

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

by

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Abstract

This paper uses VAR techniques to investigate the potential for forming monetary unions in Eastern and Southern Africa. All countries in the sample are members of various regional economic organizations. Some of the organizations have a monetary union as an immediate objective whereas others consider it as a possibility in the more distant future. Our objective is to sort out which countries are suitable candidates for a monetary union based on the synchronicity of demand and supply disturbances. 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.

JEL classification: F33; F15

Keywords: East and Southern Africa, Economic Integration, Monetary union, Structural VAR model

1. 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 (Appendix 1). Some countries also use a common currency. For example, the Common Monetary Area (CMA) uses the South African Rand while 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 recent years, with the launching of the euro, a number of regional integration groupings in Africa have started to seriously consider monetary union, a few of them even setting tentative time tables for the process. For example, the revived East African Community (EAC)¹ 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 2013². These recommendations are now to be debated by member countries. The Southern African Development Community (SADC) has monetary union in the cards too, with a Central Bank Governors meeting in February 2005³, proposing 2016 for a SADC common currency. The Common Market for Eastern and Southern Africa (COMESA) 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, 2004). However, the effect of overlapping membership is viewed by many (World Bank, 2000; 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 Eastern and Southern Africa (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 et. al. (2005) considers the possibility of extending the UEMOA to include countries in the proposed West Africa Monetary Zone (WAMZ). 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 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 a number of studies have used the same approach to investigate the situation in Central and Eastern Europe (Fidrmuc and Korhonen 2001; Frenkel and Nickel, 2002) and in East Asia (Yuen and Ling, 2001; Zhang et. al., 2004). Application of this methodology to Africa has been limited to Fielding and Shields (2001) 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 (2004) 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 rest of the paper is structured as follows. The next section gives an over view of ESA region, Section 3 introduces the methodology. Section 4 presents the empirical results and makes references to the results obtained in the literature using alternative methods. Section 5 concludes.

2. 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 1). 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 2 shows 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.⁴ A few countries show relatively 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. Estimates of unrecorded trade in the sub-region are also high, in some cases over 50% of recorded trade (Ackello-Ogutuu and Echessa, 1998). The stronger trade 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 OCA theory (Mundell, 1961; McKinnon, 1963), 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, 2004), 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, although Ethiopia has high unemployment, it appears to have downward inflexibility of wages, in contrast to South Africa where studies show that unemployment has an impact on wages identical to that found in OECD countries (Teal, 2000). Some countries have shown a union impact on wages, e.g. South Africa (Schultz and Mwabu, 1997) and Kenya (IMF, 2003).

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.

3. 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 sloping 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:

$$X_t \equiv \begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} = \sum_{i=0}^{\infty} L^i A_i \varepsilon_{t-i} \quad (1)$$

where 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 ε_{dt} , ε_{st} are independent white noise supply and demand shocks normalized so that $\text{Var}(\varepsilon_t)=I$. 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:

$$\sum_{i=0}^{\infty} a_{11i} = 0 \quad (2)$$

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 :

$$X_t = K + \Phi_1 X_{t-1} + \Phi_2 X_{t-2} + \dots + \Phi_p X_{t-p} + e_t, \quad (3)$$

where K denotes a vector of constants, Φ_i s 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:

$$\mu = K + \Phi_1 \mu + \Phi_2 \mu + \dots + \Phi_p \mu \quad (4)$$

Subtracting (4) from (3) gives (3) in terms of deviations from the mean:

$$X_t - \mu = \Phi_1(X_{t-1} - \mu) + \Phi_2(X_{t-2} - \mu) + \dots + \Phi_p(X_{t-p} - \mu) + e_t \quad (5)$$

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

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

Then (5) can be written as VAR(1):

$$\xi_t = F\xi_{t-1} + V_t \quad (6)$$

and recursive substitution of (6) implies that:

$$\xi_{t+s} = V_{t+s} + FV_{t+s-1} + F^2V_{t+s-2} + \dots + F^{s-1}V_{t+1} + F^s \xi_t \quad (7)$$

