Egypt and Ethiopia, Kenya and Rwanda, Uganda and Burundi. This is probably due to the more similar pattern of output and higher intra-sub region trade. However, no specific country seems to be a natural anchor for this sub-region. Although there are a few significant cross correlations between the Northern and Southern economies, we cannot identify any form of consistency.

The island economy of Seychelles shows significant correlations with the other insular countries of Madagascar and Comoros. It also seems to show more correlation with the Eastern African countries than with the Southern African ones, probably due to the patterns of output rather than trade. Tanzania seems to be the water-shed economy, showing significant supply shock correlation with countries in the Northern, the Southern regions and the Island economies. Coincidentally, Tanzania is also the only country that is a member of the EAC and SADC.

ESA supply shocks do not show much symmetry with those of either Europe or the US. However, except for the Comoros, the other island economies have positive and significant correlations with EMU countries. Contemporaneous shocks faced by Seychelles and EMU countries and the U.S. are symmetric, while the contemporaneous shocks for Madagascar and Mauritius are symmetric with those of the EMU and the U.S. lagged one period. In the Eastern Africa sub-region Kenya, Rwanda, Burundi, and Ethiopia show symmetry with EMU countries. The Southern African countries including South Africa do not show any synchronicity with either Europe or U.S. shocks.

Table 8. Correlations of Contemporaneous Supply Shocks

	Bo	Bu	Co	Eg	Eth	Ke	Le	Mad	Mau	Mal	Moz	Nam	Rw	S.A	Sey	Sud	Swa	Tan	Ug	Za
Bo	1.00																			
Bu	-0.08	1.00																		
Co	-0.41	-0.03	1.00																	
Eg	0.28	-0.30	0.31	1.00																
Eth	0.01	0.11	0.00	0.21	1.00															
Ke	-0.23	-0.07	-0.28	-0.04	-0.04	1.00														
Le	0.03	0.11	*0.39	0.19	0.19	-0.13	1.00													
Mad	-0.19	-0.34	0.02	0.16	-0.22	*0.40	-0.24	1.00												
Mau	-0.37	*0.42	0.08	-0.07	0.18	*0.39	0.31	*0.52	1.00											
Mal	-0.14	-0.38	-0.29	0.11	0.08	0.29	0.06	0.00	-0.07	1.00										
Moz	-0.23	0.05	0.04	-0.32	0.22	0.23	-0.04	0.17	*0.57	0.05	1.00									
Nam	-0.07	0.21	0.16	0.01	0.05	-0.39	0.34	0.00	0.21	-0.46	-0.11	1.00								
Rw	-0.10	0.19	-0.19	-0.11	0.20	*0.48	0.22	0.04	0.23	-0.05	-0.13	-0.14	1.00							
S.A.	0.02	-0.32	0.10	0.22	0.25	-0.11	*0.37	-0.06	-0.15	0.12	*0.38	-0.19	0.05	1.00						
Sey	-0.48	-0.16	0.33	-0.05	0.19	-0.12	0.08	0.20	0.30	0.27	0.07	0.32	0.13	0.05	1.00					
Sud	0.24	0.05	-0.23	-0.01	*0.34	-0.16	-0.13	-0.09	0.07	-0.05	0.21	0.11	-0.04	-0.01	-0.08	1.00				
Swa	-0.06	-0.08	0.15	0.04	-0.05	-0.05	0.13	0.17	0.29	-0.04	0.32	0.16	-0.38	*0.47	-0.05	0.01	1.00			
Tan	-0.27	-0.20	0.07	0.28	0.04	0.06	0.03	*0.40	*0.51	0.17	*0.51	-0.11	-0.12	0.30	*0.36	-0.03	*0.32	1.00		
Ug	0.11	*0.56	-0.27	-0.04	0.20	-0.20	0.03	-0.21	-0.03	-0.26	-0.09	0.10	0.13	-0.21	-0.23	0.25	-0.04	-0.30	1.00	
Za	0.25	-0.27	-0.18	0.22	-0.36	-0.07	-0.28	0.11	-0.45	0.10	-0.51	0.15	-0.33	-0.21	-0.13	-0.20	-0.14	-0.23	-0.20	1.00
Fra	0.03	-0.05	0.02	0.25	0.21	0.15	0.08	0.21	0.03	-0.14	-0.02	*0.36	*0.44	0.21	*0.36	0.01	-0.16	0.13	-0.10	-0.03
Ger	-0.09	0.12	-0.13	-0.14	*0.32	-0.16	-0.04	-0.18	-0.31	0.24	-0.14	0.13	0.00	-0.06	*0.47	0.04	-0.31	-0.08	-0.01	0.06
Ita	-0.07	-0.09	-0.31	0.18	*0.34	-0.01	0.26	-0.03	-0.22	0.06	-0.05	0.30	0.29	*0.47	0.22	0.11	-0.15	0.11	-0.14	-0.11
EU	-0.11	0.16	-0.16	-0.11	0.23	-0.06	0.10	-0.19	-0.07	0.24	-0.13	0.20	0.17	-0.02	*0.54	0.00	-0.33	-0.06	-0.13	0.00
U.K.	-0.11	*0.39	-0.05	-0.37	0.08	0.16	0.23	-0.16	0.32	-0.17	-0.12	0.06	*0.54	-0.14	0.14	-0.19	-0.41	-0.16	0.07	-0.21
U.S.	0.02	0.18	-0.13	0.23	0.23	0.05	-0.08	-0.05	0.19	0.01	-0.17	0.33	*0.37	-0.12	*0.36	-0.10	-0.21	0.12	0.15	0.09

Note: *Indicates statistical significance at the 10 % level or higher.

Table 9. Correlations of Contemporaneous Supply Shocks with Supply Shocks Lagged One Period

	Bo	Bu	Co	Eg	Eth	Ke	Le	Mad	Mau	Mal	Moz	Nam	Rw	S. A	Sey	Sud	Swa	Tan	Ug	Zam
LBo	0.03	0.08	0.02	-0.01	-0.03	0.14	0.11	-0.23	-0.27	-0.01	-0.25	-0.49	*0.34	0.01	-0.05	-0.1	-0.5	-0.11	-0.24	0.05
LBu	0.01	0.03	0.21	-0.09	-0.19	-0.02	-0.04	-0.07	-0.1	-0.03	-0.13	0.25	0.01	0	-0.16	0.12	0.17	-0.2	0.16	0.1
LCo	-0.02	0.23	-0.1	0.02	0.18	0.09	-0.17	0.22	0.12	-0.04	0.37	0.01	-0.18	-0.11	0.25	0.06	0.25	-0.24	*0.53	-0.1
LEg	*0.43	0.1	-0.5	-0.03	*0.35	0.25	0.25	-0.21	-0.27	0.27	-0.2	-0.45	0.13	-0.06	-0.28	0.07	-0.28	-0.37	0.03	-0.1
LEth	*0.39	-0.22	0.17	0.16	-0.01	0	0.02	0.09	0	-0.08	*0.37	0.15	-0.25	-0.1	-0.4	0.06	-0.15	-0.21	-0.1	*0.4
LKe	0.16	-0.12	-0.1	-0.07	-0.16	-0.12	*0.41	-0.06	0.14	-0.04	0.07	0.23	0	*0.31	0.08	-0.14	0.16	0.15	-0.16	-0.1
LLe	-0.05	-0.02	0.2	-0.15	0.05	0.17	-0.02	0.06	0.27	-0.01	0.04	0.16	-0.11	-0.22	0.14	-0.12	0.12	-0.36	-0.21	-0.1
LMad	0.03	0.05	-0.4	-0.26	0.12	-0.07	0.18	-0.03	0.19	-0.06	*0.48	-0.19	0.09	0.27	0.14	0.17	0.12	*0.41	0.12	-0.5
LMau	*0.43	0.31	0.03	-0.23	0.33	-0.18	0.27	-0.36	0	-0.24	0.03	0.23	0.19	0.01	0.05	0.3	0.27	-0.31	*0.49	-0.3
LMal	-0.01	-0.17	*0.4	0.22	0.09	-0.14	0.18	0.27	0.08	0.04	-0.28	*0.42	-0.14	-0.09	0.32	-0.09	-0.15	-0.01	-0.38	0.17
LMoz	*0.39	0.08	-0.1	0.14	-0.05	-0.26	-0.03	-0.15	-0.3	-0.44	-0.23	*0.47	0.11	-0.08	0.03	0.11	0.05	-0.13	*0.47	0.09
LNam	-0.13	0.12	0	-0.06	*0.55	0.26	0.18	0.2	0.37	-0.02	0.04	-0.15	*0.4	-0.04	-0.08	0.28	*0.46	-0.06	0.33	-0.3
LRw	0.05	-0.14	0.25	-0.36	-0.55	0.22	-0.04	0.2	0.13	-0.17	0.2	-0.32	-0.02	-0.04	-0.3	-0.26	0.11	-0.16	-0.18	-0.1
LS.A.	0.19	0.06	-0.3	0.16	-0.2	0.04	-0.09	0.06	-0.03	-0.19	-0.08	0.19	-0.17	-0.24	-0.27	0	-0.06	-0.13	0.01	0.05
LSey	-0.03	-0.08	0.06	0.1	0.06	*0.31	-0.18	*0.6	*0.53	-0.16	0.18	0.17	0.06	-0.12	-0.05	0.06	0.1	-0.04	0.1	0.04
LSud	0.11	-0.03	*0.4	*0.43	0.18	-0.08	0.13	0.04	-0.06	-0.13	-0.08	-0.2	-0.1	-0.08	-0.17	-0.12	-0.11	*0.32	0.1	-0.1
LSwa	0.07	*0.35	-0.3	0.27	*0.36	-0.24	0.06	-0.12	0.18	-0.14	0.14	0.21	-0.1	0.12	0.08	*0.46	0.13	0.15	0.3	-0.2
LTan	0.12	0.11	-0.4	0.01	*0.36	0.29	0	0.04	0.22	-0.02	0.28	0.23	0.2	-0.11	-0.04	*0.39	-0.07	0	0.22	-0.4
LUga	0.15	-0.10	0.04	-0.28	0.0	-0.27	-0.31	-0.01	-0.4	-0.05	-0.22	-0.15	-0.17	-0.05	-0.09	0.18	-0.04	-0.08	0	0.13
LZam	-0.31	0.02	-0.1	-0.01	0.17	0.19	*0.35	-0.02	-0.02	*0.43	-0.19	-0.16	*0.37	0.29	0.23	-0.22	-0.08	0.12	-0.11	0
LFra	0.08	-0.30	-0.55	-0.03	-0.31	*0.53	0.03	*0.46	0.24	0.25	-0.02	-0.41	0.19	-0.12	-0.23	0.05	-0.03	0.00	-0.01	0.04
LGer	-0.15	-0.21	0.34	0.06	-0.14	0.00	0.24	*0.36	0.21	-0.18	-0.19	*0.53	0.09	-0.18	0.01	-0.03	-0.19	-0.13	-0.08	0.18
Lita	0.08	-0.39	-0.18	0.09	-0.32	*0.31	0.08	0.26	*0.39	0.24	0.08	0.00	-0.23	-0.11	-0.34	0.09	0.21	0.08	-0.27	0.07
LEU	-0.09	-0.13	0.33	0.07	-0.25	0.11	0.30	*0.34	0.28	-0.17	-0.33	*0.47	0.14	-0.23	-0.07	-0.10	-0.08	-0.20	-0.10	0.14
LU.K.	-0.08	-0.21	-0.10	-0.23	-0.47	0.23	-0.19	0.27	*0.49	0.11	0.21	-0.01	0.26	-0.25	0.09	-0.21	-0.19	-0.14	-0.07	0.06
LU.S.	0.09	0.15	-0.25	-0.22	-0.02	*0.51	-0.13	0.23	0.04	-0.02	-0.17	-0.34	*0.51	-0.23	-0.26	0.08	-0.32	-0.34	0.14	0.12

Notes: *Indicates statistical significance at the 10 % level or higher. (L) Indicates supply shocks lagged one period.

Table 10. Correlations of Contemporaneous Demand Shocks

	Bo	Bu	Com	Eg	Eth	Ke	Le	Mad	Mau	Mal	Moz	Nam	Rw	S. A	Sey	Sud	Swa	Tan	Ug	Zam
Bot	1.00																			
Bur	0.08	1.00																		
Com	-0.23	-0.39	1.00																	
Eg	0.04	0.04	-0.09	1.00																
Eth	-0.11	-0.14	-0.25	-0.13	1.00															
Ke	-0.10	0.07	-0.39	-0.09	0.03	1.00														
Les	0.00	0.04	-0.30	-0.10	0.23	-0.06	1.00													
Mad	-0.04	-0.15	-0.06	0.06	0.02	*0.54	-0.17	1.00												
Mau	*0.42	0.21	-0.10	-0.08	0.04	0.30	-0.25	0.19	1.00											
Mal	-0.09	-0.21	0.07	-0.02	-0.11	-0.04	-0.08	0.27	-0.59	1.00										
Moz	0.24	-0.08	-0.17	*0.61	-0.10	0.12	*0.37	0.31	-0.06	0.05	1.00									
Nam	*0.59	0.23	-0.04	-0.09	0.14	-0.26	0.29	-0.03	*0.37	0.03	0.04	1.00								
Rwa	0.05	0.15	0.19	0.02	-0.06	-0.60	0.14	-0.70	-0.37	-0.03	-0.20	0.07	1.00							
S. A	0.12	0.12	-0.25	*0.32	0.17	0.00	0.12	0.04	-0.06	-0.07	0.01	0.26	0.02	1.00						
Sey	-0.13	0.42	0.02	0.28	-0.15	-0.02	-0.10	-0.37	-0.01	-0.10	0.21	0.20	*0.31	-0.04	1.00					
Sud	0.27	-0.14	-0.24	-0.03	0.20	0.03	-0.01	-0.11	0.00	0.23	0.27	0.31	-0.17	0.03	-0.11	1.00				
Swa	*0.32	*0.34	-0.16	-0.26	-0.08	-0.13	0.10	-0.06	0.19	0.06	-0.28	*0.39	0.00	*0.36	-0.13	0.19	1.00			
Tan	0.10	0.09	-0.26	*0.52	-0.01	0.20	0.05	*0.36	0.29	-0.10	*0.76	-0.04	-0.31	-0.03	0.11	0.10	-0.33	1.00		
Uga	0.19	*0.41	-0.35	0.01	0.09	0.01	*0.37	0.00	-0.01	0.11	*0.38	0.29	-0.07	-0.11	0.27	0.05	0.03	*0.40	1.00	
Zam	-0.20	0.09	-0.17	*0.38	0.09	-0.10	-0.05	-0.12	-0.14	-0.19	-0.13	-0.09	-0.14	*0.32	0.20	-0.04	0.03	0.02	-0.04	1.00
Fran	-0.07	-0.44	0.01	-0.30	0.20	0.20	0.04	0.12	-0.34	0.02	-0.19	-0.09	0.03	-0.19	-0.24	-0.10	-0.29	-0.28	-0.26	-0.38
Ger	-0.34	-0.16	-0.19	-0.18	0.14	0.22	-0.04	0.10	-0.29	0.04	-0.26	-0.64	-0.04	0.09	-0.62	0.00	-0.09	-0.12	-0.35	-0.24
Ita	-0.24	-0.21	*0.49	-0.12	0.14	0.06	0.10	0.18	-0.12	0.18	-0.07	0.04	-0.01	0.20	-0.29	0.17	-0.08	-0.06	-0.47	-0.16
EU	-0.08	0.01	-0.03	-0.16	-0.04	0.02	-0.07	-0.01	-0.26	-0.03	-0.35	-0.25	0.22	0.16	-0.42	-0.13	0.17	-0.38	-0.41	-0.28
U.K.	*0.68	0.10	-0.02	0.07	-0.29	-0.06	0.03	-0.01	*0.48	-0.17	0.19	*0.57	-0.07	-0.15	0.12	-0.11	0.01	0.08	0.23	0.00
U.S.	0.23	0.09	0.10	0.01	-0.35	0.04	-0.27	-0.02	0.31	0.04	-0.15	0.28	0.01	-0.35	*0.38	-0.14	0.17	-0.17	0.03	0.07

Note: *Indicates statistical significance at the 10 % level or higher.

