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MACROECONOMIC SHOCK SYNCHRONIZATION IN THE EAST AFRICAN COMMUNITY[1]

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Abstract

The East African Community (EAC) economic integration has gained momentum recently, with the EAC countries aiming to adopt a single currency in 2015. This paper evaluates empirically the readiness of the EAC countries for monetary union. First, structural similarity of the EAC countries is measured in terms of similarity of production and exports. Second, the symmetry of shocks among the EAC members is examined with structural VAR. Both methods point to a low shock synchronization in the EAC, suggesting that the move to EAMU would need a thorough evaluation and preparation. The paper concludes with policies that would facilitate the EAC regional economic integration, including the possible eventual establishment of a monetary union.

Keywords: shock synchronization; structural VAR; regional integration; East Africa

JEL classification: E32; F42; C53

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I. Introduction

Interest in regional integration in Africa has accelerated recently, reflecting a renewed political will and increased resource flows for regional projects under the Extended Integrated Framework and Aid-for-Trade initiatives. Integration measures in the East African Economic Community (EAC) regained momentum in 2005, after some stagnation.[2] Over the years, the members have established closer economic links through a Free Trade Area (2001), a Customs Union (2005), and a Common Market (2010). These efforts have paid off: a deeper regional integration and trade within the EAC than in other African sub-regions have contributed to East Africa's resilience during the global financial crisis (GFC) in 2009 and 2010 and to overall fast growth (Brixiova and Ndikumana, 2011; Guerguil et al., 2011, and Winston and Castellanos, 2011).

Given the progress with intra-regional trade, the objective of the EAC countries is the establishment of the East African Monetary Union (EAMU), with the circulation of the single currency in the summer of 2015. The March 2010 Joint Meeting of the EAC Ministers adopted the road map for this goal, which includes milestones such the adoption of an Exchange Rate Mechanism (ERM), creation of the regional central bank, and finally the establishment of the EAMU. However, macroeconomic convergence in the EAC has been limited. Questions have thus emerged about the countries' readiness to join the EAMU within the agreed time frame, especially in light of slow implementation of common market elements such as free mobility of labor, capital and goods.[3]

This paper investigates whether the targeted speedy creation of the EAMU and the associated loss of the ability to conduct counter-cyclical monetary policy could be too costly for the EAC countries. Using the Optimal Currency Area (OCA) approach, it tests empirically the extent of the shock synchronization among the EAC members.[4] If the countries in the union have major structural difference, common monetary police will have differential impacts that may not be helpful to some members. These differences may reduce the benefits of the union by increasing the volatility of business cycles.

The paper is organized as follows: After this Introduction, Section II highlights the progress with regional integration in the EAC. In Section III the shock synchronization of the EAC is analyzed using the indexes of structural similarity and the structural VAR model. Section IV draws policy conclusions and recommendations for advancing regional integration in East Africa.

[2] The EAC comprises of Kenya, Tanzania, Uganda, Rwanda and Burundi, with a combined population of 126.6 million people and a nominal GDP of USD73 billion in 2010.

[3] Bøds (2001) concluded that most of Africa's regional integration efforts lacked political will to be implemented, and the countries continued to focus on relative national gains and sovereignty. While this general conclusion could have been true at turn of the century, the renewed interest for deeper integration in East Africa this time around seems to represent serious efforts for change.

[4] The OCA analysis claims that membership of a currency union provides countries micro economic efficiency gains at the cost of their relinquishing independent monetary and exchange rate policy. This approach is highly relevant for economies with flexible exchange rates, such as the EAC countries.

II. Regional Convergence in the EAC: The Facts

II.1 Convergence Criteria

The OCA theory suggests the macroeconomic convergence as a precondition for forming a monetary union (Mundell, 1961 and others). This applies also to the EAMU. The EAC convergence process, measured mostly through macroeconomic criteria, has three stages: looser macro stance during 2007-10; tighter one during 2011-2014, and the monetary union from 2015 on (Table 1).

Table 1: Macroeconomic Convergence Criteria in the EAC

		<Stage		
	Indicator	**Stage 1: 2007 - 2010**	**Stage 2: 2011 - 2014**	**Stage 3: 2015**
Primary Criteria	Budget Deficit to GDP ratio			Introduction of single currency
	Excluding grants	< 6%	≤ 5%	
	Including grants	≤ 3%	≤ 2%	
	Inflation	≤ 5%	≤ 5%	
	External reserves	≥ 4 months import cover	≥ 6 months imports	
Secondary Criteria	Real exchange rate	Stable		
	Interest rates	Market based	Market based	
	Real GDP growth	≥ 7%	≥ 7%	
	Debt	Reduced to sustainable levels	Sustainable levels	
	Savings to GDP ratio	≥ 20%	≥ 20%	
	Current account *(excluding grants)*	Consistent with debt sustainability	Consistent with debt sustainability	
	Banking supervision and regulations	Implementation of the 25 Core Principles		
	Payment and settlement systems	Adhere to Core Principals for Systematically Important Systems		

Source: Adapted from Opolot and Luvanda, 2009.

Macroeconomic convergence is crucial, but research on monetary integration suggests that structural similarities among monetary union members are key for the unified impact of their joint monetary policies. This is because the adoption of a single currency eliminates some of the macro policies (monetary and exchange rate policy) that countries can use to adjust to economic shocks.[5] Instead, all countries in the monetary union are subject to the same monetary policy, which would be more effective under synchronized shocks. Even when shocks are not synchronized though, the monetary union can be economically advantageous if countries have mobile labor markets (Mundell, 1961), a high degree of economic openness (McKinnon, 1963), enabling business environment and diversification in production and consumption (Kenen, 1969).

Another stream of literature, pioneered, by Frankel and Rose (1998), argues that is that the OCA is self-fulfilling *ex post*. It underscores that by reducing transactions costs and eliminating the exchange rate risk, a common currency promotes intra-regional trade and synchronizes business cycles, as countries' economic institutions become similar. More recent work on the OCA (Corsetti, 2009) posits that factors supporting monetary integration are financial sector integration and counter-cyclical fiscal policy, which are both high among priorities of the EAC policymakers.

II.2 Macroeconomic Performance

The EAC grew faster than the rest of the continent both before and during the GFC, the lack of natural resources notwithstanding (Table 2).[6] In spite of the negative impact of the GFC, East Africa posted 5.8% real GDP growth in 2009 and has already recovered some of the lost growth momentum in 2010 and 2012. Rwanda, Tanzania and Uganda have led the regional economic expansion, alongside Ethiopia and Sudan. Kenya, which grew rapidly in 2006 and 2007, suffered a setback in 2008 due to the violence that broke out after the elections at the end of 2007. Among the EAC's members, only Burundi's growth has been low throughout the 2000s, reflecting in part the country's fragility.

Table 2. Real GDP growth in East Africa (EAC) and other Africa's sub-regions 1/

	2002-06	2007	2008	2009	2010	2011
			(annual, in percent)			
EAC	**6.6**	**7.1**	**7.4**	**4.1**	**5.1**	**5.6**
RoEA 2/	2.9	7.3	3.2	4.1	4.7	4.3
West Africa	4.7	4.7	5.4	3.4	4.5	5.1
Northern Africa	4.9	4.5	4.1	2.7	4.6	3.4
Southern Africa	4.5	5.5	4.7	2.2	4.2	5.6
Central Africa	4.6	4.0	2.9	2.0	5.5	4.3

Source: Authors' calculations based on the African Economic Outlook (AEO) 2012. 1/ Median values. 2/ Rest of East Africa other than the EAC countries.