If the eigenvalues of F all lie inside the unit root circle, then $F^s \rightarrow 0$ as $s \rightarrow \infty$ and the VAR is covariance stationary (Hamilton, 1994). The first two rows of (7) then give the vector moving average (∞) representation of X_t :

$$X_t = \mu + e_t + C_1e_{t-1} + C_2e_{t-2} + C_3e_{t-3} + C_3e_{t-3} + C_4e_{t-4}. \quad (8)$$

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 j^{th} power. Equations (1) and (8) yield the relationship between the estimated residuals (e_t) and the structural shocks (ε_t):

$$e_t = A_0\varepsilon_t \quad (9)$$

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_i s are known from estimation. To recover the four elements of

A_0 in the two-by-two case we need four restrictions⁵. Two are simple normalizations which define the variances of ε_{dt} , and ε_{st} (usually to one). Since ε_{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:

$$\begin{aligned} \text{Var}(e_{yt}) &= a_{11}(0)^2 + a_{12}(0)^2 \\ \text{Var}(e_{pt}) &= a_{21}(0)^2 + a_{22}(0)^2 \\ \text{cov}(e_{yt}, e_{pt}) &= E(e_{yt} e_{pt}) = a_{11}(0)a_{21}(0) + a_{12}(0)a_{22}(0) \end{aligned} \quad (10)$$

The final restriction is to impose the condition that demand shocks have no long term effects on output as in (2). In terms of the VAR this implies:

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

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 IMF's *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

1980-2002. 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 1980s, Rwanda and Burundi in the early 1990s 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 UK, and the US span the period 1970-2001. We consider a GDP-weighted aggregate of all EMU countries as well as a few core countries individually: Germany, France, and Italy.

4. 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 (Appendix 2). 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 3, 4, 5, and 6 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 (Bayoumi and Eichengreen, 1994). The correlations of contemporaneous and lagged supply shocks in Tables 3 and 4 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 US are symmetric, while the contemporaneous shocks for Madagascar and Mauritius are symmetric with those of the EMU and the US 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 US shocks.

The correlations of demand shocks reported in Tables 5 and 6 seem to reinforce the overall view of asymmetry seen from Tables 3 and 4. 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) and Frenkel and Nickel (2002).

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 Zambia⁶. 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 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 IOC 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 US 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 brevity, 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 7 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 percent, but nonetheless greater than those for the Euro-bloc, the UK, and the US (less than 2%). The speed of adjustment is relatively high, with most effects 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, UK and US. 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 US and UK. 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 US, UK 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 8 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. 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 (Yuen and Ling, 2001; Zhang et. al., 2004) or those presented for the European Union by Ballabriga et. al. (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.

5. 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 economies⁷; 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.