Table 11. Correlations of Contemporaneous Demand Shocks with Demand Shocks Lagged One Period

	Bot	Bur	Com	Eg	Eth	Ke	Le	Mad	Mau	Mal	Moz	Nam	Rw	S. A	Sey	Sud	Swa	Tan	Ug	Zam
LBot	0.10	*0.38	-0.40	*0.36	-0.22	0.22	-0.13	0.18	0.09	0.10	-0.10	0.20	-0.10	*0.41	0.18	-0.07	0.28	-0.03	-0.02	0.40
LBur	-0.02	-0.03	0.12	-0.05	-0.23	-0.22	0.11	-0.44	-0.16	-0.12	-0.32	0.13	0.15	0.25	0.07	0.06	0.25	-0.25	-0.09	0.30
LCom	0.27	0.22	-0.32	-0.17	-0.03	0.07	-0.20	0.03	0.35	-0.16	0.02	0.06	-0.22	-0.22	-0.26	0.16	0.13	0.12	0.22	-0.41
LEg	*0.38	0.14	-0.02	-0.07	-0.12	0.10	-0.05	-0.04	0.36	0.16	0.23	0.30	0.00	0.01	0.12	*0.42	*0.45	0.15	0.15	-0.26
LEth	-0.12	-0.53	-0.03	0.05	-0.02	*0.34	0.12	0.31	0.00	-0.04	0.07	-0.40	-0.26	-0.17	-0.37	-0.13	-0.45	0.12	-0.17	-0.02
LKe	-0.09	-0.10	0.14	0.10	0.17	-0.09	0.05	0.02	-0.49	*0.33	0.15	0.04	0.32	-0.24	0.10	0.02	-0.37	-0.01	0.04	-0.16
LLes	0.03	-0.25	*0.44	0.06	-0.26	-0.05	-0.17	0.21	0.14	-0.10	0.10	0.07	-0.29	-0.39	-0.20	0.12	-0.11	0.14	-0.24	0.24
LMad	-0.02	-0.14	0.09	-0.04	0.12	-0.07	0.28	0.09	-0.42	*0.55	0.14	0.08	0.22	-0.11	-0.17	0.23	-0.06	-0.03	0.22	-0.44
LMau	0.09	*0.48	-0.37	0.10	-0.10	0.35	0.25	*0.46	-0.09	0.08	-0.04	-0.09	-0.20	*0.44	-0.34	-0.26	0.22	0.11	0.22	0.11
LMal	-0.08	-0.32	-0.13	-0.16	0.24	-0.01	0.03	-0.18	0.08	0.09	0.02	0.02	0.11	-0.32	0.23	0.12	-0.15	-0.06	0.04	-0.16
LMoz	*0.57	0.07	-0.07	-0.23	0.12	0.08	0.03	-0.05	0.06	0.17	-0.03	0.37	0.10	-0.03	-0.06	*0.45	*0.42	-0.27	-0.08	-0.24
LNam	0.15	0.02	-0.18	0.05	-0.03	*0.43	-0.14	0.34	*0.48	-0.28	-0.25	0.06	-0.43	0.31	-0.36	-0.04	0.10	0.05	-0.10	0.17
LRw	0.04	0.17	-0.08	-0.26	-0.27	0.03	-0.16	-0.29	0.41	-0.34	-0.35	-0.01	0.00	-0.05	0.09	0.04	0.20	-0.12	-0.25	0.16
LS.A	-0.20	-0.12	0.27	0.16	0.02	0.02	0.20	-0.05	0.21	-0.09	0.16	-0.14	0.03	-0.09	-0.02	0.07	-0.02	0.18	0.00	0.05
LSey	*0.33	0.00	0.02	-0.35	0.09	-0.05	-0.16	-0.21	*0.52	-0.17	-0.43	0.39	0.00	-0.06	-0.09	0.03	0.24	-0.26	-0.22	-0.19
LSud	-0.02	0.00	-0.31	0.18	*0.44	*0.43	0.00	0.04	0.23	-0.40	-0.02	-0.10	-0.09	0.16	0.25	-0.05	-0.15	0.06	-0.03	*0.39
LSwa	-0.44	0.10	-0.19	0.23	0.03	-0.15	0.16	-0.27	-0.04	-0.18	-0.26	-0.17	0.08	0.10	0.06	-0.15	0.01	-0.06	-0.09	*0.58
LTan	*0.52	0.16	-0.18	-0.12	0.08	0.13	*0.34	0.10	-0.03	0.22	0.23	0.37	-0.05	0.05	-0.03	*0.30	*0.44	0.04	*0.38	-0.21
LUga	*0.47	-0.22	-0.02	0.13	-0.09	-0.29	0.07	-0.12	0.09	0.00	-0.06	*0.57	0.09	0.08	0.03	0.02	0.12	-0.01	0.08	0.13
LZam	-0.09	-0.15	0.31	0.31	0.25	-0.08	0.05	0.07	0.32	-0.07	0.26	0.03	-0.24	0.23	-0.05	0.05	-0.06	0.40	-0.01	0.07
LFran	0.00	-0.12	*0.38	0.09	-0.23	-0.04	-0.21	0.08	-0.17	0.09	0.16	-0.23	0.17	-0.33	0.02	-0.11	-0.42	-0.09	-0.13	-0.27
LGer	-0.38	-0.13	0.19	0.10	-0.08	-0.08	0.10	-0.19	-0.63	0.12	0.31	-0.47	*0.31	-0.22	*0.31	-0.01	-0.33	0.02	0.14	0.03
Lital	-0.32	-0.01	-0.04	-0.21	0.06	*0.52	0.14	0.12	0.03	-0.13	0.14	-0.53	-0.20	-0.37	-0.06	0.07	-0.25	0.12	0.07	-0.35
LEU	-0.30	0.05	0.01	0.16	-0.17	-0.21	0.05	-0.33	-0.40	-0.13	0.29	-0.37	*0.42	-0.02	0.14	0.15	-0.19	0.03	-0.06	0.03
LU.K.	0.10	0.20	-0.08	*0.33	-0.21	0.07	-0.55	*0.34	0.11	0.29	-0.12	0.18	-0.13	*0.33	0.03	-0.05	0.29	0.04	-0.15	-0.01
LU.S.	0.06	0.22	-0.22	-0.01	0.04	-0.07	-0.41	0.04	0.22	0.15	-0.25	0.28	0.08	0.21	0.04	-0.10	0.02	-0.02	-0.12	-0.02

Notes: *Indicates statistical significance at the 10 % level or higher. (L) Indicates demand shocks lagged one period.

The correlations of demand shocks reported in Tables 10 and 11 seem to reinforce the overall view of asymmetry seen from Tables 8 and 9. A number of contiguous states in the Southern tip (Namibia, Botswana and Swaziland, South Africa, Swaziland and Zambia) and the Eastern and North Eastern (Kenya, Ethiopia and Sudan; Sudan, Egypt, and Tanzania; Tanzania and Uganda; Burundi and Uganda) economies show some significant correlations. The demand shocks for the island economies again seem to correlate more with the Eastern African countries than Southern Africa. The demand shocks faced by ESA are predominantly asymmetric to those faced by Europe or the US. The few positive and significant correlations are in countries that are geographically dispersed.

Overall, the correlations found for the Eastern and Southern Africa seem more asymmetric compared to the correlations for the CFA zone obtained by Fielding and Shields (2001) and more comparable to the exchange rate disturbances found for the SADC by Khamfula and Huizinga (2004). They are much smaller and less symmetric than some of the results found for the European Community and the European accession countries found by Fidrmuc and Korhonen (2001).

Based on these correlations and geographical proximity, we do not find any support for an ESA-wide monetary union but tentatively suggest a tripolar route to monetary integration. The first is a monetary union to encompass the southern cone consisting of the existing CMA, expanding northwards to include Botswana, Mozambique, and Zambia.[19] The second is an East African monetary union with the nucleus as the proposed EAC monetary union. This could gradually expand to include Rwanda, Burundi, Ethiopia, Sudan and Egypt. Though it might not seem to be the natural anchor for the region it might still be the right nucleus since the East African

[19]South Africa's earlier reluctance to expand the CMA noted in Sparks (2002) seems to have slowly given way to support, thus making a SADC currency more feasible.

Community is showing the necessary political will and has taken concrete steps towards a monetary union. A third monetary union could be based on the Indian Ocean Commission (IOC)[20] for the Island economies. Of the ESA sub-regions this exhibits higher symmetry. It is also the sub-region that does not have a monetary union agenda at the moment.

The correlations do not show much support for an ESA-wide link to the Euro, Sterling pound or U.S. dollar. Based on the correlations the IOC region could benefit from linking their currency to the Euro. The evidence for the EAC seems weak, while there is no evidence at all for the SADC currency region.

Impulse Response

In addition to isolating the underlying disturbances, it is beneficial to compare the response of the economies to the shocks in terms of magnitude and speed of adjustment. This can be done by looking at the impulse response functions. The larger the size of the shock, the more disruptive its effects will be on the economy. Similarly, the slower is the adjustment after disturbances, the larger will be the cost of maintaining a single currency.

For briefness, instead of drawing an impulse response function for the impact of each shock on each variable for all countries, we focus on the asymptotic effect of each shock on each variable. Table 12 summarizes the total long-run impulse response to a unit positive supply and demand shock for each economy. The impulse responses of the output level to a supply shock for ESA are generally small, all being less than 13%, but nonetheless greater than those for the Euro-bloc, the U.K., and the U.S. (less than 2%). The speed of adjustment is relatively high, with most effects

[20] Composed of Seychelles, Madagascar, Mauritius, The Comoros and Réunion (a French colony and not included in study), the objective of IOC is economic and commercial cooperation especially on maritime resources.

dissipating by the second year and all by the third year. Except for Burundi, Comoros and Zambia, the cumulated effect of a supply shock on output is positive as expected. However there is a wider cross-country variation in the impulse response of the price level to a demand shock. For most countries, the speed of adjustment is low. Like in the output response, the effect of most shocks dissipates by around the third year, with the total effect comparing well with those of Euro bloc, U.K. and U.S. For four countries: Uganda, Zambia, Sudan, and Mozambique the accumulated effect is relatively large (40% and over). For all countries except Burundi and Swaziland, demand shocks produce an increase in prices over time. Most of the impulse responses of the price level to a supply shock also dissipate by the second or third year and compare favorably with those for U.S. and U.K. Only Uganda has a slow speed of adjustment and a large long-run effect of 52%. However for quite a number of countries the cumulative effect of a positive supply shock on the price level are non-negative though small.

From these results it would seem that the impulse responses are generally small for most countries and dissipate quickly, by the second or third year. The overall cumulative effects seem smaller than those found by Fielding and Shields (2001) for the CFA zone. Countries that show a marked difference in size and speed of adjustment seem to be confined to those (Rwanda, Uganda, Sudan, Mozambique) that have experienced major civil strife. It would be expected that as these countries stabilize the shocks to the economies will reduce. These results tentatively point to a possibility of monetary unions for some of the Eastern and Southern African economies. On average we find larger effects for ESA than for U.S., U.K. or Euro-bloc, though a few countries do compare well.

Variance Decomposition

The forecast error variance shows the contribution of each shock to the movements in the two variables of the vector $X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix}$. This gives an indication of which shocks are the more predominant accounting for the variability in vector X_t. This is important because differences in the cause of variability in the countries could be indicative of underlying differences in the transmission mechanism and the policy strategies of the Eastern and Southern African countries, which could be an obstacle to regional monetary integration.

Table 13 shows the proportion of variability of the log of real output due to demand shocks at one to six year time horizon. The proportion due to supply shock is found by subtracting from unity (100%). The percentage variability of real output accounted for by supply shocks is widely variable, ranging from less than 30% to over 90% at the six year period. These results show more variation than the results obtained for East Asia (Zhang, Sato, and McAleer 2004) or those presented for the European Union by Ballabriga, Sebastian, and Valles (1999). The variance decomposition of the price level indicates that demand shocks account for a high proportion (over 80%) of the price level variability across most economies. However, there are a few countries that show wide variations, with some countries less than 10%. Thus, these indicate that structural supply and demand shocks do not contribute to output changes and price variations in the same way across the Eastern and Southern African countries.

Table 12. Long-Run Size of Impulse Responses

	Impulse Response of Output Level to a Positive Supply Shock					*Impulse Response of Price Level to a Positive Demand Shock*					*Impulse Response of Price Level to a Positive Supply Shock*				
Time	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Botswana	**0.01**	**0.03**	**0.03**	**0.03**	**0.03**	**0.03**	**0.05**	**0.05**	**0.04**	**0.04**	**-0.02**	**-0.03**	**-0.03**	**-0.02**	**-0.02**
Burundi	**0.02**	**0.01**	**0**	**-0.01**	**-0.01**	**0.01**	**-0.01**	**-0.02**	**-0.03**	**-0.03**	**-0.07**	**-0.09**	**-0.08**	**-0.07**	**-0.06**
Comoros	**0.01**	**0.01**	**-0.01**	**0**	**-0.01**	**0.01**	**0.02**	**0.02**	**0.03**	**0.03**	**-0.04**	**-0.04**	**-0.04**	**-0.05**	**-0.05**
Egypt	**0.02**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.07**	**0.08**	**0.09**	**0.09**	**0.02**	**0**	**0.01**	**0.02**	**0.03**
Ethiopia	**0.13**	**0.12**	**0.11**	**0.11**	**0.11**	**0.11**	**0.12**	**0.12**	**0.12**	**0.12**	**-0.11**	**-0.1**	**-0.08**	**-0.08**	**-0.08**
Kenya	**0.05**	**0.1**	**0.12**	**0.13**	**0.13**	**0.04**	**0.03**	**0.02**	**0.01**	**0.01**	**-0.01**	**-0.07**	**-0.11**	**-0.12**	**-0.12**
Lesotho	**0.04**	**0.05**	**0.04**	**0.03**	**0.04**	**0.03**	**0.03**	**0.02**	**0.02**	**0.02**	**0.03**	**0.02**	**0.03**	**0.03**	**0.03**
Madagascar	**0.04**	**0.04**	**0.03**	**0.03**	**0.03**	**0.06**	**0.09**	**0.1**	**0.09**	**0.08**	**-0.02**	**-0.05**	**-0.04**	**-0.02**	**-0.02**
Mauritius	**0.04**	**0.07**	**0.07**	**0.07**	**0.06**	**0.01**	**0.02**	**0.03**	**0.03**	**0.04**	**0**	**0.03**	**0.05**	**0.06**	**0.07**
Malawi	**0.05**	**0.03**	**0.04**	**0.04**	**0.04**	**0.09**	**0.14**	**0.15**	**0.15**	**0.14**	**0**	**-0.05**	**-0.08**	**-0.1**	**-0.1**
Mozambique	**0.06**	**0.09**	**0.11**	**0.11**	**0.11**	**0.19**	**0.23**	**0.31**	**0.34**	**0.37**	**0.05**	**0.02**	**-0.02**	**-0.05**	**-0.08**
Namibia	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.04**	**0.05**	**0.04**	**0.03**	**0.04**	**0.01**	**0**	**0.01**	**0.01**	**0.01**
Rwanda	**0.09**	**0.07**	**0.05**	**0.04**	**0.04**	**0.05**	**0**	**0**	**-0.01**	**0**	**-0.11**	**-0.14**	**-0.16**	**-0.15**	**-0.15**
S. Africa	**0.02**	**0.03**	**0.02**	**0.02**	**0.02**	**0.03**	**0.04**	**0.05**	**0.06**	**0.07**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
Seychelles	**0.06**	**0.06**	**0.04**	**0.04**	**0.04**	**0.03**	**0.05**	**0.08**	**0.1**	**0.11**	**-0.04**	**-0.01**	**-0.01**	**-0.02**	**-0.02**
Sudan	**0.05**	**0.07**	**0.07**	**0.06**	**0.06**	**0.12**	**0.21**	**0.28**	**0.35**	**0.4**	**-0.06**	**-0.09**	**-0.11**	**-0.14**	**-0.17**
Swaziland	**0.04**	**0.03**	**0.05**	**0.05**	**0.05**	**-0.04**	**-0.02**	**-0.02**	**-0.02**	**-0.02**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
Tanzania	**0.02**	**0.03**	**0.03**	**0.03**	**0.03**	**0.1**	**0.16**	**0.18**	**0.19**	**0.19**	**0.02**	**0.01**	**0**	**0**	**0**
Uganda	**0.05**	**0.07**	**0.07**	**0.07**	**0.07**	**0.19**	**0.26**	**0.35**	**0.41**	**0.45**	**-0.07**	**-0.15**	**-0.25**	**-0.34**	**-0.42**
Zambia	**-0.04**	**-0.03**	**-0.02**	**-0.03**	**-0.03**	**0.15**	**0.28**	**0.39**	**0.47**	**0.53**	**-0.03**	**-0.04**	**-0.05**	**-0.07**	**-0.08**
Euro-bloc	**0.02**	**0.02**	**0.02**	**0.02**	**0.02**	**0.01**	**0.02**	**0.03**	**0.03**	**0.04**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**
U.K.	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.00**	**0.02**	**0.05**	**0.06**	**-0.02**	**-0.04**	**-0.05**	**-0.06**	**-0.07**
U.S.	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**0.01**	**0.02**	**0.03**	**0.03**	**-0.01**	**-0.02**	**-0.02**	**-0.03**	**-0.03**

Note: Multiply by 100 to get % change in variable.

