IMPLICATIONS OF CREDIBILITY AND PREFERENCE UNCERTAINTY FOR MONETARY UNION

by

Steven K. Buigut
Georgia State University

Neven T. Valev
Georgia State University

Abstract

An important benefit of monetary unions is the potential for some countries to "import monetary credibility" from other member countries with reputation for prudent monetary policy (e.g. Germany in the eurozone). However, a number of monetary unions have been proposed among groups of developing countries that lack a history of stable prices or simply have a short history of independent monetary policy. In this paper we show that a monetary union can enhance monetary stability for its member states even in this environment. An application of our theory to the proposed East African monetary union (between Kenya, Tanzania, Uganda, and possibly Burundi and Rwanda) indicates that only three out of the five countries would benefit from the union. However, the net benefit for each country depends on the institutional structure for decision-making that would be adopted in an East Africa monetary union. Furthermore, all five countries would benefit from a monetary union that is anchored to the euro.

JEL classification: F33; F15
Key words: credibility, uncertainty, welfare, monetary union

Steven Buigut (Corresponding Author): Georgia State University, P.O. Box 3992, Atlanta, GA, 30302-3992; Telephone: 770-912-0475; Fax: 404-651-4985; E-mail; sbuigut2@gsu.edu.
Valev: Georgia State University, P.O Box 3992, Atlanta, GA, 30302-3992; Telephone: 404-651-0418; Fax: 404-651-4985; E-mail: nvalev@gsu.edu.

1. Introduction

The decision to enter a monetary union can bring important economic benefits as well as costs for the member countries. Starting with (Mundell 1961), the literature has identified the restricted ability of member countries to react to negative economic shocks as the main cost of monetary unions. In a monetary union, monetary and exchange rate policies are decided at the union level and may not always be in line with the current needs of each member country. This is particularly problematic if the member countries have dissimilar business cycles and if wage rigidity and restricted labor mobility hamper macroeconomic adjustment. On the benefits side, monetary unions eliminate exchange rate uncertainty and the currency conversions costs among the member states, which may spur international trade and investment. An important benefit that has dominated recent literature is the credibility argument. Monetary unions create the potential for some countries to "import monetary credibility" (Herrendorf 1997) from other member countries with reputation for prudent monetary policy (e.g. Germany in the eurozone) rather than earn it through the alternative time consuming way of building a track record ((Blinder 2000). Participation in the union lowers expected and actual inflation for such countries.[1]

In this paper we show that a monetary union can enhance monetary stability for its member states even if none of them have a history of prudent monetary policy. This is important because a number of monetary unions have been proposed among groups of developing countries that lack a history of stable prices or simply have a short history of independent monetary policy.[2] Some authors, e.g. (Mundell 2002), have argued that monetary unions could provide a means for credible commitment to sound macroeconomic policies. For example,

[1] However a common currency area (CCA) may lead to inefficiencies associated with lack of credibility in monetary policy. For exampleBottazzi, L. and P. Manasse (2002) show that in a CCA lack of commitment to the redistribution of seigniorage leads to excessive inflation and suboptimal taxation.

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

(Guillaume and Stasavage 2000) provide evidence that African countries that participate in monetary unions tend to pursue more credible monetary policies.

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

Our theoretical analysis extends a growing literature on the monetary and fiscal policy interaction in monetary union. (Debrun, Masson et al. 2005) analyze the implication of financing needs using a theoretical framework that includes fiscal policy. (Beetsma and Bovenberg 1999) explore how monetary unification impacts the accumulation of public debt and show that under fiscal leadership it may discipline fiscal and monetary policy, while (Dixit and Lambertini 2003) explore the interaction of a centralized monetary policy with decentralized fiscal policy. They show that when monetary and fiscal authorities in a monetary union agree on the ideal output and inflation levels, ideal outcomes emerge as the equilibrium without the need for monetary

commitment. Our analysis of the effect of asymmetry of central bank preferences in a monetary union is new to the literature.

As an application to the theory, we investigate the feasibility of monetary union in the East African Community. The three member countries: Kenya, Tanzania, and Uganda, have officially declared their goal to form a currency union by year 2009. Two neighboring countries, Rwanda and Burundi, have indicated an interest to join and are included in the analysis. None of the five countries has a long or particularly successful history of monetary policy. Thus, their experience fits neatly our theoretical model. We parameterize the model to provide a welfare analysis for this monetary union based on a tradeoff between the loss of independent monetary policy and the gain from checks on monetary policy provided by member states. In this sense, we extend a small but growing literature on monetary unions in Africa, e.g. (Masson and Pattillo 2005), (Honohan and Lane 2000), (Khamfula and Huizinga 2004) and (Buigut and Valev 2005) among others.