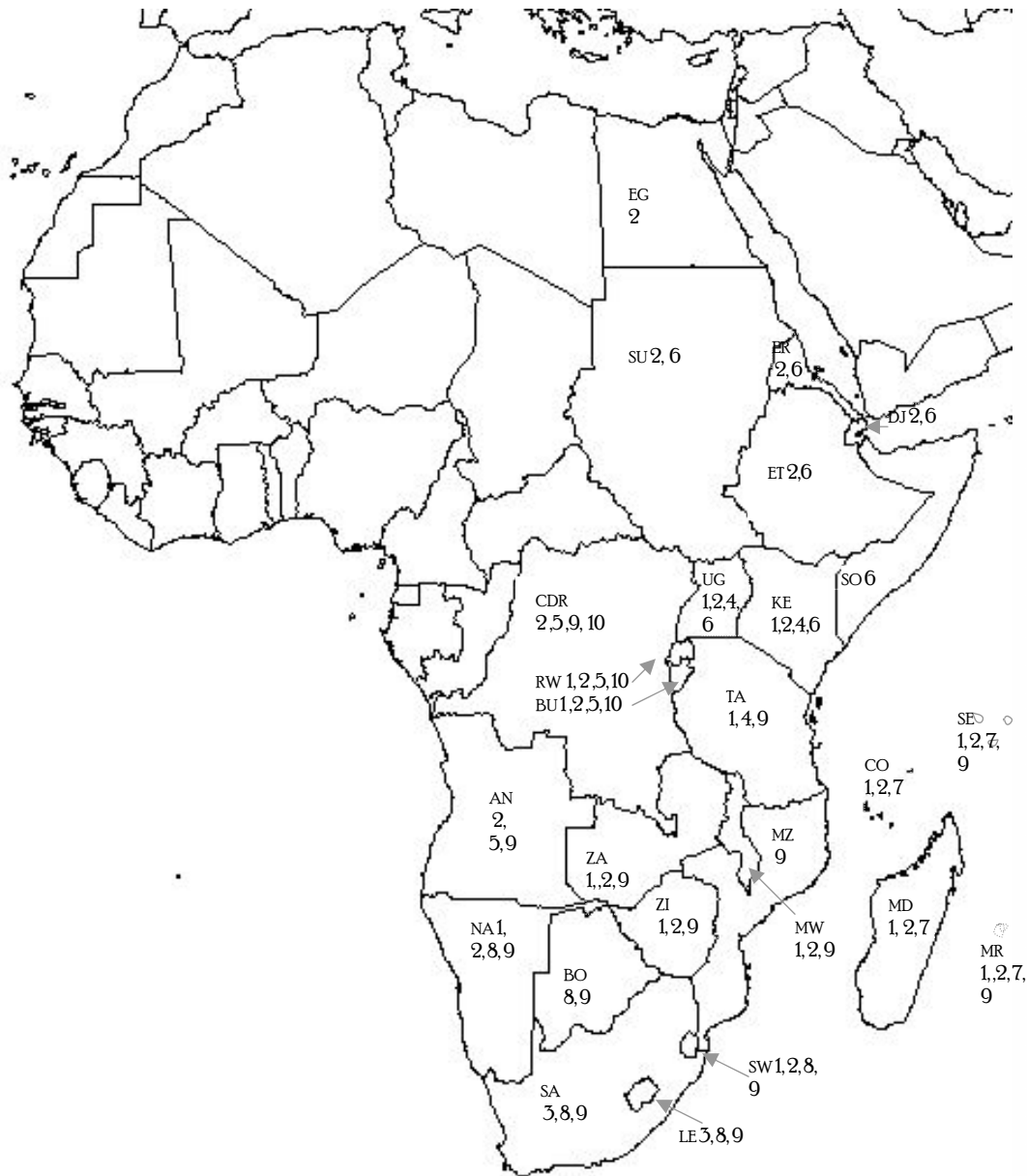
Recent literature suggests endogeneity of OCA criteria in the sense that it might be easier to satisfy them after a monetary union is formed than before. Studies have shown positive and economically significant (33%-90%) trade effect of monetary union (Rose, 2004). Theoretically, the effect of increased 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

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 integration⁸. 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 politicians would be reluctant – even in the face of unfavorable economics - to be left out.

Appendices

Appendix 1 Regional Economic Groups in Sub-Saharan Africa



Notes:

- 1) Cross Border Initiative (CBI). Launched in 1992 with the support of ADB, EC, IMF, and WB, the CBI is a framework of harmonized policies to facilitate a market-driven concept of integration in Eastern and Southern Africa region and the Indian Ocean.
- 2) Common Market for Eastern and Southern Africa (COMESA). The 20 member COMESA began as the Preferential Trade Area (PTA) in 1983. In 1994 COMESA replaced the PTA. COMESA has the objective of establishing a common market and monetary union by 2025.