Table 13. Variance Decomposition: Proportion of Real Output and Price Variability Due to Demand Shocks

	Variation in Output Due to Demand Shock						*Variation in Price Due to Demand Shock*					
Horizon: yrs	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**	**6**
Botswana	**70.69**	**68.72**	**70.35**	**70.92**	**72.97**	**70.8**	**67.45**	**70.66**	**69.59**	**63.18**	**73.95**	**68.66**
Burundi	**78.25**	**77.01**	**74.56**	**72.7**	**74.99**	**72.48**	**0.63**	**4.98**	**8.7**	**0.57**	**10.07**	**9.67**
Comoros	**74.41**	**79.31**	**63.73**	**61.28**	**65.5**	**59.72**	**8.94**	**15.58**	**15.56**	**8.9**	**17.25**	**16.42**
Egypt	**1.36**	**2.43**	**2.93**	**3.1**	**3.16**	**3.16**	**89.18**	**87.44**	**86.84**	**84.34**	**89.56**	**82.33**
Ethiopia	**15.43**	**16.92**	**18.3**	**18.58**	**18.74**	**18.71**	**49.22**	**48.93**	**48.49**	**48.84**	**48.55**	**48.52**
Kenya	**36.36**	**38.93**	**40.62**	**41.13**	**42.04**	**41.19**	**98.73**	**75.43**	**71.64**	**73.72**	**73.02**	**71.33**
Lesotho	**48.92**	**48.56**	**53.79**	**53.57**	**56.36**	**54.18**	**62**	**61.56**	**57.52**	**60.24**	**58.9**	**57.99**
Madagascar	**1.01**	**1.35**	**1.32**	**1.67**	**1.68**	**1.72**	**87.24**	**79.3**	**78.54**	**72.72**	**82.2**	**74.84**
Mauritius	**0.31**	**0.74**	**0.94**	**0.97**	**0.99**	**0.97**	**99.97**	**79.71**	**73.35**	**74.78**	**85.5**	**73.21**
Malawi	**3.81**	**3.87**	**4.01**	**3.95**	**4.01**	**3.94**	**99.9**	**81.61**	**76.39**	**77.92**	**76.62**	**74.8**
Mozambique	**1.8**	**2.19**	**3.78**	**4.12**	**4.78**	**4.92**	**94.37**	**92.86**	**91.33**	**92.53**	**94.85**	**86.74**
Namibia	**49.63**	**50.13**	**49.92**	**49.99**	**50.35**	**50.06**	**89.48**	**85.27**	**85.89**	**84.86**	**86.76**	**85.96**
Rwanda	**62.94**	**61.16**	**60.25**	**60.29**	**60.45**	**60.29**	**21.04**	**31.09**	**30.68**	**19.3**	**30.86**	**30.72**
South Africa	**7.15**	**8.93**	**11.26**	**14.33**	**16.75**	**15.79**	**97.2**	**97.65**	**97.88**	**97.19**	**105.1**	**98.01**
Seychelles	**3.53**	**7.97**	**7.61**	**7.54**	**7.68**	**7.73**	**38.89**	**36.45**	**45.35**	**29.02**	**52.84**	**49.53**
Sudan	**0**	**1.22**	**1.22**	**1.28**	**1.39**	**1.36**	**80.18**	**83.51**	**84.37**	**77.83**	**105.61**	**84.03**
Swaziland	**48.66**	**49.57**	**45.41**	**45.43**	**45.77**	**45.21**	**96.15**	**94.79**	**93.91**	**94.03**	**95.47**	**93.71**
Tanzania	**5.08**	**6.32**	**7.81**	**10.48**	**11.97**	**11.61**	**97.85**	**98.01**	**97.98**	**97.43**	**98.21**	**97.98**
Uganda	**2.18**	**2.34**	**3.81**	**4.68**	**5.46**	**5.73**	**88.99**	**78.97**	**69.52**	**76.5**	**76.68**	**58.61**
Zambia	**2.09**	**1.97**	**2.92**	**3.4**	**3.62**	**3.72**	**96.28**	**97.82**	**97.64**	**96.09**	**117.34**	**97.59**

Notes: The values indicate the proportion of the forecast error variance in real output and price level due to demand shocks. The proportion due to supply shock is found by simply subtracting from one.

Discussion

We use a two-variable VAR model to investigate the potential for forming monetary unions in Eastern and Southern Africa. The countries in the sample are members of regional economic organizations that either have a monetary union as an immediate objective or might consider it in the future. We decompose the economic shocks experienced by these economies into supply and demand disturbances and study their correlation for all pairs of countries. The results do not provide evidence in favor of a broad monetary union encompassing all countries in the region. Nonetheless, we find tentative supportive evidence for three groupings of countries: (1) in the southern tip of Africa expanding the Common Monetary Area; (2) the member countries of the East Africa Community potentially including several other neighboring economies;[21] and (3) the island economies. We should reiterate that this supportive evidence is relatively weak. Considering the question of external anchor-currency, we find some support for linking an island (IOC) currency to the euro, and weaker evidence for linking an EAC currency to the Euro. However we find no evidence to support linking a Southern Africa (SADC) currency to any of the hard currencies considered.

Recent literature suggests endogeneity of OCA criteria in the sense that it might be easier to satisfy them after a monetary union is formed than before. Studies have shown positive and economically significant (33%-90%) trade effect of monetary union (Rose and Stanley 2005). Theoretically, the effect of increased integration is ambiguous. It may lead to more symmetry because of common demand shocks or intra-industry trade (Frankel and Rose 1998), or it may lead to more

[21]The fear of South Africa hegemony Sparks (2002) by neighboring states may favor the adoption of a new SADC currency rather than adopt the South Africa's "Rand." This seems to be the thinking in the recent pronouncements by the SADC central bank governors. The same is true; to a lesser extend, of the EAC. A new currency, probably a joint "Shilling" like in the old EACB may be preferable.

concentration and less symmetry (Krugman 1993). De Grauwe (2003) suggests more synchronicity is the likely outcome, since more integration will reduce the importance of national boundaries and thus the relevant regions in which some activity is concentrated will likely transgress national borders. For ESA to benefit from deeper integration major underlying problems that hinder intra-regional trade, such as infrastructure, non-complimentary production structures Bayoumi and Ostry (1997) and economic management, and internal political tension (Longo and Sekkat 2004) need to be addressed.

Many of the arguments for membership in regional integration agreements are political concerns such as bargaining power and security. A common view is that Africa is becoming increasingly marginalized by globalization (Adepoju 2001) and that governments see deeper integration as a way to enhance their bargaining power by achieving a common negotiating position. Deeper regional integration is also a way to promote peace, security and stability by forcing a stronger commitment on members to peace within the union. Many of the countries we study have been involved in a serious internal strife in the recent past e.g., South Africa, Rwanda, Mozambique, and the Sudan. National borders, a colonial legacy that often cut across ethnic communities, have been another source of conflict e.g., between Botswana and Namibia, Ethiopia and neighboring Somalia and Eritrea. Nonetheless, this legacy has not stopped the affected countries from joining (sometimes the same) economic groups and making plans for further integration.[22] If achieved, stability may turn out to be the most important gain for the region. Monetary union is an important policy which creates opportunities in many economic and non-economic areas. Thus

[22] The complex colonial legacy of the region does not seem to have influenced regional membership. The creation of the EMU bloc has also reduced these links to two main currencies, the Euro and Sterling pound. U.K.'s entry into EMU would thus eliminate any conflict of interest.

politicians would be reluctant—even in the face of unfavorable economics—to be left out.

Essay Three: Monetary Union and Central Bank Independence

Introduction

The decision to enter a monetary union can bring important economic benefits as well as costs for the member countries. Starting with Mundell (1961), the literature has identified the restricted ability of member countries to react to negative economic shocks as the main cost of monetary unions. In a monetary union, monetary and exchange rate policies are decided at the union level and may not always be in line with the current needs of each member country. This is particularly problematic if the member countries have dissimilar business cycles and if wage rigidity and restricted labor mobility hamper macroeconomic adjustment. On the benefits side, monetary unions eliminate exchange rate uncertainty and the currency conversions costs among the member states, which may spur international trade and investment. An important benefit that has dominated the recent literature is the credibility argument. Monetary unions create the potential for some countries to "import monetary credibility" from other member countries with reputation for prudent monetary policy, e.g., Germany in the Euro-zone (Herrendorf 1997). Time wise this is a more efficient way to improve credibility than earning it through the alternative time consuming way of building a track record (Blinder 2000).

In this paper we show that a monetary union can enhance monetary stability for its member states even if none of them have a history of prudent monetary policy. This is important because a number of monetary unions have been proposed among groups of developing countries that lack a history of stable prices or simply have a short history of independent monetary policy.[23] Some authors, for example Mundell

[23] Examples are the proposed East African Community (EAC) monetary union and the Southern Africa Development Community (SADC) currency union.

(2002), have argued that monetary unions could provide a means for credible commitment to sound macroeconomic policies. For example, Guillaume and Stasavage (2000) provide evidence that African countries that participate in monetary unions tend to pursue more credible monetary policies.

We develop a Barro and Gordon (1983) type model where the preferences of the central banks of a group of countries considering monetary union are state contingent and thus not known to policy makers a priori as in Demertzis and Hallett (2004). This could arise from lack of independence such that the central banks may be pressured to accommodate government objectives in terms of output Demertzis and Hallett (2003). In addition, political patronage for particular members of management may shift over time affecting their influence on policy. In the developing countries these fears are ever present. Given the weak checks on the government, the uncertainty about the preferences of policymakers is expected to be higher in these countries. In this context, we show that shifting the conduct of monetary policy from the national level to a union level in a multilateral union decreases the variability of union-level inflation and improves welfare as long as the central banks of the member countries experience different pressures to inflate at different times. In the model, the opportunistic objectives of one member's policymakers are kept in check at the union level by other members with disparate objectives.

Our theoretical analysis extends a growing literature on the monetary and fiscal policy interactions of member states in a monetary union. Debrun, Masson, and Pattillo (2005) analyze the implications of financing needs using a theoretical framework that includes fiscal policy. Beetsma and Bovenberg (1999) explore how monetary unification impacts the accumulation of public debt and show that under fiscal leadership it may discipline fiscal and monetary policy, while Dixit and

Lambertini (2003) explore the interaction of a centralized monetary policy with decentralized fiscal policy. They show that when monetary and fiscal authorities in a monetary union agree on the ideal output and inflation levels, ideal outcomes emerge as the equilibrium without the need for monetary commitment. Our analysis of the effect of asymmetry of central bank preferences in a monetary union is new to the literature.

As an application to the theory, we investigate the feasibility of monetary union in the East African Community. The three member countries: Kenya, Tanzania, and Uganda, recently signed a customs union treaty and have officially declared their goal to form a currency union. Two neighboring countries, Rwanda and Burundi, have indicated an interest to join and are included in the analysis. None of the five countries has a long or particularly successful history of monetary policy. Thus, their experience fits neatly our theoretical model. We parameterize the model to provide a welfare analysis for this monetary union based on a tradeoff between the loss of independent monetary policy and the gain from checks on monetary policy provided by member states. In this sense, we also extend a small but growing literature on monetary unions in Africa, for example Masson and Pattillo (2005), Honohan and Lane (2000), Khamfula and Huizinga (2004) and Buigut and Valev (2005), among others.

The rest of the paper is structured as follows. Section 2 discusses the model and Section 3 assesses the effects on monetary union. In Section 4 we apply the model to estimate the expected welfare effects of the proposed East African currency union. Section 5 presents the results of the analysis and Section 6 concludes.

The Model

We assume a n country economic area where countries differ by the size of their GDP, the random supply shocks affecting output and their preferences for output stimulation. Output y_i (all variables in logarithms) in country i differs from its natural level by an amount determined by the difference between actual and expected inflation and an output shock:

$$y_i = \bar{y}_i + b(\pi_i - \pi_i^e) + \varepsilon_i, \quad i = 1, ..., n \tag{3.1}$$

The unexpected inflation ($\pi_i - \pi_i^e$) affects activity with $b > 0$ as the marginal output gain from unexpected inflation; ε_i is an output supply shock with mean zero and finite variance $\sigma^2_{\varepsilon_i}$. The central bank sets inflation to maximizes the following quasi-linear utility function as in Debrun, Masson, and Pattillo (2005) and Muscatelli (1998):

$$W_i = c_i(y_i - \bar{y}_i) - \frac{1}{2}[\pi_i - \tilde{\pi}_i(\varepsilon_i)]^2 \tag{3.2}$$

The parameter c_i in (3.2) is the weight placed by the central bank on its objective to stimulate output above the natural level of output. A greater value of c_i indicates stronger preferences for stimulating output and less aversion to high inflation. These preferences are subject to shocks (such as unexpected pressures from the executive branch), i.e., $c_i = \bar{c}_i + v_i$ where v_i is a random variable with mean zero and variance $\sigma^2_{c_i}$. Hence, there are two sources of uncertainty in the model: the shocks to output and the shocks to the decision making of the central bank. The shocks to preferences are assumed not correlated with the supply shocks within and across countries. The private sector forms expectations of inflation π_t^e before the stochastic shocks are realized and the central bank sets inflation after the shocks are realized.

The second term in (3.2) shows that deviations of inflation from the ideal level $\tilde{\pi}_i(\varepsilon_i)$ are increasingly costly. Linearity of the objective function (3.2) in output generally implies no role for stabilization policy. We restore an implicit trade-off between the variability of inflation and output as in Muscatelli (1998) and Debrun, Masson, and Pattillo (2005) by making the socially optimal level of inflation a function of the supply shock: $\pi(\varepsilon_i) = -\eta\varepsilon_i, \eta > 0$. A negative supply shock induces the policymaker to tolerate positive inflation. Parameters subscripted i are country-specific, while the parameters without subscripts are assumed identical across countries.

Optimal Inflation under Monetary Autonomy

With autonomous monetary policies, policymakers independently choose inflation rates π_i^* by maximizing (3.2) subject to (3.1). The time-consistent inflation policy is derived under rational expectations assuming, as noted earlier, that expected inflation is formed before the shocks ε_i and ν_i are realized whereas the central bank sets inflation after the shocks are realized. However, once the shocks occur they are perfectly observable by all. The solution for optimal inflation[24] yields:

$$\pi_i^* = c_i b + \tilde{\pi}(\varepsilon_i) = c_i b - \eta\varepsilon_i \tag{3.3}$$

The optimal inflation rate increases in the central bank's preference for stimulating output (c_i), in the marginal effect of unexpected inflation on output (b) and in the size of the output shock (ε_i). Knowing the central bank's optimization problem, the rationally expected inflation rate is given by $\bar{c}_i b$.

[24] Both ε_i and ν_i are stochastic and not correlated. Since it is assumed that these shocks are observable by both the CB and agents once they occur the set up used here reduces to a one period model, where each period the CB optimizes based on current shocks. We would require a multi-period set up if either or both of the shocks were only observable by the CB.

Optimal Inflation under Monetary Union

Now, suppose that monetary policy is decided by a common central bank (CCB) in a multilateral monetary union of the *n* countries. The common central bank maximizes a weighted average of the individual policymakers' utility functions:

$$U^{CCB} = \sum_{i=1}^{n} w_i U_i \,, \tag{3.4}$$

where $w_i > 0$ and $\sum_{i=1}^{n} w_i = 1$ is the weight given to country *i* in the decision-making of the common central bank. We can rewrite (3.4) as:

$$U^{CCB} = c_A(y_A - \bar{y}_A) - \frac{1}{2}[\pi_A - \tilde{\pi}(\varepsilon_A)]^2 \,, \tag{3.4'}$$

where subscript A indicates cross country $w-$weighted averages. To isolate the pure effects of monetary unification on policy outcomes it is assumed that the CCB is under the same pressures as a national central bank would be, except that in a monetary union individual pressures on the CCB are diluted according to the weight of the country in the joint decision process.[25] The time consistent optimal inflation values under monetary union are found by maximizing (3.4) to obtain π^*_{mu}:

$$\pi^*_{mu} = bc_A + \tilde{\pi}(\varepsilon_A) \tag{3.5}$$

The optimal inflation under monetary union is a function of the weighted output preferences of its members and the weighted supply shocks.

[25] This differs from the literature, e.g., Alesina and Barro (2002) and Alesina, Barro and Tenreyro (2002), that analyzes a monetary union as a process of dollarization in which the inflation prone country adopts the currency of the anchor country in a client-anchor relationship.