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

2. Model

We assume a n country economic area where countries differ by the size of their GDP, the random supply shocks affecting both output and their preferences for output stimulation. As in (Barro and Gordon 1983) output y_i (all variables in logarithms) in country i differs from its

natural level by an amount determined by the difference between actual and expected inflation and an output shock:

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

The unexpected inflation ($\pi_i - \pi_i^e$) affects activity with $b > 0$ as the marginal output gain from unexpected inflation; ε_i is an output supply shock with mean zero and finite variance $\sigma_{\varepsilon_i}^2$. The private sector forms expectations of inflation π_t^e before the stochastic shocks to the CB preferences and output are realized. Though the public knows the domestic monetary regime, there are external interferences on CB preference stance that cannot be observed at the time and the CB itself is unable to commit to one value of preference parameter. After the realization of the shocks, the central bank sets inflation to maximizes the following quasi-linear utility function as in (Debrun, Masson et al. 2005) and (Muscatelli 1998):

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

The parameter c_i in (2) is the weight placed by the central bank on its objective to stimulate output above the natural level of output. Hence it is a measure of the degree of inflation aversion. A CB with a lower value of c_i is more inflation averse, and thus more credible, than a CB with a higher value (Blinder 2000). The second term in (2) shows that deviations of inflation from the ideal level $\tilde{\pi}_i(\varepsilon_i)$ are increasingly costly. Parameters subscripted i are country-specific, while the parameters without subscripts are assumed identical across countries. As with the shock to output ε_i, the output preference of the central bank c_i is not known to the public at the time expectations are formed. These preferences are given by $c_i = \bar{c}_i + v_i$ where v_i is a random variable with mean zero and variance $\sigma_{c_i}^2$. The shocks to preferences are assumed not correlated

with the supply shocks within and across countries. The variance $\sigma_{c_i}^2$ represents the uncertainty surrounding the policymaker's output preferences.

Linearity of the objective function (2) in output generally implies no role for stabilization policy. We restore an implicit trade-off between the variability of inflation and output as in (Muscatelli 1998) and (Debrun, Masson et al. 2005) by making the socially optimal level of inflation a function of the supply shock: $\pi(\varepsilon_i) = -\eta\varepsilon_i, \eta > 0$. A negative supply shock induces the policymaker to tolerate positive inflation.

2.1 Optimal inflation under monetary autonomy

With autonomous monetary policies, policymakers independently choose inflation rates π_i^* by maximizing (2) subject to (1). The time-consistent inflation policy is derived under rational expectations assuming, as noted earlier, that expected inflation is formed before the shocks ε_i and ν_i are realized whereas the central bank sets inflation after the shocks are realized. The solution for optimal inflation[3] yields:

$$\pi_i^* = c_i b + \tilde{\pi}(\varepsilon_i) = c_i b - \eta\varepsilon_i \qquad (3)$$

The optimal inflation rate increases in the central bank's preference for stimulating output (c_i), in the marginal effect of unexpected inflation on output (b) and in the size of the output shock (ε_i). Knowing the central bank's optimization problem, the rationally expected inflation rate is given by $\bar{c}_i b$.[4]

[3] Since both ε_i and ν_i are stochastic and not correlated the set up used here reduces to a one period model, where each period the CB optimizes based on current shocks.

[4] Linearity of (2) in output ensures that rational expectations and the certainty equivalence approach give similar results. Demertzis and Hallett (2004) examine the magnitude of the resulting error in inflation and output following the assumption of certainty equivalence.

2.2 Optimal inflation under monetary union

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

$$U^{CCB} = \sum_{i=1}^{n} w_i U_i \,, \tag{4}$$

where $w_i > 0$ and $\sum_{i=1}^{n} w_i = 1$ is the weight given to country i in the decision-making of the common central bank. We can rewrite (4) as;

$$U^{CCB} = c_A(y_A - \bar{y}_A) - \frac{1}{2}[\pi_A - \tilde{\pi}(\varepsilon_A)]^2, \tag{4'}$$

where subscript A indicates cross country $w-$ weighted averages. To isolate the pure effects of monetary unification on policy outcomes it is assumed that CCB is under the same pressures as a national central bank would be, except that in a monetary union individual pressures on the CCB are diluted according to the weight of the country in the joint decision process.[5] The time consistent optimal inflation values under monetary union are found by maximizing (4) to obtain π^*_{mu}:

$$\pi^*_{mu} = bc_A + \tilde{\pi}(\varepsilon_A) \tag{5}$$

The optimal inflation under monetary union is a function of the weighted output preferences of its members and the weighted supply shocks. Appendix D summarizes the variances of inflation and output under autonomy and monetary union schemes. The variances of inflation (π^*_{mu}) and

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

output ($y^*_{i,mu}$) decrease in asymmetry of the correlation coefficient of preferences ρ_c . To obtain the variance in monetary union we write ε_A and c_A as in appendix (B4a) and (B4b).