- 3) Common Monetary Area (CMA): The CMA is a monetary arrangement that uses the South African Rand as a common currency though each member country issues its own currency at par with the Rand. The Rand zone came into existence formally in 1974 when South Africa, Botswana, Lesotho, and Swaziland signed the Rand Monetary Agreement (RMA). Botswana opted out in 1976, but remains linked to the Rand through a currency basket where the Rand weighs 60-70 percent. The CMA replaced the RMA in 1986, and Namibia joined in 1992.
 - 4) East African community (EAC): Currently only 3 countries are involved. But Rwanda and Burundi have applied to join. The East African countries revived the EAC with the treaty of 1999, and have signed a Customs Union Protocol in 2004. A Common Market, A Monetary Union, and ultimately a Federation are planned. The renewed interest in monetary cooperation in East Africa comes nearly four decades after the demise of the East African Currency Board (EACB) in 1966.
 - 5) Economic Community of Central African States (ECCAS). An 11 member community, the ECCAS was established in 1983 by members of Central African Customs and Economic Union (UDEAC) and Economic Community of the Great Lakes (CEPGL). Angola became a fully fledged member in 1999. The objective is economic stability in the region and ultimately a Central African Common Market
 - 6) Intergovernmental Authority on Development (IGAD). IGAD was created in 1996 by 7 member states in the horn of Africa to supersede the Intergovernmental Authority on Drought and Development (IGADD). The objective of IGAD is to achieve economic integration and sustainable development in the region.
 - 7) Indian Ocean Commission (IOC). IOC was created in 1984 with three members; Seychelles, Madagascar, Mauritius. The Comoros and Réunion (a French colony and not included in study) joined in 1986. The objective of IOC is economic and commercial cooperation especially on maritime resources.
 - 8) Southern African Customs Union (SACU). The five member SACU was established in 1910. Tariffs, collected by South Africa, are paid into the South African Revenue Fund. The share for the other states is calculated based on a formula, with the residual going to South Africa.
 - 9) Southern Africa Development Community (SADC). SADC is a 13 member organization established in 1992. Its forerunner, Southern Africa Coordination Conference (SADCC) was mainly concerned with lessening dependence on the then apartheid-ruled South Africa. SADC's objective is to become a common market, and Monetary union.
 - 10) Economic Community of the Great Lakes Countries (CEPGL). The three member community, CEPGL, was established in 1976. The objective is to promote security and regional economic cooperation.
- *Communauté Économique des États d'Afrique Centrale (CEMAC). A 6 member CFA Franc zone: Cameroon, Chad, Congo, Central A. Rep., E. Guinea, and Gabon.
- *Union Économique et Monétaire Ouest Africaine (UEMOA). The second 8 member CFA Franc zone: Benin, B. Fasso, Cote d'Ivoire, G-Bissau, Mali, Niger, Senegal and Togo.
- *West Africa Monetary Zone (WAMZ). A proposed monetary zone with five members: Gambia, Ghana, Guinea, Nigeria, S. Leone.
- (* Not included in study).

Appendix 2 Eigenvalue stability condition. All the eigenvalues (except for Zimbabwe) lie inside the unit root circle.

Botswana	.2590692 + .6246209i	.2590692 - .6246209i	.4089056 + .3141038i	.4089056 - .3141038i
Burundi	.3248622 + .313089i	.3248622 - .313089i	-0.41798	0.292918
Comoros	0.66989	-0.42474	-.2827078 + .315506i	-.2827078 - .315506i
Egypt	0.530908	.3099168 + .1664645i	.3099168 - .1664645i	-0.17048
Ethiopia	-0.66534	0.523973	-.02166416 + .3032552i	-.02166416 - .3032552i
Kenya	.3781657 + .2849878i	.3781657 - .2849878i	0.361337	-0.20006
Lesotho	.06656797 + .6797069i	.06656797 - .6797069i	-0.4928	0.326938
Madagascar	.2994799 + .5352505i	.2994799 - .5352505i	.00004683 + .4507063i	.00004683 - .4507063i
Mauritius	0.791532	.33261 + .485475i	.33261 - .485475i	-0.25113
Malawi	-0.57	.325979 + .2996425i	.325979 - .2996425i	0.256229
Mozambique	.6019361 + .1585619i	.6019361 - .1585619i	-0.4501	-0.02752
Namibia	.07092345 + .5326837i	.07092345 - .5326837i	-0.49132	0.397418
Rwanda	-0.41745	.2386292 + .3200258i	.2386292 - .3200258i	-0.20306
South Africa	0.720133	.1830761 + .4748003i	.1830761 - .4748003i	-0.24097
Seychelles	0.80347	.1113275 + .56843i	.1113275 - .56843i	-0.47477
Sudan	0.855946	.2296599 + .5079118i	.2296599 - .5079118i	-0.22133
Swaziland	-0.59124	-.1681201 + .4976256i	-.1681201 - .4976256i	0.52525
Tanzania	.3475588 + .3641935i	.3475588 - .3641935i	0.328399	-0.10391
Uganda	.6550534 + .05269854i	.6550534 - .05269854i	-0.40497	-0.01825
Zambia	0.762015	-.1605999 + .3214873i	-.1605999 - .3214873i	0.176776
Zimbabwe	1.182185*	-0.48305	.2441246 + .389508i	.2441246 - .389508i
France	0.9496	-0.4044	0.2261 + 0.1985i	0.2261-0.1985i
Germany	0.3823	0.3521 + 0.3478i	0.3521 - 0.3478i	-0.2265
Italy	0.9309	-0.0135 + 0.4237i	-0.0135 - 0.4237i	0.3025
UK	0.8346	0.1833 + 0.4660i	0.1833 - 0.4660i	-0.1883
US	0.9335	0.2656 + 0.6196i	0.2656 - 0.6196i	-0.3028
Euro-Bloc	0.9289	0.1564 + 0.4263i	0.1564 - 0.4263i	-0.0586