Welfare Effects of Monetary Union

The net welfare effect of moving from autonomous monetary policy to monetary union can be derived from the optimal inflation solutions obtained under autonomy and monetary union in (3.3) and (3.5). The expected net welfare (NW) effect of monetary integration for country i is obtained from:

$$E(NW_i) = EU_i\Big|_{mu} - EU_i\Big|_{autonomy} \tag{3.6}$$

The workings for (3.6) are provided in appendix C3. By bringing together equations (C5) and (C8) we obtain:

$$\begin{aligned} E(NW_i) = & -\frac{b^2}{2}\left[(w_i^{\,2}-1)\sigma_{c_i}^2 + (1-w_i)^2\sigma_{c_{-i}}^2 + 2w_i(1-w_i)\rho_c\sigma_{c_i}\sigma_{c_{-i}}\right] \\ & -\frac{\eta^2(1-w_i)^2}{2}[\sigma_{\varepsilon_i}^2 + \sigma_{\bar{\varepsilon}_{-i}}^2 - 2\rho_\varepsilon\sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}}] \\ & -(1-w_i)b^2\bar{c}_i\left[\bar{c}_{-i}-\bar{c}_i\right] - \frac{b^2(1-w_i)^2}{2}\left[\bar{c}_{-i}-\bar{c}_i\right]^2 \end{aligned} \tag{3.7}$$

where subscript –*i* indicates a *w*-weighted average of all countries in the union excluding country *i*. Note that $\text{cov}(c_i, c_{-i}) = \rho_c\sigma_{c_i}\sigma_{c_{-i}}$ with $-1 \le \rho_c \le 1$ being the coefficient of correlation of the central bank preferences across countries. Similarly, $\text{cov}(\varepsilon_i, \varepsilon_{-i}) = \rho_\varepsilon\sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}}$ where $-1 \le \rho_\varepsilon \le 1$ is the correlation coefficient of the supply shocks across countries. A positive value for (3.7) means that welfare for country i is enhanced in a monetary union.

The first and second lines in (3.7) account for the stochastic components of the net welfare function. The first line of (3.7) shows the effects of the uncertainty associated with the policymakers' preferences for stimulating output. The key result regarding this part of the net welfare function is the effect of the correlation of these preferences across countries:

$$\frac{\partial E(NW)}{\partial \rho_c} = -b^2 w_i (1-w_i)\sigma_{c_i}\sigma_{c_{-i}} < 0 \tag{3.8}$$

Expression (3.8) shows that the net benefit of a monetary union decreases in the correlation of the shocks to preferences. Intuitively, asymmetry of the shocks to output preferences across the member states allows the common central bank to achieve a lower variance of the union-wide inflation. The pressure to inflate and stimulate output (irrespective of output shocks) in some countries is counterbalanced by the desire for a more prudent policy of stable prices in other member countries at the same time. Furthermore, note from (3.8) that this benefit of checks by other member states is particularly strong if the individual central banks tend to experience large shocks to their objectives, i.e., if the σ_c's are large.

The second line of (3.7) shows the loss of welfare resulting from the reduced ability of individual central banks to react to economic shocks. This line is unambiguously negative, and is zero only if $\sigma^2_{\varepsilon_i} = \sigma^2_{\varepsilon_{-i}}$ and $\rho_\varepsilon = 1$, i.e., if the countries face the same shocks. This is the typical cost associated with monetary unions. Note that from (3.7):

$$\frac{\partial E(NW)}{\partial \rho_\varepsilon} = \eta^2 (1-w_i)^2 \sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}} > 0 \tag{3.9}$$

i.e., the greater the correlation of output shocks across countries, the smaller is the cost associated with the loss of independent monetary policy. From (3.9), the synchronicity of supply shocks is particularly important if the member countries are prone to experience large shocks, i.e., if the σ_ε's are large.[26]

[26] The effects of the correlations of supply shocks and preference shocks become even clearer if we consider a simplified case of two countries of equal weight, with $\sigma^2_{\varepsilon_i} = \sigma^2_{\varepsilon_{-i}} = \sigma^2_\varepsilon$, $\sigma^2_{c_i} = \sigma^2_{c_{-i}} = \sigma^2_c$ and $\bar{c}_i = \bar{c}_{-i}$. Then, $E(NW_i) = 1/4\left[b^2\sigma_c^2(1-\rho_c) - \eta^2\sigma_\varepsilon^2(1-\rho_\varepsilon)\right]$. It is apparent that expected net welfare increases in ρ_ε and decreases in ρ_c.

The third line of (3.7) shows the nonstochastic component of the net welfare function. This line is composed of two parts. The first part is positive when $\bar{c}_{-i} - \bar{c}_i < 0$, implying that welfare increases for a country if it enters into monetary union with countries having greater aversion to high inflation. Thus, this part of the welfare function captures the benefits of imported monetary credibility:

$$\frac{\partial E(NW)}{\partial \bar{c}_{-i}} = \frac{-(1-w_i)b^2}{a}[\bar{c}_{-i}(1-w_i) + w_i\bar{c}_i] < 0 \tag{3.10}$$

The second part of the third line in (3.7), which is always negative, shows the loss from diverging output preferences in a monetary union. The greater the difference between the expected output preferences of country i and that of partner countries the greater the loss. Note also that the third line in (3.7) is zero when the expected output preferences of country *i* are the same as in the rest of the union, i.e., when $\bar{c}_{-i} = \bar{c}_i$.

In summary, the net gain from monetary union for country *i* is greater if it joins in a union with other countries that have stronger expected preferences for low inflation (the imported credibility argument); if its output shocks are more highly correlated with those of the other union members; and if the shocks to its central bank's preferences are correlated less with those of other member countries. The literature discusses the first and second of these effects, but has not identified the third one. Yet, it is an important effect because it shows that gains in monetary credibility are possible by forming a multilateral monetary union even if all of the member countries' central banks face pressures to inflate provided that these pressures do not occur at the same time.

The following sections use the model developed here to study the expected net benefits from forming a currency union for the East African countries. This group of countries is an ideal choice for study since they have made a significant effort towards

monetary union. Given that none of these countries has a long history of independent monetary policy their experience fits our theoretical model well.

Welfare Effects of an East African Monetary Union: An Application

In this section we estimate the welfare effects of a move to monetary union for five East African countries: Burundi, Kenya, Rwanda, Tanzania, and Uganda. To derive estimates of the parameters c_i and b in (3.7), we adapt the approach in Swank (1997) to our welfare framework.[27] In Swank's model, the policy maker chooses nominal output to balance the objectives of low inflation and high output subject to a constraint based on the short-run Phillips curve (Ball, Mankiw, and Romer 1988). The reaction function derived from this optimization problem contains information about both the policy maker's preferences and the economic constraint. To disentangle this information, the Phillips curve is first estimated and then the reaction function is estimated making use of the estimates of the Phillips curve. We adapt this method to the loss function in (2) to estimate the preferences parameter c_i and the marginal output gain from unexpected inflation b. The procedure is described in appendix D.

To perform the estimations we use data on real and nominal GDP from the World Bank's *World Development Indicators* and the IMF's *International Financial Statistics*. The length of the data series, covering the period from 1990 onward, was kept short deliberately to capture relatively more recent developments in the five countries.[28] We start obtaining regression results for the sub-sample covering the

[27] Only a few other studies have developed methods to derive the preference parameter (c_i), e.g., Krause and Mendez (2005), Cecchetti, McConnell and Perez-Quiros (2002) and Favero and Rovelli (2003).

[28] The prolonged civil war in Uganda until the late 1980's makes these data unreliable around this period. Also in the 80's, Tanzania underwent transition from a socialist regime to a market economy. Furthermore, the three EAC countries have steadily moved from high inflation regimes in the late 1980's towards lower inflation through the nineties.

period up to 2000. Then these are rolled, one year at a time, to obtain a series for the trade-off and preference parameters. For example, the first regression for Kenya covers the sub-period 1990 to 2000, the second regression 1991 to 2001, and so forth. These rolling regression results are used to obtain the variances and covariances for the preferences parameter.

Next, with the same data series we identify the output shocks faced by the East Africa countries using the approach in Bayoumi and Ostry (1997). In particular, we regress the growth of real output (in logs) on its two lags. The residuals from this regression are taken to represent the underlying output disturbances.[29] This allows us to estimate the variances $\sigma^2_{\varepsilon_i}$ and $\sigma^2_{\bar{\varepsilon}_{-i}}$ and the covariance $\text{cov}(\varepsilon_i, \bar{\varepsilon}_{-i})$ of the shocks for each country. Finally, the weights (w_i) are obtained from a four year average (from 2000 to 2003) of the real GDP in U.S. dollars. We also try out alternative weights such as equal weighting of all member countries.

Results

Table 14 shows the summary results for the various coefficients required to estimate the net welfare (3.7) for each of the five countries. The Table lists results for two scenarios. The first case is when the three core EAC countries (Kenya, Tanzania and Uganda) form a monetary union on their own and the second scenario is when all the five EA countries join in the union.

The first row of Table 14 shows the estimated values for the marginal output gain from unexpected inflation (b). These are obtained as in (D7′) of appendix D. The values of b do not differ much among the countries ranging from around 0.1 to less

[29] We also use the supply shocks from Buigut and Valev (2005) decomposed using the identification framework of Blanchard and Quah (1989) and Bayoumi and Eichengreen (1992). The output shocks obtained from this method turn out to be only slightly smaller but otherwise give the same results.

than 0.2. The second row of Table 14 shows the average output preference parameters ($\overline{c}_i$) for the EA countries. These values reflect the weight placed on output stimulation relative to inflation. It is striking how different these preferences are among the EA countries. Uganda, and to a lesser extent Tanzania, places much higher weight on output relative to inflation compared to the other EA countries. Furthermore, row three in Table 14 shows that Uganda and Tanzania exhibit a much greater variation of their output preferences compared to the other three countries. The tolerance for high inflation (high $\overline{c}_i$) along with the high variability of the preferences for inflation (high $\sigma^2_{c_i}$) for Uganda and Tanzania suggest that these two countries are likely to gain from monetary union since they would face less inflation uncertainty in a monetary union than under autonomy. The fourth row of Table 14 shows that the output shocks are substantially smaller compared to the shocks to preferences for each of the EA countries, i.e., most of the economic fluctuations in these countries are the result of policy shocks rather than output shocks. Therefore, the benefit of implementing more stable policies in a monetary union may outweigh the costs of losing independent monetary policy.[30]

[30]Debrun, Masson and Pattillo (2005) found that in West Africa differences in the governments' financing needs dominate the welfare function over the supply shocks. This suggests that policy shocks are more important in developing countries. A supra-national institution (a common central bank) would therefore be beneficial if designed to promote commitment to sound macroeconomic policies.

Table 14. Estimates of Model Parameters for East Africa

Country	Burundi	Rwanda	Kenya	Tanzania	Uganda
b	0.194	0.191	0.099	0.133	0.098
$\bar{c}_i$	0.559	1.288	1.161	3.1741	6.585
$\sigma^2_{c_i}$	0.0290	2.9211	0.1230	5.1977	19.0588
$\sigma^2_{\varepsilon_i}$	0.0017	0.03965	0.0005	0.0002	0.0002
		Three-Country Union: Kenya, Tanzania, Uganda			
$\bar{c}_{-i}$			4.5085	3.3025	2.2164
$\sigma^2_{c_{-i}}$			8.7337	3.0379	1.3030
$\mathrm{Cov}(c_i, c_{-i})$			0.3428	3.1674	4.3030
ρ_c			0.331	0.797	0.863
$\sigma^2_{\varepsilon_{-i}}$			0.0001	0.0003	0.0002
$\mathrm{Cov}(\varepsilon_i, \varepsilon_{-i})$			0.0001	0.0001	0.00007
ρ_ε			0.415	0.345	0.029
	Five-Country Union: Adding Burundi And Rwanda				
$\bar{c}_{-i}$	3.12	3.19	4.03	3.00	2.09
$\sigma^2_{c_{-i}}$	2.6777	3.2147	5.8243	2.0018	0.8041
$\mathrm{Cov}(c_i, c_{-i})$	-0.1423	-2.1298	0.2835	2.4106	3.4285
ρ_c	-0.510	-0.695	0.335	0.747	0.876
$\sigma^2_{\varepsilon_{-i}}$	0.0004	0.0001	0.0005	0.0006	0.0006
$\mathrm{Cov}(\varepsilon_i, \varepsilon_{-i})$	0.00002	0.0003	0.0001	0.0002	-0.0001
ρ_ε	0.029	0.121	0.271	0.515	-0.285

Looking at the remaining results in Table 14, notice that the correlations of the preferences shocks (ρ_c) across the three EAC countries (Kenya, Tanzania, and Uganda) are positive. However, the covariances $\mathrm{cov}(c_i, c_{-i})$ are not particularly large. For the remaining two countries, Burundi and Rwanda, the correlations of the preferences shocks are actually negative. Therefore, overall a monetary union may provide a useful instrument for checks on the pressures to raise inflation in individual countries.

The net welfare effects of a monetary union are presented in Table 15. We give the results when only the 3 EAC countries form a monetary union and when all the five EA countries join in the union.

Table 15. Net Welfare from Monetary Union in East Africa

	GDP weights	Equal weights
	Three-country union: Kenya, Tanzania, and Uganda[a]	
Kenya	-0.095	-0.111
Tanzania	0.010	0.010
Uganda	0.380	0.348
	Five-country union: Adding Burundi and Rwanda[b]	
Burundi	-0.107	-0.075
Kenya	-0.093	-0.131
Rwanda	-0.084	-0.057
Tanzania	0.031	0.035
Uganda	0.463	0.469

[a] The weights are (0.392, 0.370, 0.238) for the three-country union respectively; [b] weights are (0.024, 0.357, 0.067, 0.336, 0.216) for the five-country union respectively.

We also show the results of two scenarios regarding the decision making in the union. In the first case, the power exercised by each country is proportion to its economic size (GDP). In the second case, all countries exercise equal weights in the union.

The net welfare effect of monetary union differs across the five countries. In all scenarios Uganda and Tanzania benefit from the union whereas Kenya, Burundi, and Rwanda seem to lose from a monetary union.[31] Table 16 provides further insight into these results. The Table decomposes the net welfare (3.7) into three effects: the

[31] Since b is assumed similar across the countries, we use a weighted average of 0.125 for the three EAC countries and 0.135 for all the five countries. The results in Table 15 are robust to changes in the values of b and η. Changing the value of b has no effect on the signs of the results for the countries that show negative net gain. It only changes the magnitude of the loss. However, for Uganda and Tanzania, very small values of b (less than 0.0024 and 0.0096 in the three-country case and less than 0.0036 and 0.0076 in the five-country case respectively) turn the positive net welfare gain in Table 2 into a negative net gain. Compared to the estimated values of b (0.098 and 0.133 respectively) these are quite small. Changing the value of η increases the loss from supply shock asymmetry. However, the values of η needed to change the sign for the net gainers is large; greater than 13.1 and 53.1 in the three-country case and greater than 17.9 and 37.8 in the five-country case respectively. Finally, increasing the weight exercised by a country in the union decreases the net welfare loss for the countries that are net losers, and decreases the net gain for the net gainers.

effect of the correlation of the shocks to preferences, the effect of the correlation of the shocks to output, and the effect of differences in the average output preferences across the countries. Essentially, the Table provides the estimated numerical values for the three lines in equation (3.7). Summing up the numbers from one row in Table 16 gives the overall net gain in Table 15.[32] Decomposing the net welfare allows us to investigate which of the effects influence it most strongly. The results are for the case of GDP-weighted decision making in the monetary union.

Table 16 shows that the most important factor determining net welfare are the strong preferences for output stimulation in Uganda. This shows in the third column of Table 16 where the value for Uganda is positive and large indicating that Uganda would benefit from a monetary union with countries that display stronger aversion to high inflation. Conversely, most of the remaining countries would lose from a monetary union with a country that has a relatively poor inflationary record.

Table 16. Decomposing the Net Welfare Gain from Monetary Union in East Africa

	Preference shocks	Output shocks	Mean preferences
	Three-country union: Kenya, Tanzania, and Uganda[a]		
Kenya	-0.0257	-0.0008	-0.0695
Tanzania	0.0141	-0.0001	-0.0041
Uganda	0.1228	-0.0001	0.2572
	Five-country union: Adding Burundi and Rwanda[b]		
Burundi	-0.0231	-0.0009	-0.0829
Kenya	-0.0223	-0.0002	-0.0705
Rwanda	0.0035	-0.0171	-0.0707
Tanzania	0.0243	-0.0001	0.0064
Uganda	0.1514	-0.0003	0.3122

[a] The weights are (0.392, 0.370, 0.238) for the three-country union respectively; [b] weights are (0.024, 0.357, 0.067, 0.336, 0.216) for the five-country union respectively.

[32] For example, the net gain from monetary union for Uganda is 0.1228 – 0.0001 + 0.2572 (in Table 16) = 0.38 (in Table 15).