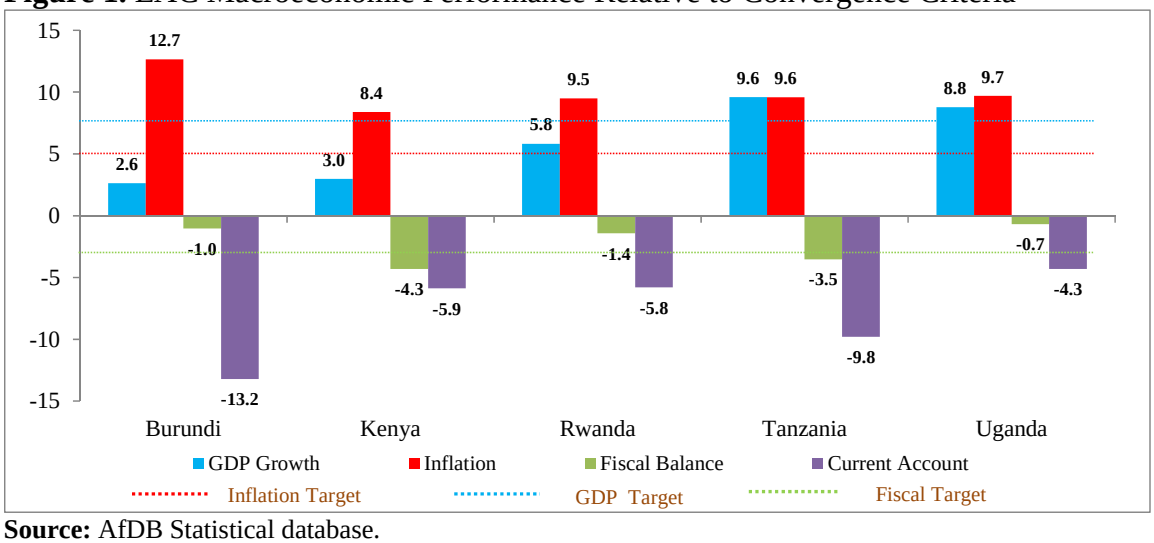
[5] On the positive side, countries eliminate the economic costs related to the exchange rate fluctuations.
[6] The discovery of oil and subsequent development of the resources has been changing Uganda's position. Tanzania also benefitted from rising gold prices although the sector is not the main driver of growth.

Overall macroeconomic performance was mixed. While inflation was in single digits in 2007, it jumped to double digits due to increased food prices in 2008. Despite the global financial crisis' dampening of the inflationary pressures in 2009, the inflation accelerated in 2010 and 2011 due to droughts and rising food prices. On the positive side, external debt is sustainable and debt payments are low, in part due to debt relief initiatives from mid-2000s. While the fiscal deficits remained under control despite the stimulus packages adopted in 2009 and 2010, the relatively sizeable trade and current account deficits continue to pose a challenge for macroeconomic convergence of the EAC.

Meeting these convergence criteria has so far been elusive. An inspection of the performance of the EAC member countries' performance since 2000, relative to the convergence criteria, reveals significant variations (Figure 1). Notwithstanding the high regional growth, only Tanzania and Uganda have managed average GDP growth of more than 7% over the last four years to 2010. There are down-side risks to growth in these two countries, especially when the growth has largely been driven by resource-based exports or investments as in the case of Uganda.

Important threats for macroeconomic stability in the region persist. Inflation and exchange rates in particular are still volatile. In August 2011 the annual inflation was in double digits – way above the 5 percent target -- in Kenya, Uganda, and Tanzania, due to rising food prices. In 2009 and 2010 the budget deficits (after grants) of Kenya and Tanzania exceeded the 3 percent target when counter-cyclical fiscal policies were adopted against the impacts of the global financial crisis (Kasekende, et al., 2010). Ensuring adherence to macroeconomic targets in the absence of any agreed rules therefore poses serious challenges to the proposed EAMU.

Figure 1. EAC Macroeconomic Performance Relative to Convergence Criteria



Source: AfDB Statistical database.

Even though all EAC countries fall into the low income category, substantial differences exist in their levels of development. The different levels of development of the EAC countries and divergence of their economic outcomes have been one of the arguments

against speedy creation of the EAMU.[7] On the one side of the spectrum is Kenya, which is the most developed and the largest EAC member. It is the regional trade hub, while its private enterprises lead the intra-regional investment. Kenyan banks also operate across the region, with subsidiaries in Rwanda, Tanzania and Uganda (AfDB, 2011).[8]

Nevertheless, the region's financial sector is not yet sufficiently integrated. Although foreign banks dominate in the EAC, their focus is largely on domestic markets. Despite the creation of a regional Securities Regulatory Authority and partial capital account liberalization and the encouragement of cross-listing; capital market cooperation and integration has been limited. For instance, the November 2006 agreement between the Uganda Stock Exchange and the Kenya Stock Exchange allowed cross-listing of blue-chip companies yet cost considerations prevented most of the firms from doing so (World Bank, 2007). Following an example of Nigerian banks that have entered the region, Kenyan banks have recently established operations in Rwanda, Tanzania and Uganda. This development needs to be supported by an appropriate regulatory framework, including through home country supervision and regulation.

More broadly, one of the arguments against speedy creation of the EAMU has been the different levels of development of the EAC countries and their varied economic outcomes. For example, the Burundi's average import growth exceeded that of exports by a factor of 3 since 2003, resulting in the current account deficit of 19.1 percent of GDP in 2008 – far above the other EAC members. While inflation was in single digits until 2007, it jumped to almost 25 percent in 2008 due to the food crisis. The question arises if such divergent performance would reduce the country's benefits from the EAMU. Conversely, and as the experience of the euro area suggests, unless Burundi strengthens its macroeconomic situation, its membership may destabilize the EAMU.

II.3 Trade Flows, Structure and Barriers

According to the OCA criteria, rising intra-regional trade is consistent with the objective of monetary integration, as a common currency would lead to substantial cuts in transaction costs (McKinnon, 1963). In that aspect, the EAC countries fare well, as trade among the EAC members has intensified prior to the GFC.

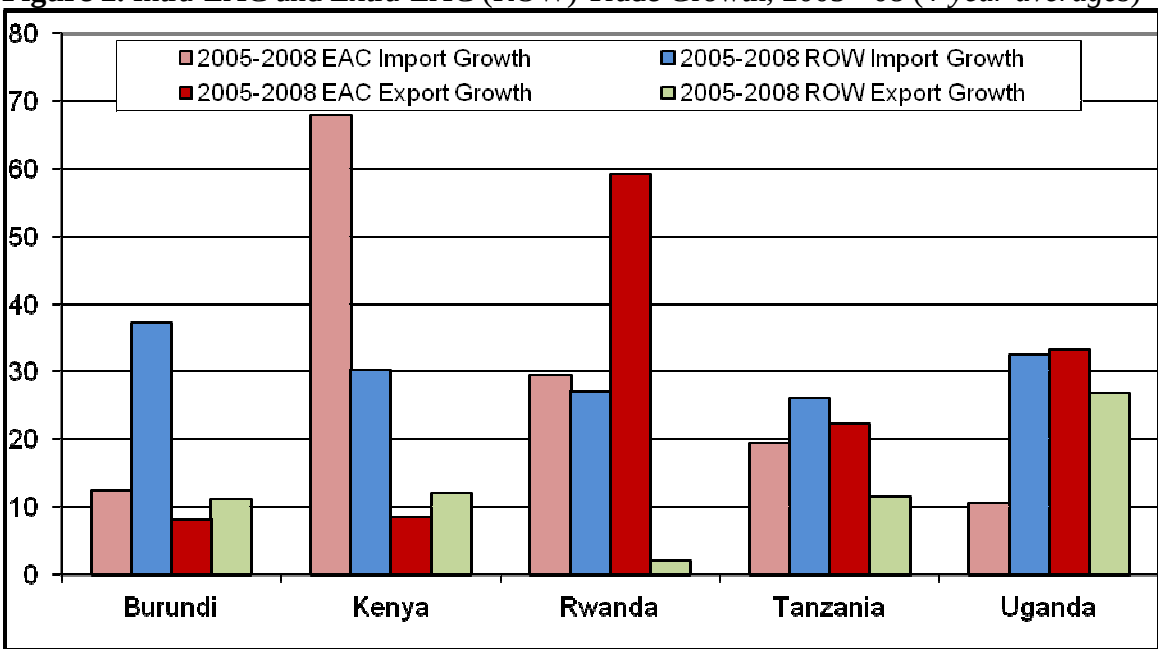
Specifically, the share of imports from Europe and other advanced economies has been falling while the share of trade within the EAC is rising. About 20 percent of East African exports were within the EAC during 2000-07 (Table 3). The average growth in intra-EAC exports exceeded that of extra-EAC in Rwanda, Tanzania and Uganda (Figure 2). Still, average import growth within the EAC has been lower than import growth from outside the region in Burundi, Kenya and Rwanda, reflecting the dominance of basic consumer products in intra-regional trade, with manufactures coming mostly from the

[7] The euro introduction took much longer for countries of markedly greater structural similarity than exhibited by the EAC countries.