Notes: The eigenvalues λ of the matrix F in (6) satisfy:

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

The VAR is covariance stationary as long as $|\lambda| < 1$, that is lie within the unit root circle, such that the consequences of (ε_t) eventually dies out. Except for Zimbabwe (which is dropped from analysis) the VAR satisfies stability condition.

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NOTES

¹ The EAC 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.

² See www.eac.int/news

³ See Business Report, March 1, 2005. www.busrep.co.za

⁴ Political interferences in monetary affairs, which is widespread in Africa, are prime causes of harmful monetary uncertainty. Several authors (Mundell, 2002; Guillaume and Stasavage, 2000) make an argument for monetary union on this ground, that a monetary union acting as an agent of monetary and possibly fiscal restraint could produce large gains for its members from increased macroeconomic stability.

⁵ Four equations to solve for four unknowns

⁶ South Africa's earlier reluctance to expand the CMA noted in Sparks (2002) seems to have given way to a support of a SADC currency, making a SADC currency more feasible.

⁷ 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 extent, of the EAC. A new currency, probably a joint "Shilling" like in the old EACB may be preferable.

⁸ 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. UK's entry into EMU would thus eliminate any conflict of interest.

Table 1. East and Southern Africa countries' main exports (2003) as percent of total exports

Country	Commodity	Country	Commodity	Country	Commodity
Botswana:	Diamonds (87.6)	Madagascar:	Vanilla (24.7), Crustaceans (16.2), Assorted clothing (27.5)	South Africa:	Platinum (10.1), Cars and trucks (7.5)
Burundi:	Coffee (76.8)	Mauritius:	Assorted clothing (51.5), Cane(& beet) sugar (16.3)	Seychelles:	Prepared Fish and caviar (54.2), Fish (whole) (28.9)
Comoros:	Vanilla (74.9), Cloves (11.6)	Malawi:	Tobacco (unmanufactured) (49.3), Cane(beet) sugar (23.1)	Sudan:	Crude petroleum (80.0)
Egypt:	Petroleum oils (not Crude) (15.5), Crude petroleum (13.1)	Mozambique:	Unwrought Aluminum (69.4)	Tanzania:	Gold (36.1), Fish (9.4)
Ethiopia:	Coffee (36.0), Vegetable products (21.6)	Namibia:	Fish (16.5), Banknotes, unused stamps (11.3), Diamonds (10.9)	Uganda:	Coffee (22.4), Fish (14.2)
Kenya:	Petroleum oils (not Crude) (19.1), Tea (19.0), Cut flowers (6.9)	Rwanda:	Coffee (27.8), Tea (23.8)	Zambia:	Refined copper, copper alloys (35.5), copper plates/sheets (13.8), cobalt mattes (11.0)
Lesotho:	Assorted clothing (94.7)	Zimbabwe:	Tobacco (32.9), Nickel ore and unwrought (17.4)		

Source; United Nations, www.intracen.org

Table 2. Trade relations of ESA countries as percent of total exports (imports), (2003)