Table 16 also highlights the importance of the correlation of the shocks to preferences that is the main focus of this paper. Consider the case of Tanzania as an example. If the net benefit from a monetary union for Tanzania was determined only considering the cost of losing monetary policy (value -0.0001 in the second column of Table 16) and the "imported" credibility argument (value -0.0041 in the third column of Table 16) the overall net gain for Tanzania would be negative (-0.0001-0.0041 = -0.0042). Adding the consideration of checks on individual countries' policies by the union (value 0.0141 in Table 16) reverses this result into a positive net gain of 0.010.[33]

Conclusions

This paper studies the implications of uncertainty regarding the central banks preferences for monetary union. We develop a model where the preferences of the central banks of potential member countries in a monetary union are subject to shocks (such as unexpected pressures to accommodate government objectives). We find that the net gain from monetary union for a country is greater if it joins in a union with other countries that have greater credibility for low inflation; if its output shocks are more highly correlated with those of the other union members; and if the shocks to its central bank's preferences are correlated less with those of other member countries. The latter result occurs because the supranational central bank is able to even out the preference shocks across the member countries. While the literature has discussed the first two effects, it has not identified the third one.

[33] Monetary union among the EA countries is not likely to produce a strong currency, and would likely require stabilization against major currencies. The euro has been suggested by a number of authors (Honohan and Lane 2000; Buigut and Valev 2005) as the most appropriate currency for an anchor. Though this is not the theme of our discussion here we do estimate the welfare effect of anchoring an EA currency to the euro. Our analysis shows that the net welfare for all the five countries is positive when the EA currency is linked to the euro.

We use data from East Africa to calibrate the model and to estimate the expected gains from forming a monetary union in the East African Community. Such a union has been proposed and steps are being made for its implementation in the near future. Yet, not much economic analysis has been carried out to inform these policies. We find that two of the EA countries: Tanzania and Uganda will benefit from a monetary union whereas the remaining three countries Burundi, Kenya, and Rwanda will lose.

Clearly, there are additional considerations when discussing the potential benefits of an EAC monetary union. Nonetheless, our calibrations serve to highlight the importance of taking into account the shocks to central bank preferences when investigating the gains from monetary unions among developing countries. The model presented here or an expanded version that includes, for example, fiscal policy or multiple periods can be applied to other groupings of developing countries that have considered monetary union in other parts of Africa such as the SADC, in Latin America (MERCOSUR), or the transition countries of Eastern Europe.

Essay Four: Prospects for an East African Community (EAC) Monetary Union

Introduction

Monetary cooperation initiatives in independent East Africa go back to the East African Currency Board (EACB) arrangement that existed prior to independence. This was a continuation of a broader economic coordination scheme set up by the British colonial power in the three East African countries: Kenya, Tanzania, and Uganda. The board arrangement was backed by the sterling pound and in practice each country held a veto over the EACB decisions (Guillaume and Stasavage 2000). Following the collapse of the EACB in 1966, each country introduced its own currency and soon thereafter abandoned the peg to the sterling pound. This was followed by the collapse of the EAC in 1977. The collapse of the old EAC has been attributed to a number of factors (Goldstein and Ndung'u 2001; Masson and Pattillo 2005), key among them: (1) Differences relating to the distribution of benefits. Primarily Uganda and Tanzania felt that Kenya (the most industrialized of the three countries) benefited more from the arrangement and that the compensation mechanisms put in place to address the issue were not successful; (2) Ideological differences, with Tanzania and to a lesser extend Uganda leaning towards a more socialist path and Kenya towards a capitalist path, which led to divergent economic management and political distrust.

The consequence of the collapse was that the assets of the old EAC were divided up. However, even during this period, the leaders of the three countries agreed on the need for future cooperation. The heads of the partner countries thus signed into the asset division mediation agreement a provision that allowed for the revival of the cooperation in some future time. This new effort was formalized with the

establishment of the Permanent Tripartite Commission for East African Cooperation in 1993 which became operational with the launching of the East African Secretariat in 1996. In 1999 a treaty for the Establishment of an East African Community was ratified by Kenya, Uganda, and Tanzania[34] and came into force in July 2000 with the objective of fostering a closer co-operation in political, economic, social, and cultural fields. An East Africa Customs Union protocol was signed in March 2004. A Common Market, a Monetary Union, and ultimately a Political Federation of East Africa states are planned.

Overall, an EAC monetary union seems viable. However, it is essential that the EA economies continue their efforts at achieving economic convergence. Furthermore, a discussion about the institutional framework of the union, the timetable for integration, and the legal background of the union has to take place. All of those would be facilitated by the creation of a supranational institution, an East Africa Monetary Institute, to coordinate the process of monetary union. We elaborate on these points in the rest of the chapter which is structured as follows. Section 2 discusses the political and ideological developments in EA, while Sections 3 and 4 analyze the economic benefits and costs of monetary union. Section 5 raises the possibility that the benefits of integration in EA may increase even further once the common currency is introduced. Section 6 discusses the recent achievements of the EA countries in lowering inflation and nominal interest rates. In Section 7 the framework for a monetary union is discussed and Section 8 suggests the way forward. A conclusion is provided in Section 9.

[34]The two neighboring countries, Rwanda and Burundi, have applied to join and the expectation is that they will be admitted soon. Their admission is basically dependent on the state of security in these countries affected by civil war in the mid nineties. There has been significant improvement in stability over the recent years. They are included in the study.

Political and Ideological Convergence in EA

Economic integration is as much a political phenomenon as an economic one, if not more so. Integration is invariably seen as a way to achieve security and bargaining power and as a commitment mechanism for trade and other policy reform measures (World Bank 2000). A leading recent example is the creation of the European Monetary Union (EMU) which is mainly a political construct (Eichengreen and Frieden 2001; Feldstein 1997). The EMU went ahead even though studies were not conclusive that these set of countries formed an optimum currency area (OCA). Similarly the development and the preservation of the CFA zone in West Africa was mostly political. The zone's persistence has been attributed to the preferences of transnational French and African political and administrative elites for preserving the monetary union as a mechanism of political stability for Francophone African regimes (Stasavage 2003; Zhang, Sato, and McAleer 2004). Compared to the Franc zone (that has survived) the old EAC fulfilled more of the OCA criteria in terms of greater intra-regional trade and labor mobility. However, the same level of transnational contacts was not maintained in Anglophone Africa as in Francophone Africa (*ibid*), which helps explain why the monetary link to the sterling pound failed.

The collapse of the old EAC in the 70s and its reemergence in the 90s was largely political. Though asymmetry in the distribution of benefits of integration was at the root of the economic problems faced by the old EAC, ideological differences led to a particularly uneasy political climate at the time. Barely a year after the break-up of the EAC this tension degenerated into a border dispute leading to the (1978 to

1979) Tanzania-Uganda war.[35] It is thus no wonder that the political establishments of the time could not tolerate the imbalances of the EAC, nor had the patience to try and work things out.

Developments since then have made integration more appealing politically. The end of civil war in Uganda ushered in a change of regime in the mid eighties. This brought relative stability in the country. The failure and subsequent abandonment of *Ujamaa*-socialism in Tanzania has also permitted this country to move towards a more market-oriented path. The collapse of the Soviet Union and the introduction of economic reforms as a donor conditionality served to accelerate this process. Thus while the old EAC emphasized joint ownership and management of common services, the new strategy for cooperation emphasizes the role of the private sector and civil society. Another impetus for renewed effort at closer integration is the current prevalent view that Africa is increasingly being marginalized (Collier 1995). It is also the region most fragmented into small economies – a legacy of its colonial past. Integration schemes are seen as a way to improve bargaining power at such forums as the WTO and to enable them to cut better deals (ECA 2004; World Bank 2000).

Three issues are therefore likely to help foster closer integration in the EAC; (1) Increasing intra-regional trade and liberalization has underscored the importance of cross-border contagion from bad economic polices (Goldstein and Ndung'u 2001). Thus countries in the region are increasingly more interested in cross-border stability and good economic policies; (2) The growth of regional blocs around the world also means that regional cooperation in Africa is seen as a necessary counter-weight; (3) The collapse of the ideological divide in the region has ushered in political convergence and a measure of goodwill. It is this political accord at the top that has

[35] This led to the overthrow of Uganda's president Idi Amin, and the installation of Yusuf Lule as president. However peace eluded Uganda till Yoweri Museveni and his national resistance army (NRA) toppled Tito Okello's government and assumed control in January 1986.

propelled the EAC. Participation from the civil society and the electorate has so far been minimal.[36]

Some studies (Goldstein and Ndung'u 2001; Masson and Pattillo 2005) suggest that the existence of and the membership of EA countries in other competing integration schemes (i.e., SADC and COMESA) could act as exit options and make the EAC more fragile. However, it should be pointed out that these institutions are not close substitutes for the EAC. The objectives and the time frames to achieve the stated objectives are different. The EAC treaty offers, at least in theory, deeper economic and political integration options (ultimately a federation) than the others—in a shorter time frame. The group dynamics (cultural, language, and economic convergence) are more diverse for SADC and for COMESA, making negotiations and agreements harder on all fronts. Lack of progress in COMESA and to a lesser extent in SADC has been an issue. Furthermore, the EAC countries will have less influence in these larger entities.

These partially explain why the new EAC emerged when all the three EAC countries were members of COMESA and Tanzania was also a member of SADC at the time. Since then Tanzania has pulled out of COMESA in 2000. Rather than look at the SADC and COMESA as alternatives, the EAC could act as a bench-mark in the larger framework if they could stay ahead in the integration process. This way the EAC could play the role of a monetary union nursery and have more say in shaping the direction of COMESA like the Rand zone is doing in the SADC. Nonetheless, the fact that there are other options just might allow for more sobriety in the negotiations and decisions within the EAC. The real danger to the EAC, we believe, still comes from the political landscape – the ability to sustain the still fragile political cohesion

[36]It is only in the Third EAC Development Strategy (2006-2010), currently under preparation, that consultation and sensitization of the people of East Africa on the political federation is expected to be launched.

and to set up adequate structures for efficient functioning of the community. However, a monetary union would have enormous economic consequences for the EAC countries. These are discussed in the next two sections.

The Economic Benefits of Monetary Union in East Africa

Intra-Regional Trade

In a monetary union the transaction costs of currency exchange and the uncertainty arising from exchange rate fluctuations between the member states are eliminated. More bilateral trade thus means greater benefits. Intra-regional trade in EA is still relatively low, but has been increasing with intra-regional exports rising from 6% in 1991 to 16% in 2001 and imports rising from 2.7% to 10.55% respectively (McIntyre 2005). This compares well with the level of trade in the ECOWAS, SADC, and is slightly less than trade in SACU (Masson and Pattillo 2005). Table 17 shows that trade relations in the region are quite asymmetric. In 2004, the region absorbed 22% of Kenya's and 23% of Uganda's exports. Uganda is the single most important market for Kenyan goods while Kenya is the largest destination for Uganda's goods within the region. Burundi and Rwanda also receive a large proportion of their imports (30% and 32% respectively) from Kenya.[37]

Ackello-Ogutu and Echessa (1998) indicate that unrecorded trade is substantial in EA reaching 58% of total trade (recorded and unrecorded trade) between Tanzania and her neighbors for the 95/96 period. Ackello-Ogutu and Echessa (1997) estimate an even higher value (157%) for informal trade between Kenya and

[37] Manufactures are important in the intra-regional trade. For example, McIntyre (2005) estimates that 11.5% of Kenya's imports from Uganda and 43.4% of its imports from Tanzania were manufactures in 2001. For Uganda, 33.8% of its imports from Kenya and 71.3% of its imports from Tanzania were manufactures. Expansion of intra-regional trade is therefore crucial for the manufacturing sectors.

Uganda during 1995. When this is taken into account intra-regional trade becomes a significant and growing aspect of EA relations.

Table 17. Trade Relations (Exports and Imports) of EA Countries (2004)

	Burundi		Kenya		Rwanda		Tanzania		Uganda	
	exp	imp	Exp	imp	exp	imp	exp	imp	Exp	imp
Burundi			0.83[a]	0.00[b]	0.23	0.65	1.74	0.00	1.98	0.00
Kenya	0.08	13.64			0.08	24.37	4.65	5.39	15.42	32.31
Rwanda	5.93	0.44	3.26	0.01			0.51	0.00	4.09	0.05
Tanzania	0.08	11.14	4.44	1.15	0.02	1.49			1.15	0.98
Uganda	2.07	5.60	13.17	2.01	0.17	6.33	1.02	0.29		
Africa	9.92	37.89	33.94	13.66	1.30	38.97	19.15	24.91	30.03	42.08
Industrial Countries	49.16	49.05	43.16	35.97	7.90	29.66	42.61	31.53	49.65	31.29

Source: Calculated from Direction of Trade Statistics (2005).
Note: [a)] 0.83% of Kenyan exports go to Burundi; [b)] 0% of imports come from Burundi.

Furthermore, McIntyre (2005)and Busse and Shams (2003) show that the recent customs union will boost intra-region trade even further.[38] Thus potential benefits from reduced transaction costs and reduced exchange rate risks could be significant and increasing. Outside the EAC, the European Union is the region's main trading partner as a major destination for the EA's primary products.

Credibility from Agency of Restraint

An important benefit of monetary union that has received prominence recently is the credibility argument. Monetary union creates the potential for some countries to import credibility from countries with greater reputation for more prudent monetary policy (Herrendorf 1997; Ozkan 1994). However, all of the EA countries lack a

[38] The EAC customs union protocol is based on a three-band 0-10-25 percent (for raw materials, intermediate products and finished goods respectively) common external tariff over the next five years. However the removal of internal tariffs recognizes existing asymmetry in development among partner countries and requires the relatively more developed partner (Kenya) to open up faster. In turn the other two countries will phase out internal tariffs on a list of selected Kenyan goods over a period of five years (Masson and Pattillo 2005; McIntyre 2005). This list was a major sticking point in the negotiations and is one more indication that the success of the integration process will ultimately depend on the ability of the region to sustain the political goodwill.

history of stable prices with none clearly superior in this regard. None of them can therefore take the role of an anchor. Therefore unless such a union is linked to an external anchor not much improvement in credibility can be expected.

However, another argument for improved credibility more relevant to the EAC case (and developing countries generally) arises from the formation of a supranational monetary authority or a common central bank (CCB) acting as an agency of restraint. Monetary mismanagement in most African countries offers a strong case for the delegation of monetary policy to a suitable supranational monetary authority (Honohan and Lane 2000; Masson and Pattillo 2005). In EA, although monetary policy in the recent past has been better than in most other countries in the region, the conduct of monetary policy has often been subject to political interference. When monetary policy is ceded to a common central bank, the influence of any single government on the common central bank would be less than in the case of national central banks. This could enhance its independence and its ability to resist pressure for monetary financing (Buigut and Valev 2006; Masson and Pattillo 2005) forcing governments to adhere to more sound fiscal policy as well.

Other Benefits

In addition to reducing the cost of regional trade and promoting the prudence of monetary policy, a monetary union might lead to greater foreign direct investment. Larger markets within the union and better economic policy would create a more attractive climate for private investments. Regional cooperation on public goods such as shared resources, e.g., water basins, fisheries, and infrastructure, could lead to better utilization. McIntyre (2005) has noted that there is a lot of scope for cooperation in these areas, with the support of multilateral, bilateral and regional

donor agencies. Furthermore, a monetary union reduces the need to maintain large liquid foreign exchange reserves that can be redirected to generate greater returns. Finally, pegging the exchange rates would help reduce relative price volatility (Gandolfo 2001) as all of the EAC countries are relatively open economies (see Table 18).

Table 18. Total Exports, Imports and Degree of Openness (Percentage) For EA Countries

Year		1998	1999	2000	2001	2002	2003
Burundi	Exports	8	9	9	6	8	7
Kenya	,,	25	25	26	26	27	25
Rwanda	,,	6	6	8	9	8	9
Tanzania	,,	14	13	14	16	17	18
Uganda	,,	10	12	11	12	12	12
Burundi	Imports	20	18	24	18	22	18
Kenya	,,	33	31	36	36	28	29
Rwanda	,,	23	23	24	25	25	28
Tanzania	,,	28	26	23	25	25	27
Uganda	,,	21	24	23	24	27	26
Kenya	openness	57	57	62	62	55	54
Rwanda	,,	29	29	33	34	33	36
Tanzania	,,	42	40	37	41	42	46
Uganda	,,	30	37	34	36	38	39
Burundi	,,	28	27	33	25	29	25

Source: Calculated from WDI (2005); Note: Openness is calculated as (Ex+Im)/GDP

The Cost of Monetary Union─Loss of Independent Monetary Policy

The major cost of monetary union is the loss of independent monetary policy. The member countries of a union have a common central bank and the same monetary policy applies to the entire union. This could be a problem if the business cycles of the member countries are not similar. A one-size-fits-all policy would not be suitable simultaneously for, say, Kenya which might be experiencing a recession and Tanzania which might be experiencing an expansion. Hence, in theory, only countries with

similar business cycles (i.e., with positively correlated economic shocks) are good candidates for a monetary union.