[8] Nevertheless barriers to the greater financial integration – one of the preconditions for successful monetary integration – remain high and include capital flows restrictions (Wang, 2010).

outside. Kenyan exports to the region accounted for almost 65 percent of the total intra-regional exports.

Figure 2. Intra-EAC and Extra-EAC (ROW) Trade Growth, 2005 - 08 (*4-year averages*)



Source: Authors' Calculations based on the IMF Direction of Trade Statistics Online Database.

Another key characteristic of East Africa that bodes well for formal economic integration is the large share of informal trade in the region. For example, the share of the informal trade in total trade in Uganda has increased markedly during 2000s. In fact, in 2009 the informal exports to the EAC countries and other neighbors (Sudan, DRC) exceeded its total formal exports. The large informal trade volume suggests that formal trade can expand further. To facilitate this process, barriers to trade should be eliminated to reduce the informality and the related transactions cost. Increasing the stock and quality of regional infrastructure is also needed to harness this intraregional trade potential.

Despite the relatively large volume of trade among the EAC countries, significant challenges to monetary integration remain, including the transaction costs for across-the border trade. Over the medium term regional integration strategies need to develop complementarity in higher value added products than basic agricultural commodities to raise the capacity of East African countries' to trade.[9] Incentives to formalize will be important as informal firms find it more difficult to innovate and adopt new technology. Modernizing immigration policies to facilitate the flow of labor and address persistent skill shortages will be key to fostering intraregional trade, which is likely to bring about greater structural similarities. Moreover, reducing volatility of exchange rates would help increase trade and finance flows (Newfarmer and Söderbom, 2012).

[9] Additional impediments to monetary integration in Kenya, Tanzania and Uganda are substantial financial barriers such as restrictions on capital flows.

Table 3. Share of intra-regional and intra-Africa trade by RECs (million US$)

	2000	2003	2005	2007	2000-07
EAC total exports	3,053	4,133	5,984	7,788	4,951
intra EAC exports	689	879	1,075	1,385	957
% of total exp.	**22.6**	**21.3**	**18**	**17.8**	**20**
exports to rest of	286	457	664	1,037	572
% of total exp.	9.4	11.1	11.1	13.3	11.1
total exports to Africa	32	32.3	29.1	31.1	31.1
AMU total exports	49,048	54,933	99,669	139,040	77,883
intra UMA exports	1,094	1,338	1,886	3,076	1,698
% of total exp.	**2.2**	**2.4**	**1.9**	**2.2**	**2.3**
exports to rest of	80	14	216	1,770.00	460
% of total exp.	0.2	0	0.2	1.3	0.4
total exports to Africa	2.4	2.5	2.1	3.5	2.7
SADC total exports	47,772	55,998	89,058	133,525	74,735
intra SADC exports	4,296	5,484	7,454	11,678	6,512
% of total exp.	**9**	**9.8**	**8.4**	**8.7**	**8.8**
exports to rest of	1,230	1,879	2,731	3,740	2,193
% of total exp.	2.6	3.4	3.1	2.8	3
total exports to Africa	11.6	13.1	11.4	11.5	11.8
WAEMU total exports	6,662	9,850	12,661	15,039	11,166
intra WAEMU	741	1,076	1,390	1,917	2,063
% of total exp.	**11.1**	**10.9**	**11**	**12.7**	**11**
exports to rest of	947	1,194	1,879	2,731	1,658
percent of total	14.2	12.1	14.8	18.2	14.8
total exports to Africa	25.3	23	25.8	30.9	25.9
CEMAC total exports	8,361	11,552	22,944	29,898	16,683
intra CEMAC	96	146	198	304	177
% of total exp.	**1.1**	**1.3**	**0.9**	**1**	**1.1**
exports to rest of	220	282	483	580	382.3
percent of total	2.6	2.4	2.1	1.9	2.5
total exports to Africa	3.8	3.7	3	3	3.6

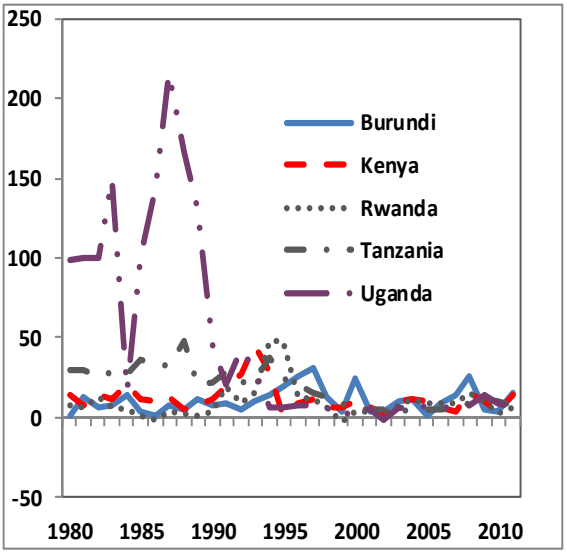
Source: ECA, AfDB and AUC (2010). Assessing Regional Integration in Africa IV: Enhancing Intra-African Trade, Addis Ababa: ECA.

To achieve greater intra-regional trade and structural similarity -- and hence shock synchronization -- barriers to trade within EAC need to be eliminated while common policies towards the outside of the EAC should be adopted. The region's trade agenda has thus a wider scope than reducing intra-regional tariff barriers. Its current primary focus is on removing structural – mostly non-trade -- barriers to competitiveness and

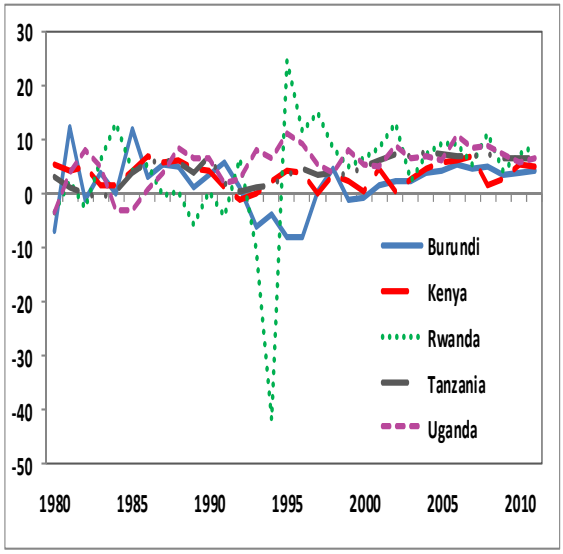
trade.[10] Besides its traditional objectives (removing quotas and tariffs), trade policy of the EAC thus now strives to strengthen the members 'soft' and 'hard' infrastructure so as to enable them to leverage their relative comparative advantages. The focus on relative comparative advantages would also help diversify the EAC product mix and could enhance the scope for intra-regional trade along the value chains.[11]

Figure 3. The Real GDP growth and inflation in the EAC, 1980 - 2011

3a. The EAC: Inflation (%)



3b. The EAC: Real GDP Growth (%)



Source: AEO 2012 and IMF WEO database (as of April 2012).