		US	W/Europe	Africa	ESA	Top two ESA trading partners
Burundi	Exports	1.63	60.53	9.07	8.19	Rwanda (5.7), Uganda (2)
	Imports	2.12	32.16	44.03	40.86	Kenya (14.4), Tanzania (11.7)
Comoros	Exports	11.77	73.19	0.95	0.69	Madagascar (0.4), Mauritius (0.3)
	Imports	0.56	41.62	22.56	21.62	South Africa (10.2), Kenya (5.4)
Egypt	Exports	13.35	54.22	4.52	2.01	Sudan (1.1), Kenya (0.3)
	Imports	13.65	19.39	2.59	1.23	Kenya (0.6), Sudan (0.3)
Ethiopia	Exports	5.07	31.85	18.46	2.43	Kenya (1.1), Egypt (0.8)
	Imports	17.03	20.59	2.51	1.99	Kenya (1.2), South Africa (0.7)
Kenya	Exports	9.43	32.90	37.46	32.02	Uganda (12.7), Egypt (4.6)
	Imports	5.14	23.84	14.02	13.06	South Africa (8.6), Uganda (2.1)
Madagascar	Exports	29.23	50.48	8.03	7.62	Mauritius (5.2), South Africa (1.9)
	Imports	2.27	23.84	14.56	11.40	South Africa (6.3), Mauritius (2.9)
Mauritius	Exports	17.55	67.35	10.01	9.60	Madagascar (6.3), South Africa (1.5)
	Imports	2.62	29.49	17.01	16.12	South Africa (12.1), Madagascar (2.1)
Malawi	Exports	13.47	33.29	34.21	31.90	South Africa (23.3), Egypt (5.7)
	Imports	2.97	12.64	69.55	65.60	South Africa (53.7), Tanzania (3.8)
Mozambique	Exports	0.80	52.81	21.71	16.59	South Africa (14.4), Malawi (1.2)
	Imports	3.87	14.48	27.50	26.76	South Africa (26.3), Malawi (0.2)
Rwanda	Exports	1.73	11.07	2.95	1.82	South Africa (0.9), Botswana (0.4)
	Imports	2.44	25.38	38.33	35.71	Kenya (23.4), Uganda (6.3)
SACCA*	Exports	2.97	93.32	2.58	1.75	Kenya (1.1), Uganda (0.3)
	Imports	16.02	45.27	0.45	0.63	Madagascar (0.3), Malawi (0.3)
S. Africa	Exports	12.38	40.90	14.46	7.34	Zambia (1.9), Mozambique (1.3)
	Imports	8.25	45.64	4.45	1.74	Zambia (0.6), Mozambique (0.4)
Seychelles	Exports	0.81	95.56	0.47	0.43	South Africa (0.3), Mauritius (0.1)
	Imports	0.86	39.18	14.22	14.16	South Africa (10.8), Mauritius (2.2)
Sudan	Exports	0.26	12.79	4.39	3.72	Egypt (2.4), Kenya (0.6)
	Imports	0.64	23.90	7.98	7.47	Egypt (3.8), Kenya (2.4)
Tanzania	Exports	2.51	31.47	19.72	15.90	Kenya (4.7), Malawi (2.4)
	Imports	3.22	22.61	23.80	23.34	South Africa (10.1), Zambia (6.4)
Uganda	Exports	2.39	40.41	36.07	30.65	Kenya (14.8), south Africa (5.6)
	Imports	5.70	19.33	35.72	35.53	Kenya (26.1), South Africa (7.2)
Zambia	Exports	0.65	43.50	45.62	39.61	South Africa (21.6), Tanzania (13.9)
	Imports	2.10	15.05	67.66	54.06	South Africa (48.3), Tanzania (1.5)

Source: IMF's Direction of Trade Statistics (2004).

Note: SACCA*: SACU countries excluding South Africa.

Table 3. Correlations of contemporaneous supply shocks

	BO	BU	CO	EG	ET	KE	LE	MD	MR	MW	MZ	NA	RW	SA	SE	SU	SW	TA	UG	ZA
Botswana	1.00																			
Burundi	-0.08	1.00																		
Comoros	-0.41	-0.03	1.00																	
Egypt	0.28	-0.30	0.31	1.00																
Ethiopia	0.01	0.11	0.00	0.21	1.00															
Kenya	-0.23	-0.07	-0.28	-0.04	-0.04	1.00														
Lesotho	0.03	0.11	0.39	0.19	0.19	-0.13	1.00													
Madagascar	-0.19	-0.34	0.02	0.16	-0.22	0.40	-0.24	1.00												
Mauritius	-0.37	0.42	0.08	-0.07	0.18	0.39	0.31	0.52	1.00											
Malawi	-0.14	-0.38	-0.29	0.11	0.08	0.29	0.06	0.00	-0.07	1.00										
Mozambique	-0.23	0.05	0.04	-0.32	0.22	0.23	-0.04	0.17	0.57	0.05	1.00									
Namibia	-0.07	0.21	0.16	0.01	0.05	-0.39	0.34	0.00	0.21	-0.46	-0.11	1.00								
Rwanda	-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							
South Africa	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						
Seychelles	-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					
Sudan	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				
Swaziland	-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			
Tanzania	-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		
Uganda	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	
Zambia	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
France	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
Germany	-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
Italy	-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
Euro-bloc	-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
UK	-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
US	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

Notes: Bold indicates statistical significance at the 10 percent level.