However, as Mundell (1961) explains the similarity of business cycles is less important if there is sufficient labor mobility among the countries so that the flow of people (from the recession country to the expansion country) can equalize economic conditions. Similarly, adjustment can be achieved if wages are flexible so that economic activity would shift to the recession country where wages have declined because of high unemployment. Finally, fiscal transfers between the countries (from the expansion country to the recession country) can help equalize economic conditions. How do the EAC countries score on these counts?

The Similarity of Economic Fluctuations

Some studies that have looked at the correlation of shocks in EA suggest qualified optimism. Using a Generalized purchasing power parity (G-PPP) model, Mkenda (2001) finds that the real exchange rates of the EAC countries are cointegrated for the period 1981-1998. Using a VAR model, Buigut and Valev (2005) decompose and analyze the supply and demand shocks for the EAC (Figures 3).

Figure 3. Demand and Supply Shocks for EA Countries (1973 to 2001)

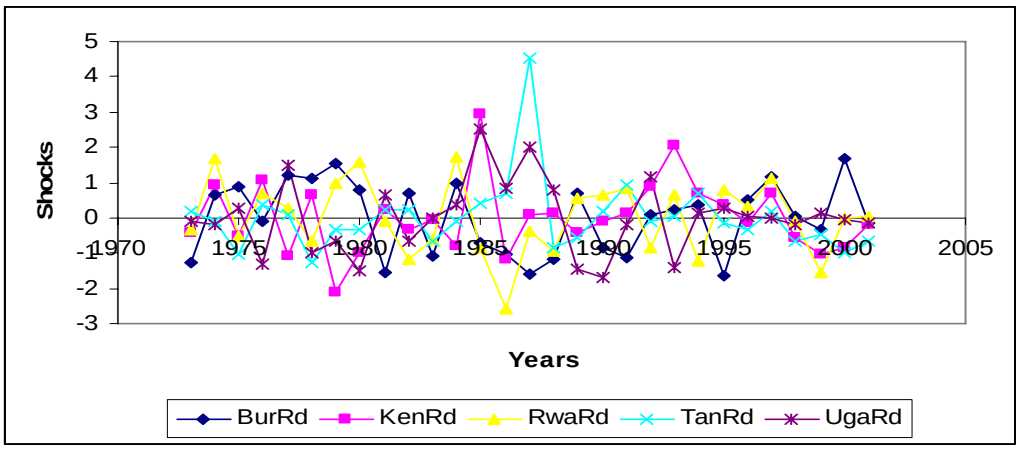


Figure 3 a). Demand Shocks for EA Countries (1973 to 2001)

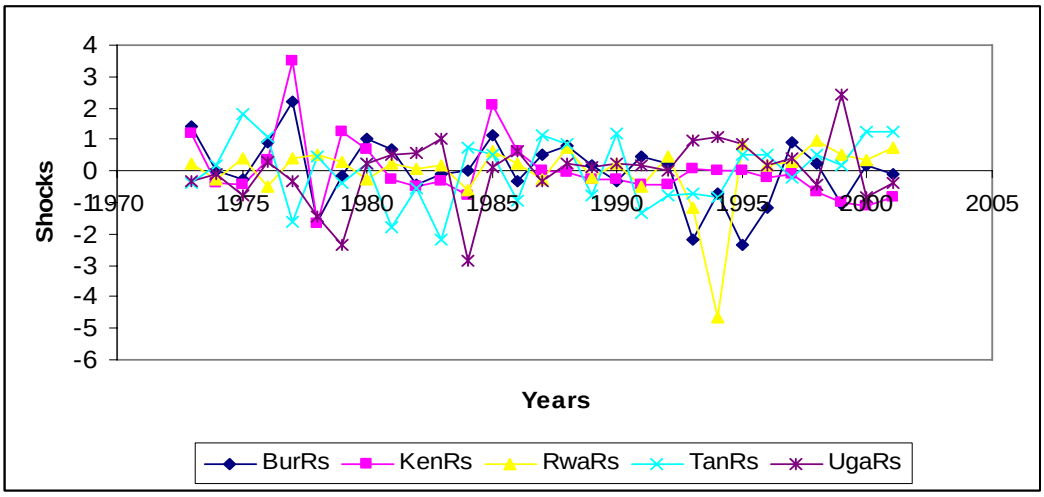


Figure 3 b). Supply Shocks for EA Countries (1973 to 2001)
Source: Buigut and Valev (2005), World Development 33(12).

Overall, the correlations of the supply shocks across the EAC countries indicate asymmetry which could be attributed to their reliance on different primary products that are subject to varying international price shocks. Conversely, the demand shocks show a decline in volatility after the mid nineties and a weak positive correlation related to trade patterns. Furthermore, the impulse response functions to shocks are similar across the five countries.

Labor Mobility and Wage Flexibility

The costs associated with asymmetry of economic shocks would be lower if labor is mobile between countries and/or wages are flexible to allow for adjustment when the exchange rates are fixed. Labor mobility in the region and in general in Africa is believed to be high (Adepoju 2001). However, EA does not have free flow of labor yet. The existing EAC passport allows holders free travel within the community but it is not a substitute for a work permit. Individuals still need a work permit to be employed legally in another EAC country. Although labor mobility is a

sensitive issue given the high level of unemployment, the EAC is currently negotiating a protocol[39] on the free movement of persons, labor, and services. Its adoption will hopefully pave way for more cross-border labor flows. Shared languages and many cross-border communities are expected to help mobility once a framework on labor is in place.

The African labor markets generally have a dual labor market structure, with the formal sector being more rigid than the informal sector (Kingdom, Sandefur, and Teal 2005). The EA countries have wage laws with varying degrees of enforceability. For example, in Kenya strong union structures in the formal sector have succeeded in raising real wages after a period in which inflation eroded real wages (IMF 2003). However the informal sector, not covered by unions, has grown rapidly because of the failure of the formal sector to keep up with the growth in the labor force. High and growing unemployment is another source of downward pressure on wages.

Fiscal Transfers

An alternative way of adjustment when monetary policy is not available is through a social insurance scheme. A centralized budget or scheme for compensatory fiscal transfers across affected countries would alleviate the effects of differential shocks. However, this is not a viable option for the EA countries given their level of development. Another restraint is that the EA countries have high debts, which constrains fiscal adjustment at the national level.

[39] The first meeting of the EAC high level task force (HLTF) took place March 2006. The targeted time-frame for completion is two years. Adoption of the protocol will upgrade the EAC customs union to a common market.

Endogeneity of the Optimum Currency Area Criteria

From an economic perspective, countries considering monetary union will weigh the benefits of integration related to lower transaction costs in bilateral trade and improved monetary policy credibility and the cost associated with foregoing monetary policy to dampen business cycles discussed in the previous two sections. However, using historical data to evaluate these criteria (as we did in the previous two sections) could be limiting in the sense that they are backward looking. Historical data do not reflect the switch in the policy regime (Mongelli 2005). Frankel and Rose (1998) have suggested that the conditions for evaluating whether a group of countries is a good candidate for monetary union (i.e., if the countries form an Optimum Currency Area) are endogenous. In particular, the reduced transaction costs could spur trade among countries that had not traded extensively in the past. Furthermore, greater trade links may promote greater synchronicity of business cycles. Thus countries may be better candidates for monetary integration ex-post rather than ex-ante.[40]

Although trade is probably boosted by forming a monetary union, the size of the effect is not clear. A meta-analysis by Rose and Stanley (2005) rejects the hypothesis that there is no effect of currency union on trade. The combined estimates imply that a currency union increases bilateral trade by between 30% and 90%. De Grauwe and Mongelli (2005) estimates that the trade effect of monetary union ranges from a few percentage points to over 100 percent with respect to the EMU. Further evidence is obtained from the CFA zone where Fielding and Shields (2004) find that trade was greater than what would otherwise have been expected without the currency union.

[40] De Grauwe and Mongelli (2005) examine other sources of endogeneity of OCA e.g., endogeneity of financial integration.

The next question is whether greater trade makes the business cycles more similar. From a theoretical perspective the effect of increased trade from integration on cross-country correlation of business cycles is ambiguous. It is possible that reduced trade barriers could lead to more specialization according to comparative advantage and therefore more asymmetry (Krugman 1993). Conversely, increased integration may result in more highly correlated business shocks because of common demand shocks and intra-industry trade. De Grauwe (2003) supports this second view, suggesting that although concentration may occur, deeper integration reduces the importance of national borders increasing the likelihood that clusters of economic activity will transgress national borders. Similarly, Fidrmuc (2004) shows that intra-industry trade induces convergence of business cycles in the OECD countries. Higher intra-industry trade indicates that there is scope to realize gains from specialization in differentiated products. However intra-industry trade is more important in developed countries than in developing countries. It is non existent among many African countries, largely due to the fact that exports among African countries are highly concentrated in very similar primary products which limits the gains from exchange (Simuyemba 2000). Therefore, although some increase in trade is predicted for EA from deeper integration it is not clear what will be the effect on business cycle convergence.

Besides a trade channel, Artis (2003) argues that eliminating independent monetary policy can further increase the similarity of business cycles across countries since idiosyncratic policy is a prime source of idiosyncratic shocks. With a common monetary policy this source of idiosyncrasy would disappear. This probably will be an important benefit for EA where executive interference in monetary policy is substantial. This argument would be in line with the view raised in the literature

(Guillaume and Stasavage 2000) that common central banks could act as agents of restraint in Africa. This is because African countries have generally lacked checks and balances in their political institutions that are necessary for the conduct of credible monetary policy at the national level.

A Look at Some Convergence Criteria

To achieve stable monetary union member countries need to follow national policies that will ensure credibility and durability of the union. Evidence for such policies must exist before forming the union. Essentially, this requires relatively small budget deficits and low levels of government debt. Getting public finances in order helps achieve prudence in monetary policy evidenced by low inflation and relatively low nominal interest rates. This helps stabilize nominal exchange rates so that the transition to irrevocably fixed rates in the union is smooth. Has such convergence occurred in EA?

Public Finances

Figure 4 shows that Kenya and Tanzania have relatively low budget deficits (less than 5% of GDP) when the deficit is defined to include grants. If, however, grants are excluded on the grounds that they have been unreliable and therefore a source of shocks, then Kenya is the only country with a relatively small budget deficit. The other countries need to lower their deficits.

Figure 4. Budget Deficits (% of GDP)

Figure 4(a): Budget Deficit when Grants are Included (Percentage of GDP)

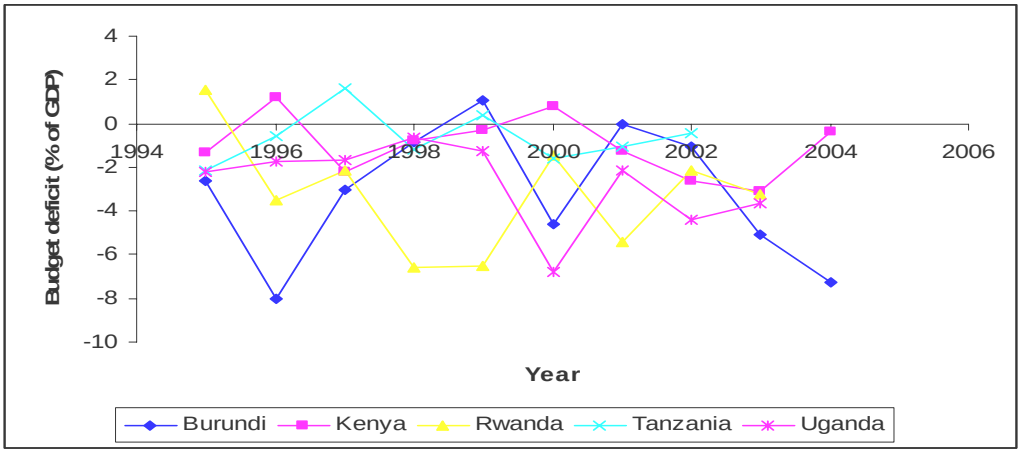
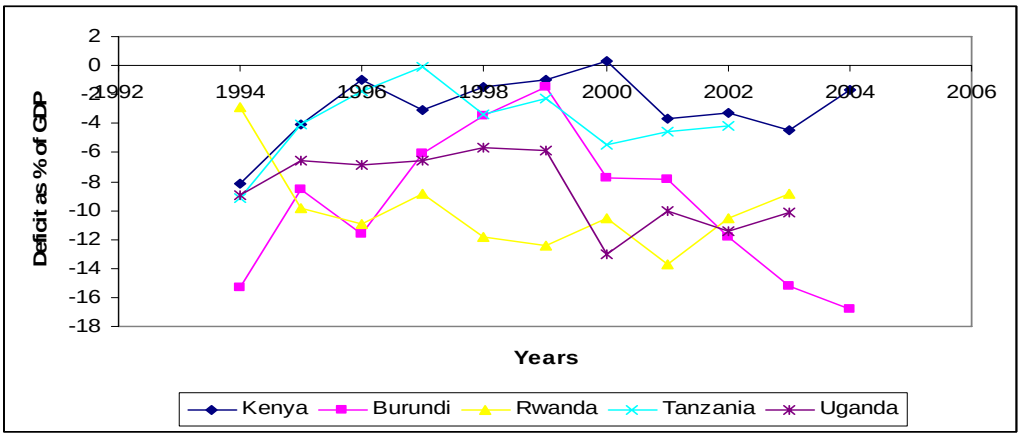


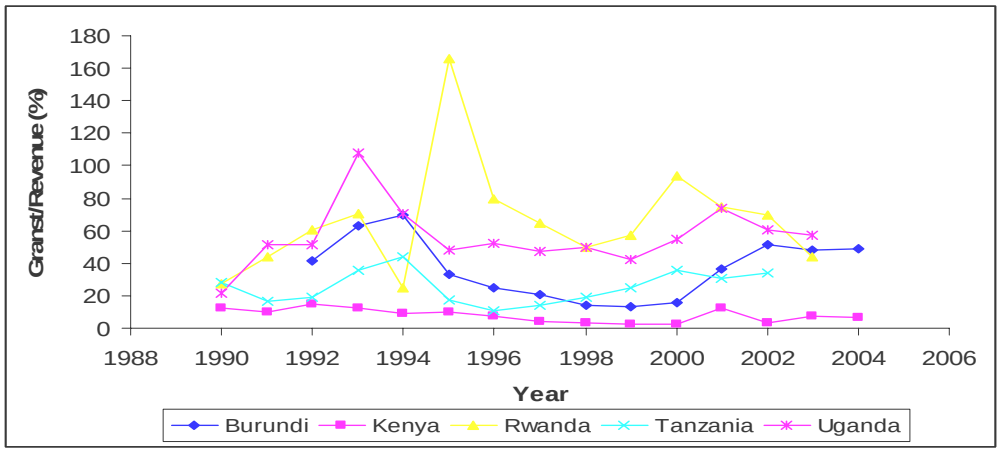
Figure 4(b): Budget Deficit when Grants are Excluded (Percentage of GDP)



Source: Calculated from International Finance Statistics (2005)

Table 19 and Figure 5 further emphasize the aid dependency of the EA countries. Kenya is the only country that relies relatively little on aid, followed by Tanzania. Furthermore, all of the EA countries are relatively highly indebted and most of the debt is external and denominated in foreign currencies. This provides a strong disincentive to using exchange rate policy to respond to economic shocks. Thus the EA countries need to reduce the debt burden in order to reduce the incentives for future inflation and to reduce the limitations on exchange rate policy. A sustained fiscal deficit reduction effort is needed to reduce both the domestic debt and the external debt.

Figure 5 Dependency on External Grants by EA Countries



Source: Calculated from International Finance Statistics (2005).

Table 19. Debt and Aid Dependency (percentage) Indicators for EA Countries (2001)

Debt & Aid	Kenya	Burundi	Rwanda	Tanzania	Uganda
Total external debt/Exports	192.9	1842.7	787.3	451.0	552.6
Total External debt/GNI	51.9	156.8	76.3	71.9	67.4
Total debt service/Exports	15.4	39.8	11.3	10.3	7.4
Total debt/GNI	70	170	86.4	-	73
Domestic debt/Total debt	35	8.3	13.2	-	7.7
Aid per capita	15	19	33	36	34
Aid as percentage of GNI	4.0	19.3	17.3	13.3	14.1
Aid (percentage of cross capital formation)	31.1	274.3	92.7	77.7	40.5

Source: Buigut and Valev (2005), World Development 33(12).