Sections below test the degree of shock synchronization among the EAC countries formally, adopting simple correlation and structural vector auto-regression analysis (SVAR) methods on the real GDP growth and inflation data during 1981 - 2009. Moreover, given the increased formal intra-regional trade and high informal trade within the EAC countries, the empirical analysis will also examine the endogeneity of the OCA hypothesis. This will be carried out by subdividing the period into two sub-periods: before and after 1990.

III.1 Correlation of Economic Activity is low

First, we examine the degree of synchronization of economic shocks between the EAC countries using correlations for output growth and inflation for all pairs of countries. Pair-wise correlations of the real GDP growth and inflation during 1981 – 2009 are mostly positive, albeit low, and increased during 1990 - 2009 (Figure 4). This result informs the split in the data in estimations below, which also accounts for periods of high inflation in

[10] For linkages between competitiveness, trade and FDI in Africa, please see Blanke *et al*. (2011).
[11] To promote intra-regional trade, the revised EAC Protocol aimed at gradual reduction in tariffs for goods classified under category B, i.e. agricultural products, building materials, plastics, wood and paper, textiles, iron and steel and other manufactures. No tariffs were to be charged on category A products. An annual 2 percent reduction in tariffs was agreed with the objective of complete elimination of the tariffs by 2010.

the series for Tanzania and Uganda. The high levels of inflation are not observed after 1990 (Figure 3b). Volatility in GDP growth and inflation also decreased since 1990.

Figure 4a. Pair-wise correlations between the real GDP growth in the EAC countries

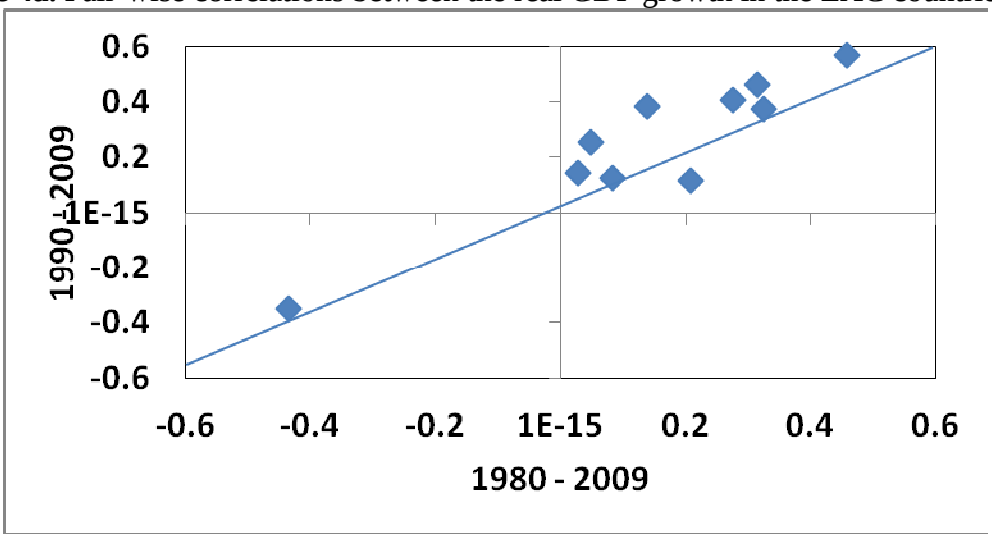
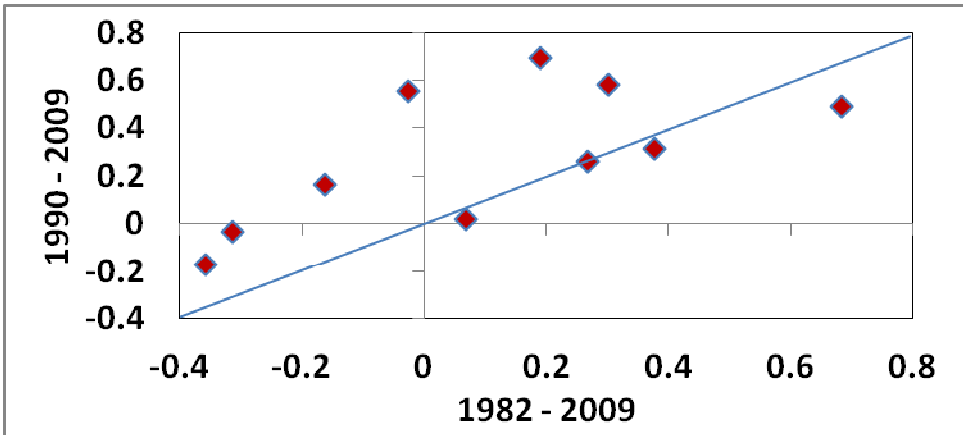


Figure 4b. Pair-wise correlations between the inflation rates in the EAC countries



Source: Authors' calculations based on the AEO and IMF WEO database.

III.2 Structural Similarity Indexes indicate growing similarity

a. Structural Similarity Measured by Value Added

The structural similarity of production between the EAC members and Kenya is measured in terms of Bray-Curtis index.[12] Denoting x_{ij} to be the share of sector *i* in the total value added of country *j*, and x_{ik} denoting the share of sector *i* in total value added

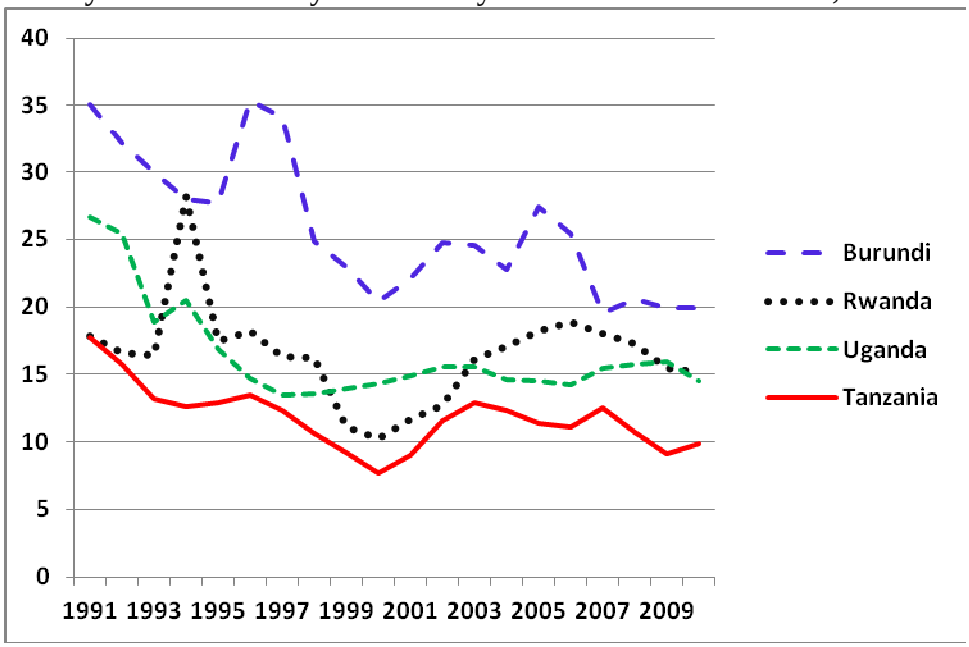
[12] Kenya, the largest and most developed economy in the region, was chosen as the reference point for the degree of convergence.

of Kenya. The countries in this case being (i) the EAC members other than Kenya and (ii) Kenya, and *N* as total number of sector, the index is defined as:

$$d_{ij} = \frac{\sum_{i=1}^{N} \left| x_{ij} - x_{ik} \right|}{\sum_{i=1}^{N} \left(x_{ij} + x_{ik} \right)} \qquad (1)$$

The index takes values between [0,1]. The index is a measure of distance, and hence lower values indicate a greater structural similarity between sectoral contributions to total values added in (i) the EAC members other than Kenya and (ii) Kenya. According to this index, the EAC's production structure – measured by six categories (agriculture, industry, construction, trade, other private sector services, social services) – has converged to that of Kenya over the past twenty years. Most of the convergence occurred during 1990s though, with stagnation afterwards. Moreover, in all countries except Uganda and Kenya, the share of agriculture is 30 percent or more of the output. The large share of similar low value production in countries' GDP inhibits trade and regional integration.