Table 4. Correlations of contemporaneous supply shocks with supply shocks lagged one period.

	BO	BU	CO	EG	ET	KE	LE	MD	MR	MW	MZ	NA	RW	SA	SE	SU	SW	TA	UG	ZA
LBotswana	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
LBurundi	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
LComoros	-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
LEgypt	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
LEthiopia	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
LKenya	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
LLesotho	-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
LMadagascar	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
LMauritius	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
LMalawi	-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
LMozamb.	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
LNamibia	-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
LRwanda	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
LSouth Africa	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
LSeychelles	-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
LSudan	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
LSwaziland	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
LTanzania	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
LUganda	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
LZambia	-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
LFrance	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
LGermany	-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
Litaly	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
Leuro-bloc	-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
LUK	-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
LUS	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: Bold indicates statistical significance at the 10 percent level. (L) Indicates supply shocks lagged one period.

Table 5. Correlations of contemporaneous demand shocks.

	BO	BU	CO	EG	ET	KE	LE	MD	MR	MW	MZ	NA	RW	SA	SE	SU	SW	TA	UG	ZA
Botswana	1.00																			
Burundi	0.08	1.00																		
Comoros	-0.23	-0.39	1.00																	
Egypt	0.04	0.04	-0.09	1.00																
Ethiopia	-0.11	-0.14	-0.25	-0.13	1.00															
Kenya	-0.10	0.07	-0.39	-0.09	0.03	1.00														
Lesotho	0.00	0.04	-0.30	-0.10	0.23	-0.06	1.00													
Madagascar	-0.04	-0.15	-0.06	0.06	0.02	0.54	-0.17	1.00												
Mauritius	0.42	0.21	-0.10	-0.08	0.04	0.30	-0.25	0.19	1.00											
Malawi	-0.09	-0.21	0.07	-0.02	-0.11	-0.04	-0.08	0.27	-0.59	1.00										
Mozamb.	0.24	-0.08	-0.17	0.61	-0.10	0.12	0.37	0.31	-0.06	0.05	1.00									
Namibia	0.59	0.23	-0.04	-0.09	0.14	-0.26	0.29	-0.03	0.37	0.03	0.04	1.00								
Rwanda	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							
South Afr.	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						
Seychelles	-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					
Sudan	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				
Swaziland	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			
Tanzania	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		
Uganda	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	
Zambia	-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
France	-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
Germany	-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
Italy	-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
Euro-bloc	-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
UK	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
US	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

Notes: Bold indicates statistical significance at the 10 percent level.

Table 6. Correlations of contemporaneous demand shocks with demand shocks lagged one period.

	BO	BU	CO	EG	ET	KE	LE	MD	MR	MW	MZ	NA	RW	SA	SE	SU	SW	TA	UG	ZA
LBotswana	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
LBurundi	-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
LComoros	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
LEgypt	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
LEthiopia	-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
LKenya	-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
LLesotho	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
LMadagascar	-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
LMauritius	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
LMalawi	-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
LMozamb.	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
LNamibia	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
LRwanda	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
LSouth Africa	-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
LSeychelles	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
LSudan	-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
LSwaziland	-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
LTanzania	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
LUganda	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
LZambia	-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
LFrance	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
LGermany	-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
Litaly	-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
Leuro-bloc	-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
LUK	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
LUS	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: Bold indicates statistical significance at the 10 percent level. (L) Indicates demand shocks lagged one period.

Table 7. Long-run size of impulse responses.