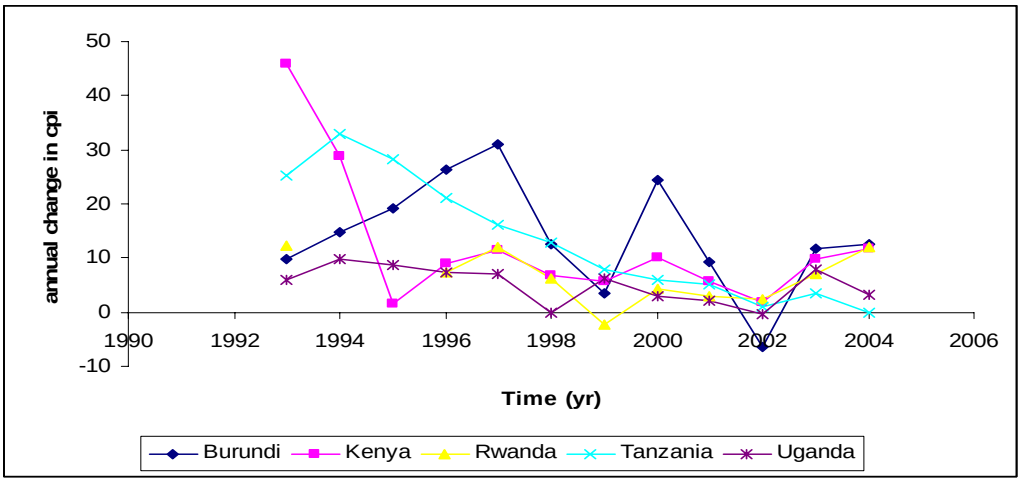
Inflation and Interest Rates

Figure 6 shows a significant convergence in inflation over the last few years. The EA countries have succeeded in reducing inflation to single digits (or close) from relatively high double digits in the early nineties. Tanzania for example has made remarkable achievements bringing down inflation from about 30% in the mid nineties to less than 5% in 2004.[41] The other countries need to do a bit more to achieve their

[41] Some stated macroeconomics convergence targets for The Second EAC Development Strategy 2001-2005, http://www.eac.int/documents/Development%20Strategy.pdf (accessed March 2006) include; Real GDP growth rate of at least 7%; Inflation of less than 5%; Lower ratio of current account deficit; Reduction of fiscal deficit to less than 5%; Maintaining reserves at least 6 months

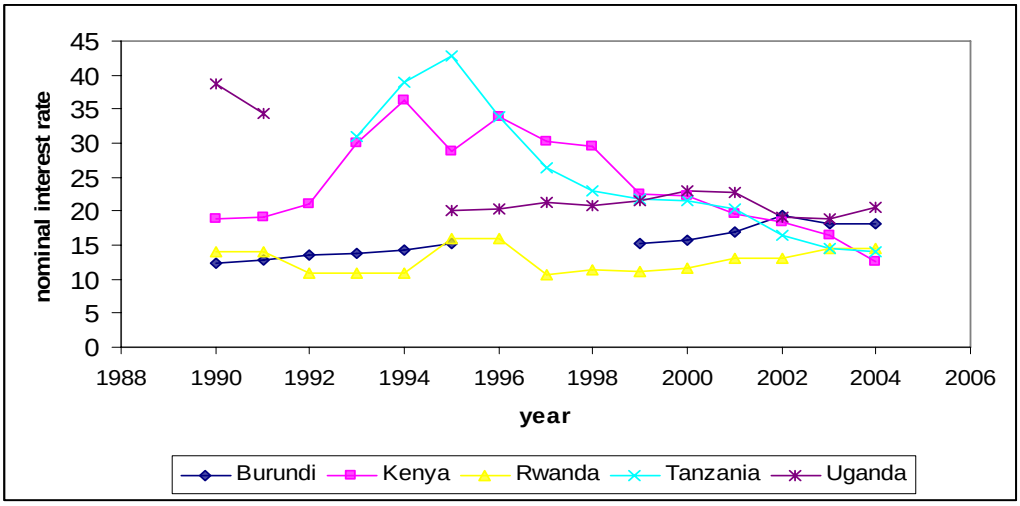
stated goal of 5%. Similarly, Figure 7 shows marked achievement of convergence in interest rates in EA. The nominal interest rates have been declining over the last decade from highs (in the twenties to thirties) in the early and mid nineties converging to around 10%-15% in 2004. Stability, however, remains an issue. The EA countries need to sustain this single digit inflation rates and to reduce the fluctuations.

Figure 6. Convergence of Inflation Rates in EA: Annual Changes in CPI (Base Year 2000)



Source: Calculated from International Financial Statistics (2005)

Figure 7. Convergence of Nominal Interest Rates in EA Countries



Source: International Financial Statistics (2005).

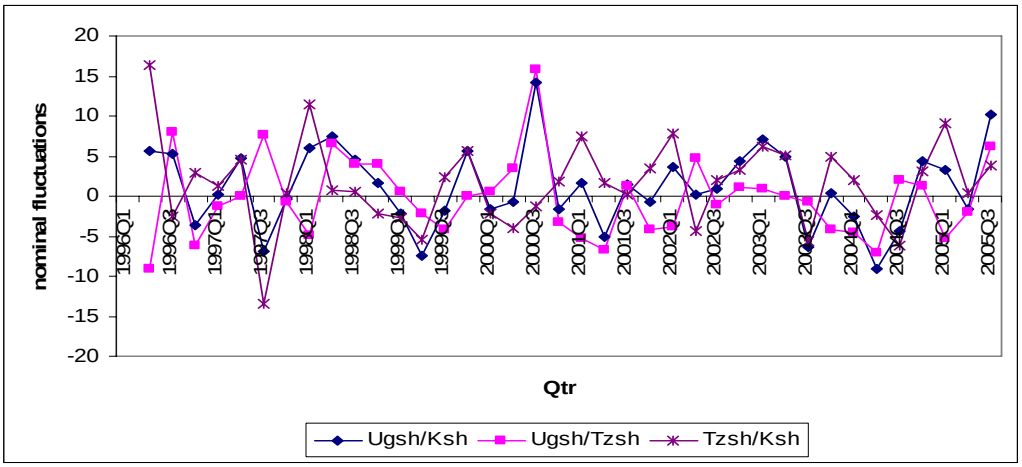
equivalent of normal imports; Scaling up the ratio of domestic savings to GDP of at least 20%; Undertake debt reduction initiatives and maintaining the fiscal burden of serving the external obligations to less than 15%

Note: Lending rates (Burundi, Kenya, Tanzania, and Uganda), Discount rate (Rwanda)

Exchange Rates

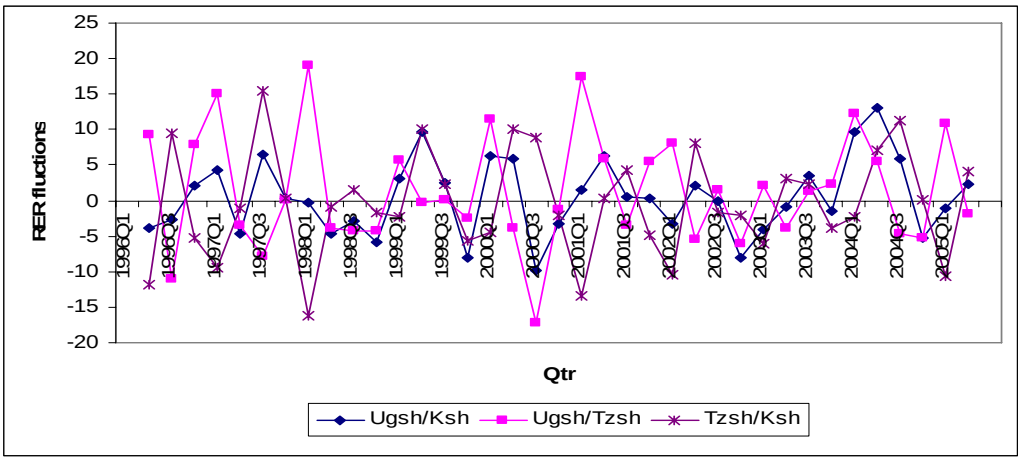
Figure 8 and 9 show that the bilateral nominal and real exchange rates between Kenya, Tanzania and Uganda have been volatile. Hence, it seems that finding a lock-in rate (or tight band of fluctuations) would be hard right now. Another issue is that these currencies are not currently freely floating. They have been defined as independent and managed floats (Masson and Pattillo 2005). This raises the question of what exchange rate the currencies would be allowed to lock-in at. To avoid strategic manipulation, the currencies probably need to be allowed to freely float against major currencies for a while to determine the bilateral lock-in rates. However, currently the "fear of floating" (Calvo and Reinhart 2002) is an incentive for managed float systems.

Figure 8. Quarterly Percentage Fluctuations in the EAC Bilateral Nominal Exchange Rates



Source: Calculated from International Financial Statistics (2005)

Figure 9. Quarterly Percentage Fluctuations in the EAC Bilateral Real Exchange Rates



Source: Calculated from International Financial Statistics (2005)

Overall, the evidence presented here suggests that the EA countries have made important progress in terms of the convergence criteria but still face significant challenges. Formulating explicit goals regarding public finances, monetary policy, and exchange rate policy and getting on a timetable for achieving these goals is essential to keep the monetary union plans on track. But what kind of a monetary framework should the EAC adopt if a monetary union is pursued? The options are analyzed below.

Framework for Monetary Policy in the Union

Peg to the Euro?

A key issue to be handled if a monetary union is instituted is the framework such a system would take to be able to credibly deliver the primary objective of price stability. Due to the region's significant trade and financial links to the EU most studies suggest the euro as an external anchor for the region. Eliminating exchange

rate fluctuations versus the euro may lead to substantial gains. Furthermore, linking the EA currency to the euro would lower inflation and increase the long-term credibility of monetary policy. This probably would be the most important gain, given that the national central banks in the EA countries have not had a good track record of prudent monetary policy management.

There are, however, important considerations against a peg to the euro as well. First, the EAC and the U.K. also have large trade and financial relations that go back to colonial times. So the attractiveness of a link to the euro is undermined if the U.K. stays out of the euro-zone. In addition, some of the primary commodities exported by the EA countries are traded in dollars internationally. Appreciation of the euro could lead to loss of competitiveness of EA products against competing exporters and ultimately to more unemployment in economies already grappling with high unemployment. The experience of the CFA zone in the 1990's is an example of this risk. As Adam, Bevan, and Chambas (2001) and Nashashibi and Bazzoni (1994) describe real exchange rate misalignment was a major factor in the deterioration of fiscal performance in the CFA zone during the second half of the 80s and early nineties. The misalignment arose from cross-rate fluctuations, with the French Franc appreciating against the U.S. dollar. The corrections in exchange rates that often follow such misalignments are associated with a period of turmoil and with tremendous real economic costs (Valesco 2000).[42]

[42] The CFA though pegged to the French franc did not achieve fiscal discipline in the 80s and 90s. The region actually performed worse than the non CFA Sub-Saharan Africa in the mid eighties. Governments pushed state-owned banks to lend to public enterprises (to keep the transactions off the fiscal account). Eventually the unsustainable macroeconomic policy in the CFA led to 50% devaluation in 1994. However, without the support of the French treasury the devaluation would probably have happened much earlier. Thus an external guarantor could have both positive and negative effects on the promotion of fiscal discipline. The positive side is that it provides external surveillance. But there is the potential for moral hazard related to bail-outs and partial funding of fiscal indiscipline (Stasavage 1997). Masson and Pattillo (2002) argues that in this period political interests in France were more interested in preserving the zone and assuring short-term political stability of heads of state than in forcing fiscal adjustment. The same political interests could not support the application of strict rules

A second concern is that economic shocks in the euro-area and in the EAC show very little symmetry (Buigut and Valev 2005). Hence, the monetary policies of the European Central Bank would seldom fit the needs of the EA countries. In addition, in an asymmetric system (anchor-client peg) business cycles in the periphery countries (EAC in this case) are likely to be made more volatile by the pro-cyclical movements of the money stock in the periphery countries (De Grauwe 2003).

It also has to be mentioned that although the euro is oft cited in the literature as the appropriate currency to peg to, this has not received any discussion in the political arena within the EAC. It is not possible to determine at this stage whether the idea of a link to the euro would receive the political goodwill required or nationalism would prevail. This is important since the EAC integration, as stated earlier, is propelled by political dynamics.

Inflation Targeting

If the decision is to create a single currency that would float independently, then right at the outset the principle of independence of the supranational body has to be fully accepted and structures to insulate it from the political system would be needed. To avoid political intrigues transparency would need to be built into the functioning of such an institution. A number of small to medium-sized economies starting with New Zealand (others include Australia, the U.K., Canada and more recently South Africa) have successfully used inflation targeting (IT) as a way to achieve price stability and credibility, as well as accountability and transparency of monetary policy.

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since these would have put the francophone African regimes in precarious positions. This raises the question whether the CFA would have survived this long if strict fiscal rules were applied.

The experience of New Zealand, a country that had no tradition of central bank independence, is that the regime brought down inflation from 9% in 1988 to less than 2% in 1991 with a decline in output volatility as compared to the previous two decades (Brash 2002). An inflation target is agreed upon by the central bank governor and the Minister of Finance. The central bank is accountable for delivering the target with the governor, by legislation, at risk of losing his job for inadequate performance. Such a requirement in the EAC case could help ensure that the common central bank leadership has incentive to resist political pressure. Mutual agreement on the inflation target, as in the case of New Zealand, would shield the common central bank from undue criticism from the governments. On the African continent, South Africa adopted an explicit IT regime in 2000 and has achieved some success (van der Merwe 2004) though the period is too short for a verdict.

The requirement for an IT system is that the common central bank will have only a single mandate – that of price stability. Currently the three EAC central banks (in Kenya, Tanzania, and Uganda) all list price stability as their primary objective (although they also have other secondary sub-objectives).[43] In fact the Bank of Tanzania clearly states the reason for emphasis on the price objective: that the multiple objectives approach has not been such a success in the past. Recent efforts in reducing inflation to (or near) single digits show that IT will not be an alien idea politically. The assessment of an optimal inflation target may be more complex for developing countries mainly because the benefits of low inflation have rarely been quantified or related to numerical values (Masson, Savastano, and Sharma 1997). However, Brash (2002) argues that the core elements of inflation targeting are not

[43] http://www.centralbank.go.ke/about/objectives.html, http://www.bot-tz.org/AboutBOT/BOT_Function.htm, http://www.bou.or.ug/about.htm; accessed March 2006

particularly complex, or more complex than operating other approaches to monetary policy.

An additional (political) argument for a floating currency has to do with the African Union objective of closer integration. If the agenda is to use the regional blocs as a stepping stone for an eventual African monetary union, then this may be an opportunity to build the institutional structure needed to allow for eventual expansion of the EAC, e.g., to encompass the COMESA region. The EAC could thus be considered as a sort of currency union nursery, a learning centre as it were.

The Way Forward for EAC Monetary Integration

The process of forming a monetary union is a demanding endeavor. To achieve a smooth transition cogent planning and implementation will be needed. What is critically needed now is for the EAC secretariat and governments to vest the technical process of the monetary union to a central professional organ. Such an organ, an East African Monetary Institute (EAMI), would consolidate research and carry out the planning and implementation of the monetary process. The EAMI would act as the forerunner of an East African Central Bank. Coordination of monetary policy and decisions such as the convergence targets, time-frame, and issues of lock-in rates for the exchange rates would be made within such a structure. Other key decisions such as the legal framework of introduction of a new currency, the decision on the best framework to be adopted for the new currency (link to euro, IT, etc), bank supervision in the joint system, and organizational framework for the East African Central Bank would also fall under its purview.

Conclusion

The EAC shows a fair degree of linkages. Intra-regional trade is substantial and growing. The official estimates understate the true volume of trade because unrecorded trade is high in the region. In addition estimates indicate that the implementation of the customs union will have positive trade effects for the region. Thus potential benefits from reduced transaction costs and exchange rate risks could be significant and increasing. The symmetry of shocks is low, but demand shocks show symmetry related to trade linkages. Labor mobility in the region and in Africa generally is believed to be high. The protocol on factor mobility currently being negotiated, and the similarity in language and culture are expected to improve labor flows. Hence, the cost of losing independent monetary policy may not be so great. Furthermore, this cost might be minimal if we consider that these countries have not shown a particularly good record of monetary prudence. This becomes more relevant if the structure of a supranational central bank allowed for a more credible system. The existing political accord in the region is also a big plus for the process. Overall the idea of monetary union in the EAC seems potentially viable.

However, although some remarkable progress has been made towards convergence in a relatively short time, more needs to be done. More effort is needed to achieve inflation and interest rate convergence. Similarly, more effort is needed to achieve sustainable fiscal policy in terms of fiscal deficits and debt management. Unlike trade issues that could be handled by the relevant ministries, monetary union will involve establishing a new supranational institution to oversee the transition and eventually be in charge of monetary policy. The groundwork for this has not started and will need time to set up. Chief among the issues to be assessed by such an institute is the framework such a system will eventually take. A number of papers

have advocated a peg to the euro, but some inherent weaknesses of such a system and the experiences of several economies over the last decade suggest that an inflation targeting system merits a serious look as an alternative. So far the process of integration has been a political agenda. This process therefore needs to cultivate and gain public support in all the member countries for legitimacy and long term stability.