Figure 5. Bray-Curtis Similarity Index: Kenya and other EAC members, 1991 - 2010



Source: Authors' calculations based on data from the UN national account statistics.

b. Structural Similarity Measured by Exports

Despite increasing intra-regional trade, the EAC countries exhibit export dissimilarities. Indices presented in Table 4 show no evidence of export similarities between Kenya and the other EAC members. Following Xu and Song (2002) the indices focus on the market domain, where the objective is to compare the similarity between Kenya's exports and

those of the other EAC countries. The indices, where x_{ik} is the export of good *k* by country *i*, and x_{jk} are Kenya's exports of good *k*, are obtained as follows:

$$s_{ij} = \sum_{k} \left\{ \left[\frac{x_{ik} + x_{jk}}{x_i + x_j} \right] . \left[1 - \frac{x_{ik} - x_{jk}}{x_{ik} + x_{jk}} \right] \right\} . 100 \qquad (2)$$

The index ranges between 0 and 100, where zero and 100 denote no similarity and perfect similarity, respectively. For both years, Burundi's and Rwanda's exports to the EAC are the least similar to those of Kenya while there is very limited similarity between the latter's exports and those of Tanzania and Uganda (Table 4).

Table 4 Export Similarity Indices between Kenya and those of the other EAC Members

Year	Burundi	Rwanda	Tanzania	Uganda
2009	1.4	2.4	14.0	19.6
2010	0.7	2.7	25.1	19.2

Source: Authors' calculations.

III.3 Structural VAR Approach

This section applies a two-variable structural VAR (SVAR) framework to assess suitability of the EAC countries for monetary union. The economic shocks experienced by the EAC countries are decomposed into supply and demand shocks and their correlations examined. The section also examines whether the supply and demand shocks have become more synchronized over time.

The SVAR framework was developed by Blanchard and Quah (1989) and utilized by Bayoumi and Eichengreen (1993) to analyze the suitability of European monetary integration. More recently, it was applied by Fidrmuc and Korhonen (2003) and Brixiova, *et al*, (2010), among others, to assess the degree of synchronization of countries of Central and Eastern Europe with the Eurozone. In the Asian context this approach was utilized for example, by Zhang *et al.* (2004), among others.

III.2.1 The AD-AS Model

The shock synchronization model is based on a two variable (output growth and inflation) aggregate demand-aggregate supply (AD-AS) macroeconomic framework. The AD-AS framework assumes that fluctuations in real output, y_t, and the price level, p_t, are due to supply and demand shocks. In this framework the long run aggregate supply curve is vertical at the full employment level of output, but the short run one is upwards sloping due to sticky wages.[13] In the EAC context, it is worthwhile to note that as all members have removed most price controls, prices in the goods and services markets are

[13] Real wages initially decline with price increases, leading to higher employment and output. With a lag (in the long run), real wages adjust to their initial value.

best characterized as flexible. However, wages are sticky due to the presence of minimum wages and the role of public sector wages as a reference point for private sector wage levels. Moreover, unemployment in the region remains high.[14]

As discussed above, in this AD-AS framework, the responses of real output and the price level to positive demand and supply shocks can be summarized as follows (Table 5):[15]

Table 5. Expected Dynamic Responses for the AD-AS Framework

	Type of shock	**Short Run**	**Long Run**
Output response to	Positive AS shock	Positive	Positive
	Positive AD shock	Positive	None
Price response to	Positive AS shock	Negative	Negative
	Positive AD shock	Positive	Positive

III.2.2 Estimation Results

Data

We use annual and seasonally unadjusted data on real GDP and inflation from the five EAC countries for the period 1980 - 2009. The data was obtained from the African Development Bank online data platform. To avoid any spurious relationships the Ng-Perron unit-root test was used to determine the process generating the data series. This test was used because experiences in the application of the Augmented-Dickey-Fuller (ADF) and Phillip-Perron (PP) unit root tests have shown that they are affected by finite sample power and size problems.[16] Specific attention was given to the lag truncation criterion, with the optimal lag determined as one. The results of the stationarity and estimation tests are presented in Annex B. Overall, output growth and inflation series from the five countries were found to be stationary while inflation data for Tanzania and Uganda only became stationary after the first difference.

Correlations of Demand and Supply Shocks

Table 6 presents correlation coefficients of the supply and demand shocks (the SVAR error terms) between Kenya and the remaining four EAC countries. Only recently the EAC members agreed on convergence criteria and none of them has satisfied them to date, leaving Kenya as a natural anchor.

[14] While the depiction of the short-run AS relationship as a reduced form mark-up price-setting equation of a disequilibrium labor market has been questioned, Rao (2007), Boyd (2010) and others have supported it.
[15] Identification of supply and demand shocks is detailed in Annex A.
[16] DeJong, *et al* (1992) has shown that the ADF and PP tests can result in rejecting the alternative hypothesis of stationarity. On the other hand, the ADF and PP tests are also known to suffer from severe size distortions leading to bias towards rejecting the null hypothesis of non-stationarity (Schwert, 1989).

Table 6a. Correlation of shocks between Kenya and the EAC-4 (1981 – 2009)

Country	Supply shock	Demand shock
Burundi	0.0940	0.2429
Rwanda	0.0011	0.2779
Tanzania	0.1207	0.2510
Uganda	0.0113	-0.3034

Table 6b. Correlation of shocks between Kenya and the EAC-4 (1990 – 2009)

Country	Supply shock	Demand shock
Burundi	0.0432	0.1714
Rwanda	-0.0122	0.2101
Tanzania	-0.1574	0.5142*
Uganda	-0.0677	-0.0302

Source: Authors' calculations. * Indicates statistical significance. Note: Kenya is the reference country in the comparisons.

Table 6a shows the limited degree of shock synchronization between the EAC-4 (Burundi, Rwanda, Uganda, and Tanzania) and Kenya during 1981-2009. While most shocks are positively correlated, the correlation coefficients are low and none of them is statistically significant. Moreover, the demand shock has an opposite effect in Uganda. The results are not surprising in light of the major disparities in macroeconomic performances of the EAC countries, especially before 2000.

Impulse Response

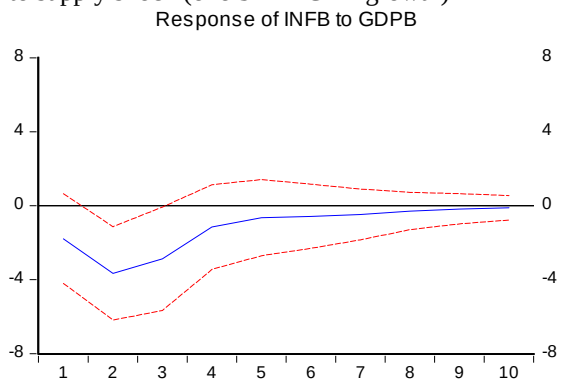
This section utilizes impulse response function to examine responses of the EAC countries to the supply and demand shocks in terms of size and the speed of the adjustment. The larger the size of the shock and the slower the adjustment, the more costly it would be for a country to maintain membership in monetary union.