Time	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						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Botswana	0.01	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.05	0.04	0.04	0.04	0.04	-0.02	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02
Burundi	0.02	0.01	0	-0.01	-0.01	-0.01	-0.01	0.01	-0.01	-0.02	-0.03	-0.03	-0.03	-0.03	-0.07	-0.09	-0.08	-0.07	-0.06	-0.06	-0.06
Comoros	0.01	0.01	-0.01	0	-0.01	-0.01	-0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	-0.04	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05
Egypt	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.07	0.08	0.09	0.09	0.1	0.1	0.02	0	0.01	0.02	0.03	0.03	0.04
Ethiopia	0.13	0.12	0.11	0.11	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.12	0.12	-0.11	-0.1	-0.08	-0.08	-0.08	-0.08	-0.08
Kenya	0.05	0.1	0.12	0.13	0.13	0.13	0.12	0.04	0.03	0.02	0.01	0.01	0.01	0.01	-0.01	-0.07	-0.11	-0.12	-0.12	-0.12	-0.12
Lesotho	0.04	0.05	0.04	0.03	0.04	0.04	0.04	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.03	0.03	0.03	0.03	0.03
Madagascar	0.04	0.04	0.03	0.03	0.03	0.03	0.03	0.06	0.09	0.1	0.09	0.08	0.08	0.08	-0.02	-0.05	-0.04	-0.02	-0.02	-0.02	-0.03
Mauritius	0.04	0.07	0.07	0.07	0.06	0.06	0.06	0.01	0.02	0.03	0.03	0.04	0.04	0.04	0	0.03	0.05	0.06	0.07	0.07	0.07
Malawi	0.05	0.03	0.04	0.04	0.04	0.04	0.04	0.09	0.14	0.15	0.15	0.14	0.14	0.14	0	-0.05	-0.08	-0.1	-0.1	-0.1	-0.1
Mozambique	0.06	0.09	0.11	0.11	0.11	0.11	0.1	0.19	0.23	0.31	0.34	0.37	0.38	0.39	0.05	0.02	-0.02	-0.05	-0.08	-0.11	-0.12
Namibia	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.05	0.04	0.03	0.04	0.04	0.04	0.01	0	0.01	0.01	0.01	0.01	0.01
Rwanda	0.09	0.07	0.05	0.04	0.04	0.04	0.04	0.05	0	0	-0.01	0	0	0	-0.11	-0.14	-0.16	-0.15	-0.15	-0.15	-0.15
South Africa	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.07	0.07	0.07	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Seychelles	0.06	0.06	0.04	0.04	0.04	0.04	0.04	0.03	0.05	0.08	0.1	0.11	0.12	0.13	-0.04	-0.01	-0.01	-0.02	-0.02	-0.02	-0.02
Sudan	0.05	0.07	0.07	0.06	0.06	0.06	0.06	0.12	0.21	0.28	0.35	0.4	0.45	0.49	-0.06	-0.09	-0.11	-0.14	-0.17	-0.19	-0.21
Swaziland	0.04	0.03	0.05	0.05	0.05	0.05	0.05	-0.04	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Tanzania	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.1	0.16	0.18	0.19	0.19	0.19	0.19	0.02	0.01	0	0	0	0	0.01
Uganda	0.05	0.07	0.07	0.07	0.07	0.07	0.06	0.19	0.26	0.35	0.41	0.45	0.48	0.51	-0.07	-0.15	-0.25	-0.34	-0.42	-0.48	-0.52
Zambia	-0.04	-0.03	-0.02	-0.03	-0.03	-0.02	-0.02	0.15	0.28	0.39	0.47	0.53	0.58	0.61	-0.03	-0.04	-0.05	-0.07	-0.08	-0.09	-0.09
Euro-bloc	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.03	0.03	0.04	0.05	0.05	0.00	0.00	0.00	0.01	0.01	0.01	0.01
UK	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.02	0.05	0.06	0.07	0.08	-0.02	-0.04	-0.05	-0.06	-0.07	-0.08	-0.09
US	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.02	0.03	0.03	0.04	0.04	-0.01	-0.02	-0.02	-0.03	-0.03	-0.03	-0.04

Notes: Multiply by 100 to get percent change in variable

Table 8. Variance decomposition: Proportion of real output and price variability due to demand shocks.

Horizon: yrs	Variation in output due to demand shock						Variation in price due to demand shock					
	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.