Appendix A: Identification of Supply and Demand Shocks by VAR

We assume that fluctuations in real output $\{y_t\}$ and the price level $\{p_t\}$ are the result of two underlying types of shocks: supply and demand shocks. Assume that the variables are unit root, so that the vector $X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix}$ is stationary. The joint process of two variables (Δy_t and Δp_t) can be represented by an infinite moving average representation of a vector of the two variables and an equal number of structural shocks. Let ε_t be the vector of demand and supply shocks, ($\varepsilon_{dt}, \varepsilon_{st}$). Formally, the bivariate moving average of X_t can be represented as:

$$X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} = \sum_{i=0}^{\infty} L^i A_i \varepsilon_{t-i} \qquad \text{(A1)}$$

which is equation (1) in main text. Δy_t and Δp_t represent changes in the log of output and prices and L is the lag operator. A_i represents the impulse response function of the shocks to the elements of the vector X_t, and $\varepsilon_{dt}, \varepsilon_{st}$ are independent white noise supply and demand shocks normalized so that $Var(\varepsilon_t)=I$. To decompose the shocks, the AD-AS framework assumes that demand shocks do not have any effect on output in the long-run. Thus, the cumulative effect of demand shocks on the change of the log of output (Δy_t) must be zero:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \qquad \text{(A2)}$$

The supply side and demand side shocks can be recovered from estimating a finite order VAR. The optimal lag length (p) is chosen such that its residuals approximate white noise. Each element of vector X_t is regressed on lagged values of all the elements of X_t:

$$X_t = K + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \ldots + \Phi_p X_{t-p} + e_t, \qquad \text{(A3)}$$

where K denotes a vector of constants, Φ_is are the coefficients from the estimating equation and e_t is a vector of the residuals $\begin{bmatrix} e_{yt} \\ e_{pt} \end{bmatrix}$. The vector e_t is a composite of demand and supply shocks. If the process is covariance stationary we can take expectations of (A3) to calculate the mean μ of the process:

$$\mu = K + \Phi_1 \mu + \Phi_2 \mu + ... + \Phi_p \mu \tag{A4}$$

Subtracting (A4) from (A3) gives (A3) in terms of deviations from the mean:

$$X_t - \mu = \Phi_1 (X_{t-1} - \mu) + \Phi_2 (X_{t-2} - \mu) + ... + \Phi_p (X_{t-p} - \mu) + e_t \tag{A5}$$

The VAR(p) in (A5) can be represented as a VAR(1) process. To do this, define:

$$\xi_t \equiv \begin{bmatrix} X_t - \mu \\ X_{t-1} - \mu \\ . \\ . \\ X_{t-p+1} - \mu \end{bmatrix}, F \equiv \begin{bmatrix} \Phi_1 \; \Phi_2 .....\Phi_p \\ I_2 \;\; 0 \; .... \\ . \\ . \\ 0..... \quad I_2 \;\; 0 \end{bmatrix}, V_t \equiv \begin{bmatrix} e_t \\ 0 \\ . \\ . \\ 0 \end{bmatrix}$$

Then (A5) can be written as VAR(1):

$$\xi_t = F\xi_{t-1} + V_t \tag{A6}$$

and recursive substitution of (A6) implies that:

$$\xi_{t+s} = V_{t+s} + FV_{t+s-1} + F^2 V_{t+s-2} + ... + F^{s-1} V_{t+1} + F^s \xi_t \tag{A7}$$

If the eigenvalues of F all lie inside the unit root circle, then $F^s \to 0$ as $s \to \infty$ and the VAR is covariance stationary (Hamilton 1994). The first two rows of (A7) then give the vector moving average (∞) representation of X_t :

$$X_t = \mu + e_t + C_1 e_{t-1} + C_2 e_{t-2} + C_3 e_{t-3} + C_3 e_{t-3} + C_4 e_{t-4} \; ..... \tag{A8}$$

where $C_j = F_{11}^{(j)}$ and $F_{11}^{(j)}$ denotes the upper left block of F^j which is the matrix F raised to the jth power. Equations (A1) and (A8) yield the relationship between the estimated residuals (e_t) and the structural shocks (ε_t):

$$e_t = A_0\varepsilon_t \tag{A9}$$

Therefore we need to know the elements of A_0 to calculate the underlying structural supply and demand shocks. The variance-covariance matrix of residuals $E(e_t e_t') = A_0 E(\varepsilon_t \varepsilon_t') A_0'$ and the C_is are known from estimation. To recover the four elements of A_0 in the two-by-two case we need four restrictions. Two are simple normalizations which define the variances of $\varepsilon_{dt,}$ and ε_{st} (usually to one). Since $\varepsilon_{dt,}$ and ε_{st} are deemed to be pure shocks, a third restriction applied is to assume that demand and supply shocks are orthogonal so that $E(\varepsilon_{dt}\,\varepsilon_{st}) = 0$ (Bayoumi and Eichengreen, 1992). $E(\varepsilon_t \varepsilon_t')$ then drops out as I_2, and we have $E\,(e_t e_t') = \Omega = A_0 A_0'$. The variance-covariance matrix of residuals (Ω) is a known symmetric matrix. From this we obtain the following three restrictions:

$$\begin{aligned} &\mathrm{Var}(e_{yt}) = a_{11}(0)^2 + a_{12}(0)^2 \\ &\mathrm{Var}(e_{pt}) = a_{21}(0)^2 + a_{22}(0)^2 \\ &\mathrm{cov}(e_{yt}e_{pt}) = E(e_{yt}e_{pt}) = a_{11}(0)a_{21}(0) + a_{12}(0)a_{22}(0) \end{aligned} \tag{A10}$$

The final restriction is to impose the condition that demand shocks have no long term effects on output as in (A2). In terms of the VAR this implies:

$$\sum_{i=0}^{\infty}\begin{bmatrix} c_{11i} & c_{12i} \\ c_{21i} & c_{22i} \end{bmatrix}\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} = \begin{bmatrix} 0 & * \\ * & * \end{bmatrix} \tag{A11}$$

These restrictions allow the matrix A_0 to be uniquely defined and hence the demand and supply shocks to be identified.

Appendix B: Eigenvalue Stability

Table A1: Eigenvalue stability condition.

Kenya	-0.4641	.07157 + .4228i	.07157 - .4228i	0.14065
Tanzania	.3476 + .3642i	.3476 - .3642i	0.3284	-0.1039
Uganda	.6551 + .05270i	.6551 - .0527i	-0.405	-0.0182
Burundi	0.51663	-0.3575	.0991 + .5520i	.0991 - .5520i
Rwanda	-0.5353	.1241 + .4022i	.1241 - .4022i	0.33329
France	0.9496	-0.4044	.2261 +.1985i	.2261 -.1985i
Germany	0.3823	.3521 +.3478i	.3521 -.3478i	-0.2265
Italy	0.9309	-0.0135+.4237i	-0.0135-.4237i	0.3025
U.K.	0.8346	.1833 +.4660i	.1833 -.4660i	-0.1883
U.S.	0.9335	.2656 +.6196i	.2656 -.6196i	-0.3028
Euro-bloc	0.9289	0.1564+.4263i	0.1564-.4263i	-0.0586

Note: All the eigenvalues lie inside the unit circle.

The eigenvalues λ of the matrix F in (A6) satisfy:

$\left| I_n \lambda^p - \Phi_1 \lambda^{p-1} - ..... - \Phi_p \right| = 0$. For p=2 we have $\left| I_n \lambda^2 - \Phi_1 \lambda - \Phi_2 \right| = 0$

The VAR is covariance stationary as long as $|\lambda| < 1$ so that the consequences of (ε_t) eventually die out. The VAR satisfies this stability condition.

Appendix C: The Welfare Effects of Monetary Unification

The expected net welfare of monetary union for country i is given by:

$$E\left(NW_i^G\right) \equiv EU_i^G\big|_{MU} - EU_i^G\big|_{Autonomy} \tag{C1a}$$

This can be written as:

$$\{-\frac{1}{2}(E[\pi_{mu}^* - \tilde{\pi}_i(\varepsilon_i)]^2)\} - \{-\frac{1}{2}(E[\pi_{i,Aut}^* - \tilde{\pi}_i(\varepsilon_i)]^2)\} \tag{C1b}$$

Using, $E(Q^2) = [E(Q)]^2 + Var(Q)$, we can rewrite (C1b) as:

$$NW_i^G = [-\frac{1}{2}\{[E[\pi_{mu}^* - \tilde{\pi}(\varepsilon_i)]]^2\} - \frac{1}{2}\{Var(\pi_{mu}^* - \tilde{\pi}(\varepsilon_i))\}]$$

$$-[-\frac{1}{2}\{[E[\pi_{i,aut}^* - \tilde{\pi}(\varepsilon_i)]]^2\} - \frac{1}{2}\{Var(\pi_{i,aut}^* - \tilde{\pi}(\varepsilon_i))\}] \tag{C2}$$

STOCHASTIC COMPONENT

Net welfare for the stochastic component (SW) of (C2) is given by:

$$E(SW_i) = -\frac{1}{2}\{Var(\pi_{mu} - \tilde{\pi}(\varepsilon_i)) - Var(\pi_{i,aut} - \tilde{\pi}(\varepsilon_i))\} \tag{C3}$$

Using the solutions for optimal inflation (3) and (5), we have:

$$E(SW_i) = -\frac{1}{2}\{Var\left[bc_A + \tilde{\pi}(\varepsilon_A) - \tilde{\pi}(\varepsilon_i)\right] - Var\left[bc_i\right]\} \tag{C4}$$

Now, we can write the aggregate stochastic variable $\varepsilon_A = \sum_{i=1}^{n} w_i \varepsilon_i$, $\sum_{i=1}^{n} w_i = 1$ as a weighted average of the supply shock to country i and the weighted average supply shocks of all other member countries excluding country i:

This gives $\varepsilon_A = w_i\varepsilon_i + (1-w_i)\sum_{k=1,k\neq i}^{n}(\frac{w_k}{1-w_i})\varepsilon_k = w_i\varepsilon_i + (1-w_i)\varepsilon_{-i}$ (C4a)

Similarly we can write $c_A = w_i c_i + (1-w_i)c_{-i}$ (C4b)

where ε_{-i} (c_{-i}) is the weighted average of supply shocks (output preference) across the $n-1$ other union members. Thus writing the cross-country aggregate shock ε_A and the shocks to preferences c_A as in (C4a) and (C4b), and assuming that the preferences and the supply shocks are not correlated we obtain:

$$SW_i = \frac{-\eta^2(1-w_i)^2}{2}[\sigma^2_{\varepsilon_i} + \sigma^2_{\bar{\varepsilon}_{-i}} - 2\operatorname{cov}(\varepsilon_i, \varepsilon_{-i})]$$
$$-\frac{b^2}{2}\left[(w_i^{\ 2}-1)\sigma^2_{c_i} + (1-w_i)^2\sigma^2_{c_{-i}} + 2w_i(1-w_i)\operatorname{cov}(c_i, c_{-i})\right] \qquad \text{(C5)}$$

NONSTOCHASTIC PART

The non-stochastic part of the net welfare is given by:

$$E(NSW_i) = -\frac{1}{2}\{[E[\pi^*_{mu} - \tilde{\pi}_i(\varepsilon_i)]]^2 - [E[\pi^*_{i,aut} - \tilde{\pi}_i(\varepsilon_i)]]^2\} \qquad \text{(C6)}$$

which reduces to:

$$-\frac{1}{2}\{[b\bar{c}_A]^2 - [b\bar{c}_i]^2\} = -\frac{b^2}{2}\{[\bar{c}_A]^2 - [\bar{c}_i]^2\} \qquad \text{(C6´)}$$

But $[E[\pi^*_{mu} - \tilde{\pi}(\varepsilon_i)]]^2 \equiv [E[\pi^*_{mu} - \pi^*_i + \pi^*_i - \tilde{\pi}(\varepsilon_i)]]^2$. Let $b\bar{c}_i = A_{\pi,i}$ and $b\bar{c}_A - b\bar{c}_i = \Delta_{\pi,i}$. Hence we can write (C6) as:

$$-\frac{1}{2}\{([\Delta_{\pi,i} + A_{\pi,i}]^2 - A^2_{\pi,i})\} = -\frac{1}{2}\{[2A_{\pi,i}\Delta_{\pi,i} + \Delta^2_{\pi,i}]\} \qquad \text{(C7)}$$

The net welfare for the non-stochastic part becomes:

$-\frac{1}{2}\{2[b\bar{c}_i][b(\bar{c}_A - \bar{c}_i)] + [b(\bar{c}_A - \bar{c}_i]^2\}$, which using (C4b) yields;

$$NSW_i = -(1-w_i)b^2\bar{c}_i[\bar{c}_{-i} - \bar{c}_i] - \frac{b^2(1-w_i)^2}{2}[\bar{c}_{-i} - \bar{c}_i]^2 \qquad \text{(C8)}$$

Combining (C5) and (C8) yields equation (7) in the text.

Appendix D: Deriving the Estimates of Parameters b And c_i

The policy maker is assumed to care about economic growth and inflation. The welfare function describing the policymaker's preferences is given as in (2) in the text by;

$$W_i = c_i(y_{i,t} - \tilde{y}) - \tfrac{1}{2}(\pi_{i,t} - \tilde{\pi}(\varepsilon_{i,t})^2 \qquad \text{(D1)}$$

where y_t is the log of real output. Each period the policymaker plans to achieve a particular nominal growth rate Δx_t^d;

$$\Delta x_t = \Delta x_t^d + \varepsilon_{xt}, \qquad \text{(D2)}$$

Actual nominal output growth Δx_t may differ from the planned nominal output. As in (Ball, Mankiw and Romer 1988), we express the short-run output inflation trade-off as:

$$y_t = \alpha_1 + \alpha_2 t + \alpha_3 y_{t-1} + \alpha_4 \Delta x_t + \varepsilon_{yt} \qquad \text{(D3)}$$

The log of the real GDP is regressed on its own lag, a time trend, and the change in the nominal GDP. Thus change in real output is given by;

$$\Delta y_t = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) y_{t-1} + \alpha_4 \Delta x_t + \varepsilon_{yt} \qquad \text{(D4)}$$

The coefficient of the change in nominal demand (α_4) tells how much of a shock to nominal GDP shows up in output in the first year. If $\alpha_4 = 1$, then all of the change in nominal GDP shows up in real GDP; and if $\alpha_4 = 0$, then all the change in nominal GDP shows up in inflation. Since inflation is defined as $\pi_t = \Delta x_t - \Delta y_t$, then the inflation rate can be written as;

$$\pi_t = (1 - \alpha_4)\Delta x_t - h_t, \text{ where } h_t = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) y_{t-1} + \varepsilon_{yt} \qquad \text{(D5)}$$

The policy maker optimizes (D1) with respect to Δx_t^d, subject to (D2), (D4) and (D5) to yield:

$$\Delta x_t = \frac{c_i \alpha_4}{(1-\alpha_4)^2} + \frac{h_t^e}{(1-\alpha_4)} + \varepsilon_{xt}\ ;\ h_t^e = \alpha_1 + \alpha_2 t + (\alpha_3 - 1)E(y_{t-1}) + E(\varepsilon_{yt}) \qquad \text{(D6)}$$

Equation (D6) expresses the policy maker's reaction to the desired growth rate of real output and h_t^e which represents the past development of real output growth.

Following the two-step estimation procedure in Swank (1997), we first estimate the economic constraint (D3). From these estimates we calculate h_t^e, which then allows us to estimate the reaction function of nominal demand (D6) with the coefficient on h_t^e constrained to be $\frac{1}{1-\alpha_4}$. The results from (D6) allow c_i to be calculated. This value allows us to estimate the $\bar{c}_i$, $\bar{c}_{-i}$, and $\text{cov}(c_i, c_{-i})$.

In addition, from $\pi_t = \Delta x_t - \Delta y_t$ and (D4) the value of b in (7) in the text can be approximated. By writing $\pi = \Delta p$ then from $\pi_t = \Delta x_t - \Delta y_t$ we get:

$$\frac{\Delta y}{\Delta x} = \alpha_4 = 1 - \frac{\Delta p}{\Delta x} \qquad \text{(D7)}$$

From (1) in text, $b = \frac{\Delta y}{\Delta p}\frac{\Delta p}{\Delta \pi *}$ where $\pi *$ is unexpected inflation. By appropriately rebasing prices we have $\frac{\Delta p}{\Delta \pi *} = 1$. Therefore we approximate b from the following equation;

$$b = \frac{\Delta y}{\Delta p} = \frac{\Delta x}{\Delta p} - 1 = \frac{\alpha_4}{1-\alpha_4} \qquad \text{(D7}'\text{)}$$

Thus the value of b can be estimated from (D7′). The weighted average of these values for the five East African countries is used as an estimate of the cross-country b value.

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