An examination of the impulse response functions (Figure 6) suggests that while demand shocks have no effect on the long-run output in Burundi, Rwanda and Uganda, adjustment to such shocks takes a minimum of six years. Such slow adjustment points to rigidities in the business environments and labor markets (greater wage stickiness, for example). Moreover, past demand shocks in Tanzania and Kenya seem to have a long-lasting effect on output, suggesting that these were accompanied by supply shocks (i.e. increases in government spending accompanied by greater outlays on infrastructure, which could increase the countries' potential outputs).

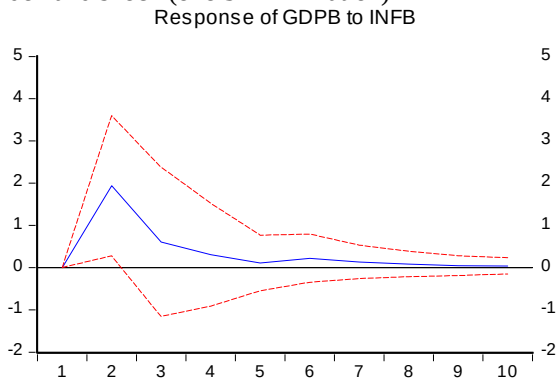
On the other hand, and as predicted by the AD-AS framework, a positive income/output shocks appear to have long-run effects on inflation in all EAC countries, with the greatest impacts in Uganda and Tanzania. These two countries have exhibited higher than the average regional variability in inflation. In general as low – income countries with high income propensity to consume, the EAC members may experience self-reinforcing effects when income shocks occur. Specifically, a positive income shock may lead to higher demand response that is reflected in rising prices.

Figure 6: Accumulated Impulse Responses to Shocks

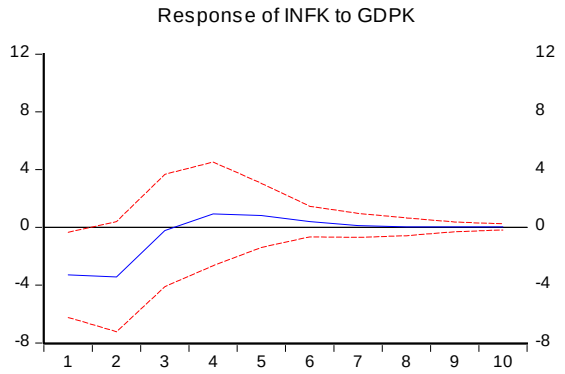
6a. Burundi: Accumulated response of inflation to supply shock (one SD in GDP growth)



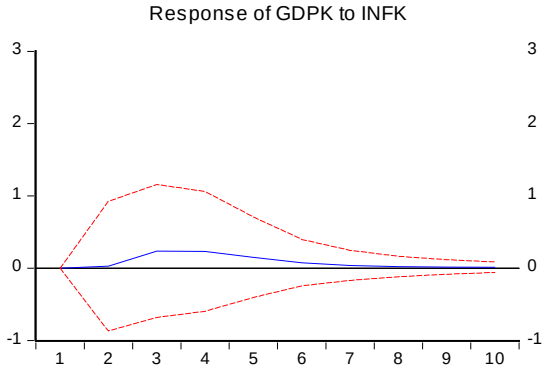
6b. Burundi: Accumulated response of GDP growth to demand shock (one SD in inflation)



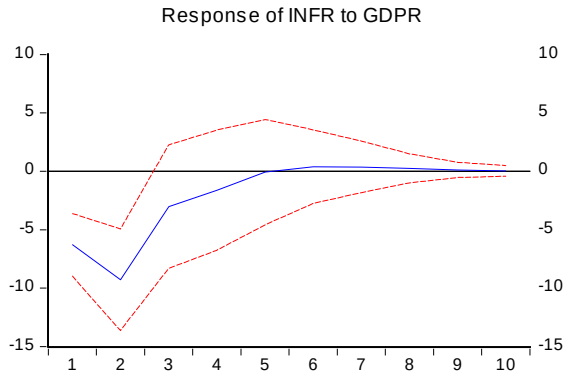
6c. Kenya: Accumulated response of inflation to supply shock (one SD in GDP growth)



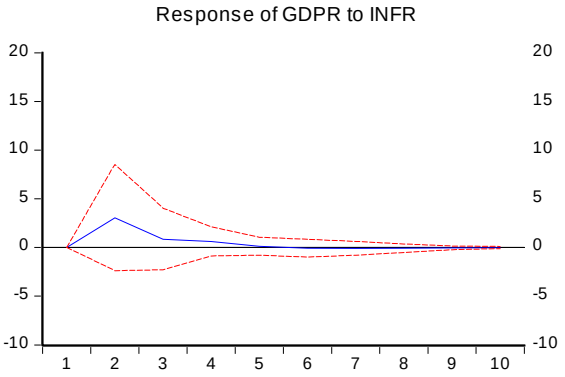
6d. Kenya: Accumulated response of GDP growth to demand shock (one SD in inflation)



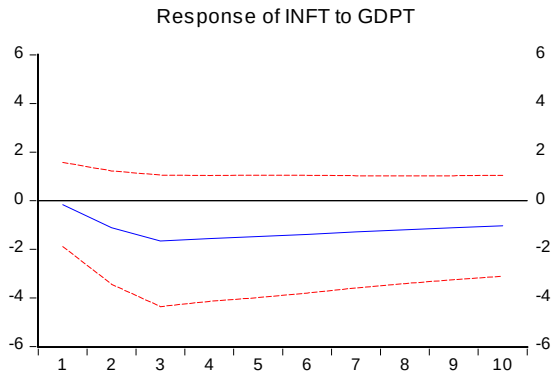
6e. Rwanda: Accumulated response of inflation to supply shock (one SD in GDP growth)



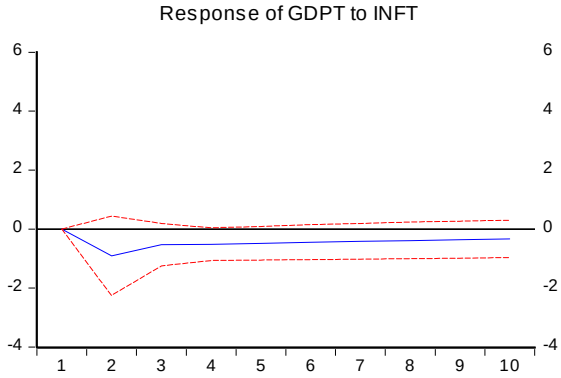
6f. Rwanda: Accumulated response of GDP growth to demand shock (one SD in inflation)



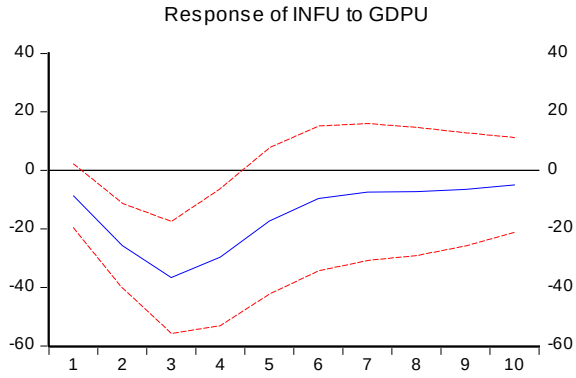
6g. Rwanda: Accumulated response of inflation to supply shock (one SD in GDP growth)



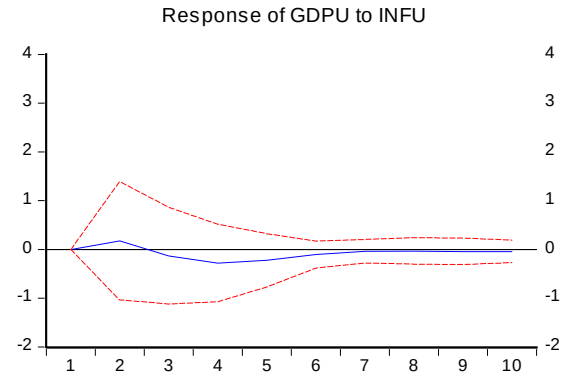
6h. Rwanda: Accumulated response of GDP growth to demand shock (one SD in inflation)



6i. Uganda: Accumulated response of inflation to supply shock (one SD in GDP growth)



6j. Uganda: Accumulated response of GDP growth to demand shock (one SD in inflation)



Source: Authors' calculations. Note: time period (on the horizontal axis); vertical axis illustrates percentage changes; and continuous line indicates percentage changes (vertical axis) in the response variable to one Standard Deviation to shock.

Variance Decomposition

This section examines which of the underlying shocks – supply and demand – contributes most to the variance of output growth and inflation in each country. The information helps gauge the degree of convergence between countries' transmission mechanisms.

Variance decomposition of the structural VAR revealed that supply shocks (e.g., changes in commodity prices, weather) accounted for most of the real output variability in all countries and tended to last longer. On the other hand, demand shocks (e.g. demand management policies) had large effects on the variability of inflation in all the EAC countries except Uganda. In Burundi prices responded more to output shocks than the rest of the regional countries. The immediate effect of the output shock was limited. The high levels of inflation Uganda until the mid-1990s tended to reinforce inflationary pressures in the short-run. Results are detailed in Table 7.

Table 7: Variance Decompositions – Full Sample

	GDP growth									
Period	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock
	Burundi		Kenya		Rwanda		Tanzania		Uganda	
1	100.0	0.0	90.8	9.2	100.0	0.0	100.0	0.0	100.0	0.0
2	81.3	18.6	91.1	8.9	75.4	24.6	92.7	7.3	99.8	0.2
3	81.4	18.6	91.0	8.9	74.1	25.9	90.5	9.5	99.7	0.3
4	81.4	18.6	90.3	9.7	73.5	26.5	88.6	11.4	99.1	0.9
5	81.4	18.6	89.9	10.1	73.6	26.4	86.9	13.1	98.8	1.2
6	81.4	18.6	89.9	10.1	73.7	26.3	85.6	14.4	98.7	1.3
7	81.4	18.6	89.9	10.1	73.7	26.3	84.5	15.5	98.7	1.3
8	81.4	18.6	89.9	10.1	73.6	26.4	83.5	16.5	98.7	1.3
9	81.4	18.6	89.9	10.1	73.6	26.4	82.7	17.3	98.7	1.3
10	81.4	18.6	89.9	10.1	73.6	26.4	82.1	17.9	98.7	1.3
	Inflation									
Period	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock	Variance to Supply Shock	Variance to Demand Shock
1	7.7	92.3	1.3	98.7	1.0	99.0	0.1	99.9	9.0	91.0
2	29.8	70.2	5.7	94.3	18.7	81.3	3.7	96.3	44.2	55.8
3	34.2	65.8	5.7	94.3	21.5	78.5	8.4	91.6	68.5	31.5
4	34.7	65.3	6.7	93.3	22.4	77.6	10.7	89.3	75.3	24.7
5	35.1	64.9	7.4	92.6	22.5	77.5	12.2	87.8	76.8	23.2
6	35.4	64.6	7.6	92.4	22.5	77.5	13.2	86.8	76.9	23.1
7	35.5	64.5	7.6	92.4	22.5	77.5	13.8	86.2	77.0	23.0
8	35.7	64.3	7.6	92.4	22.5	77.5	14.3	85.7	77.2	22.8
9	35.6	64.4	7.6	92.4	22.5	77.5	14.7	85.3	77.4	22.6
10	35.6	64.4	7.6	92.4	22.5	77.5	15.0	84.9	77.5	22.5

Note: Inf = Inflation; Q = Output

III. Conclusions and Policy Recommendations

Would the EAC countries need to give up macroeconomic stabilization capacity when establishing a common currency? We apply the OCA approach to gain some insights into this issue. The actual practice of monetary integration is underpinned by a diverse set of factors, including politics, increased credibility of monetary policy and more favorable expectations. Given this complexity, there is no (and cannot be) a "benchmark correlation coefficient" that would determine that the shock correlation of a country with potential monetary zone is sufficient for it to benefit from a common currency. Still, given the EAC's low -- albeit increasing -- synchronization of shocks and business cycles as well as the rigidities in the business environment and underdeveloped infrastructure, costs of a premature adoption of common currency in the region are likely to exceed its benefits.

The OCA approach is only one angle that countries consider when deciding whether or not to proceed with monetary integration, where the revealed shock asymmetry cautions against hasty implementation of a joint currency. The asymmetry underscores the importance of developing broader adjustment mechanisms other than monetary and

exchange rate policies. Labor and product market flexibility, and integration of financial markets are critical before establishing the EAMU. These mechanisms are crucial not only for the EAC's monetary integration, but also the creation of a prosperous and economically well connected region that could compete in the global economy.

Moreover, the recent experience from the euro zone indicates that besides fiscal union, banking union with joint supervision and regulation of systemically important financial institutions is an important element for preventing currency crises. Recent debates among the EAC policymakers indicate a preference for establishing a regional central bank that would control all the financial institutions in the region. These topics, so far unexplored for the EAC, could be addressed in future research.

The lack of macroeconomic convergence strengthens the case against a hurried transition into a monetary union in the EAC. Given the divergent macroeconomic outcomes in the EAC countries, structural reforms, including closing infrastructure gaps, and harmonized macroeconomic policies that would raise synchronization of business cycles need to be in place before a move to monetary union. In that context, the role of appropriately prudent and coordinated fiscal policy cannot be emphasized enough. As the example of the Eurozone shows, a well-functioning fiscal transfer system (or union) may be needed for the longer-term viability of monetary union.[17] Strengthening institutions charged with coordinating the regional integration agenda and increased information sharing within the region are needed. Basic rules for the regional bloc would help in this regard.

Currie, *et al* (1989) established that policy coordination was problematic unless it was based on a rules-based framework. A rules-based framework, if properly implemented, engenders some discipline among member countries and reduces the risk of bad policies being pursued. The Eurozone debt crisis is a good example of weakly enforced rules and inadequate policy coordination.

In light of the shock asymmetries in the EAC, policy coordination as currently pursued bodes well for achieving macroeconomic convergence. However, the linear approach to deepening regional integration is problematic. First, the economies are structurally different and at different stages of development. Second, intraregional trade within the region is still very low, which in itself could be a reflection of structural asymmetry. Strengthening institutions and improving the infrastructure that supports a competitive production system and trade is therefore central to deepening regional integration.

Production asymmetries aside, the compensation framework is set to mitigate the likely varied impacts that countries will experience while implementing the EAC protocol. The resources for compensation could come under pressure if the transition to the EAMU is hurried. This compensation process – if well managed and timed - will allow member countries to transform structurally and respond to regional opportunities through the optimal utilization of their comparative advantages.

[17] The EAC established a fund to compensate those countries that may face losses in implementing the EAC protocol.

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Annex A. The AD-AS Framework and Identification of Supply and Demand Shocks

Formally, the AD-AS framework is described as:

$$y_t^S = E_{t-1}y_t + \alpha\left(p_t - E_{t-1}p_t\right) + \varepsilon_t^S \qquad \text{(A1)}$$

$$y_t^D + p_t = E_{t-1}(y_t^D + p_t) + \varepsilon_t^D \qquad \text{(A2)}$$

$$y_t = y_t^S = y_t^D \qquad \text{(A3)}$$

where y_t is (the log of) output in period *t,* and $E_{t-1}y_t$ is (the log of) output expected in period *t* given information at *t-1*. Similarly, p_t is (the log of) price level in period *t,* while $E_{t-1}p_t$ is (the log of) price level expected at *t-1*. The superscripts S and D represent supply and demand, and ε_t^S and ε_t^D denote the (serially uncorrelated) structural aggregate supply and structural aggregate demand shock, respectively.

Equation (A1) is the AS curve, where output increases with unexpected increases in the positive supply shocks and price level. The AD in (A2) increases with its expected value and positive demand shocks. In (A1) – (A3) the long-run independence of nominal and real variables are independent in the long run, as the short run AS curve is upward sloping, but the long-run AS curve is vertical. System (A1) – (A3) can be written as:

$$\begin{bmatrix} y_t \\ p_t \end{bmatrix} = \begin{bmatrix} E_{t-1}y_t \\ E_{t-1}p_t \end{bmatrix} + \begin{bmatrix} \frac{1}{1+\alpha} & \frac{\alpha}{1+\alpha} \\ \frac{-1}{1+\alpha} & \frac{1}{1+\alpha} \end{bmatrix} \cdot \begin{bmatrix} \varepsilon_t^S \\ \varepsilon_t^D \end{bmatrix} \qquad \text{(A4)}$$

The joint process of changes in real output and prices can be represented by an infinite moving average representation of a vector of two variables -- real output and prices) and a vector of supply and demand shocks:

$$X_t = A_o\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \ldots\ldots = \sum_{i=0}^{\infty} L^i A_i \varepsilon_t \qquad \text{(A5)}$$

where $X_t = \begin{bmatrix} y_t \\ \pi_t \end{bmatrix}$, $\varepsilon_t = \begin{bmatrix} \varepsilon_t^S \\ \varepsilon_t^D \end{bmatrix}$, and L^i is the lag operator. The matrices A_i represent the impulse response functions that transmit effects of the shocks to the variables (elements of X_t). A finite version of (A5) can be estimated as VAR:

$$y_t = \sum_{j=0}^{k} b_{11(j)} y_{t-j} + \sum_{j=0}^{k} b_{12(j)} \pi_{t-j} + e_{yt} \qquad \text{(A6)}$$

$$\pi_t = \sum_{j=0}^{k} b_{21(j)} y_{t-j} + \sum_{j=0}^{k} b_{22(j)} \pi_{t-j} + e_{pt} \qquad \text{(A7)}$$

The matrices B_i can be estimated from $A_i = B_i A_0$ and $\sum_{i=0}^{\infty} A_i = \sum_{i=0}^{\infty} B_i A_0$. The regression residuals e_{yt}, e_{pt} consist of the underlying structural supply and demand shocks $\varepsilon_t^D, \varepsilon_t^S$. Since these shocks are not observed, they need to be identified from the VAR residuals. The equations (A5) – (A7) describe the relationship between the estimated residuals (e) and the original shocks (ε), which can be written as $e_t = A_o \varepsilon_t$:

$$\begin{bmatrix} e_{yt} \\ e_{\pi t} \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \cdot \begin{bmatrix} \varepsilon_t^S \\ \varepsilon_t^D \end{bmatrix} \qquad \text{(A8)}$$

where a_{ij} is the effect of shock *j* on variable *i*. Therefore we need to know the elements of A_0 to calculate the underlying supply and demand shocks. From (A4), the variance-covariance matrix of the VAR residuals $e_{yt}, e_{\pi t}$ is given by:

$$\begin{bmatrix} Var(e_{yt}) & Cov(e_{yt} e_{pt}) \\ Cov(e_{yt}, e_{pt}) & Var(e_{pt}) \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \cdot \begin{bmatrix} \sigma_S^2 & \sigma_{SD} \\ \sigma_{SD} & \sigma_D^2 \end{bmatrix} \cdot \begin{bmatrix} a_{11} & a_{21} \\ a_{12} & a_{22} \end{bmatrix} \qquad \text{(A9)}$$

Since estimation of the VAR yields $Var(e_{yt}), Var(e_{pt}), Cov(e_{yt}, e_{\pi t})$, the identification of the structural model requires four restrictions being imposed on the VAR. Standard assumptions are that $\sigma_S^2 = 1, \sigma_D^2 = 1$, that is variability of the demand and supply shocks is equal and normalized to unity, and that the shocks to aggregate demand and supply are uncorrelated with each other, $Cov(\varepsilon_S, \varepsilon_D) = 0$. In addition, the long-run neutrality restriction implies that cumulative effect of demand shocks on output must be zero, that is $\sum_{j=1}^{\infty} a_{12}(j) = 0$ (demand shocks has no permanent impact on output). Alternatively, the last restriction can be written as $a_{12}[1 - b_{22}(1)] + a_{22} b_{12}(1) = 0$. Finally, model assumptions that positive demand shock will raise prices in both short and long run, while positive supply shock will lower them are below used for interpreting the results of the model.

Annex B Tests for Stationarity and Residual Normality

Ng-Perron Stationarity Statistics

Country	Variable	1981 - 2009	1990 - 2009
Burundi	GDP Growth	-9.27826	-6.83788
	Inflation	-12.7881	-8.72226
Kenya	GDP Growth	-11.1380	-8.29530
	Inflation	-10.1670	-6.60626
Rwanda	GDP Growth	-13.8411	-9.31760
	Inflation	-8.94909	-10.8064
Tanzania	GDP Growth	-10.9057	-8.79786
	Inflation	-1.60702**	-2.30190**
Uganda	GDP Growth	-9.08951	-644.906
	Inflation	-4.65552**	-6.29288
*Ng-Perron (2001) Table 1 Asymptotic critical values	1%	-13.8000	
	5%	-8.10000	
	10%	-5.70000	

Notes: ** Stationary after differencing once

Example of the VAR Residual Normality Tests for Tanzania

Component	Skewness	Chi-sq	df	Prob.
1	1.940304	16.94151	1	0.0000
2	0.645145	1.872955	1	0.1711
Joint		18.81446	2	0.0001

Component	Kurtosis	Chi-sq	df	Prob.
1	8.575759	34.97522	1	0.0000
2	3.098419	0.010897	1	0.9169
Joint		34.98612	2	0.0000

Component	Jarque-Bera	df	Prob.
1	51.91673	2	0.0000
2	1.883852	2	0.3899
Joint*	53.80058	4	0.0000

* Null Hypothesis that residuals are multivariate normal cannot be rejected using the joint Jarque-Bera test.

VAR Lag Order Selection

Endogenous variables:	Lag	FPE	AIC	SC	HQ
GDPB, INFB	0	1172.426	12.74250	12.84001	12.76954
	1	857.4511*	12.42739*	12.71992*	12.50853*
	2	949.3369	12.52059	13.00814	12.65581
	3	1180.660	12.71885	13.40142	12.90817
	4	1493.049	12.91679	13.79438	13.16019
GDPK, INFK	0	403.3516	11.67548	11.77299	11.70252
	1	315.3601*	11.42715*	11.71968*	11.50828*
	2	400.6108	11.65781	12.14536	11.79304
	3	502.4777	11.86458	12.54715	12.05389
	4	440.8077	11.69682	12.57441	11.94023
GDPR, INFR	0	30860.12	16.01289	16.11040	16.03993
	1	6900.221*	14.51274*	14.80527*	14.59387*
	2	8017.876	14.65425	15.14180	14.78948
	3	9004.647	14.75052	15.43309	14.93984
	4	9819.409	14.80033	15.67792	15.04373
GDPT, INFT	0	1224.112	12.78564	12.88315	12.81269
	1	180.9008*	10.87138*	11.16391*	10.95251*
	2	248.4010	11.17987	11.66742	11.31509
	3	305.0350	11.36545	12.04802	11.55477
	4	409.8930	11.62411	12.50170	11.86751
GDPU, INFU	0	32088.84	16.05193	16.14944	16.07898
	1	6352.749	14.43007	14.72260*	14.51121
	2	7307.924	14.56154	15.04909	14.69676
	3	5839.882	14.31749	15.00006	14.50681
	4	4557.396*	14.03272*	14.91031	14.27612*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion.

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