Note that $\frac{\partial V(\pi^*_{i,mu})}{\partial \rho_c} > 0$ and $\frac{\partial V(y^*_{i,mu})}{\partial \rho_c} > 0$. Thus asymmetry in preferences leads to more stable inflation and output in monetary union. The decrease in variance of inflation is large if σ_c is large.

3.0 Welfare Effects of Monetary Union

The net welfare effect of moving from autonomous monetary policy to monetary union can be derived from the optimal inflation solutions obtained under autonomy and monetary union in (3) and (5). The expected net welfare (*NW*) effect of monetary integration for country i is obtained from:

$$E(NW_i) = EU_i^G\Big|_{MU} - EU_i^G\Big|_{Autonomy} \qquad (6)$$

By bringing together equations (B5) and (B8) from appendix B we obtain:

$$E(NW_i) = -\frac{b^2}{2}\left[(w_i{}^2 - 1)\sigma^2_{c_i} + (1-w_i)^2\sigma^2_{c_{-i}} + 2w_i(1-w_i)\rho_c\sigma_{c_i}\sigma_{c_{-i}}\right]$$

$$\frac{-\eta^2(1-w_i)^2}{2}[\sigma^2_{\varepsilon_i} + \sigma^2_{\bar{\varepsilon}_{-i}} - 2\rho_\varepsilon\sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}}]$$

$$-(1-w_i)b^2\bar{c}_i\left[\bar{c}_{-i} - \bar{c}_i\right] - \frac{b^2(1-w_i)^2}{2}\left[\bar{c}_{-i} - \bar{c}_i\right]^2 \qquad (7)$$

where subscript *–i* indicates a *w*-weighted average of all countries in the union excluding country *i*. Note that $\mathrm{cov}(c_i, c_{-i}) = \rho_c\sigma_{c_i}\sigma_{c_{-i}}$ with $-1 < \rho_c < 1$ being the coefficient of correlation of the CB's preferences. Similarly, $\mathrm{cov}(\varepsilon_i, \varepsilon_{-i}) = \rho_\varepsilon\sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}}$ with ρ_ε the correlation coefficient of the

supply shocks. A positive value for (7) means that welfare for country i is enhanced in a monetary union.

The first and second lines account for the stochastic components of the net welfare function. The first line of (7) shows the effects of the uncertainty and correlation associated with policymakers' preferences for stimulating output. This part is positive when the variance of the aggregate preferences a country faces in monetary union is less than variance the country would face under autonomy. It is zero if these two are equal; i.e. $\rho_c = 1$ and $\sigma_{c_i} = \sigma_{c_{-i}}$. Thus it improves a country's welfare if it is going to face less uncertainty in the union. Note also the effect of the correlation of these preferences across countries:

$$\frac{\partial E(NW)}{\partial \rho_c} = -b^2 w_i (1 - w_i)^2 \sigma_{c_i} \sigma_{c_{-i}} < 0 \qquad (8)$$

Expression (8) shows that the net benefit of a monetary union decrease in the correlation of the shocks to preferences. Intuitively, asymmetry of the shocks to output preferences across the member states allows the common central bank to achieve a lower variance of the union-wide inflation. The pressure to inflate and stimulate output (irrespective of output shocks) in some countries is counterbalanced by the desire for more prudent policy of stable prices in other member countries at the same time. Furthermore, note from (8) that this benefit of checks by other member states is particularly strong if the individual central banks tend to experience large shocks to their objectives, i.e. if the σ_c's are large.

The second line shows the loss of welfare resulting from the reduced ability of individual central banks to react to economic shocks. This line is unambiguously negative, and is zero only if $\sigma^2_{\varepsilon_i} = \sigma^2_{\varepsilon_{-i}}$ and $\rho_\varepsilon = 1$, i.e. if the countries face the same shocks. This is the typical cost associated with monetary unions. Note that from (7);

$$\frac{\partial E(NW)}{\partial \rho_{\varepsilon}} = \eta^2 (1-w_i)^2 \sigma_{\varepsilon_i} \sigma_{\varepsilon_{-i}} > 0 \qquad (9)$$

i.e. the greater the correlation of output shocks across countries, or the more synchronized the business cycles across member countries, the smaller the cost associated with the loss of independent monetary policy. From (9), the synchronicity of business cycles is particularly important if the member countries are prone to experience large shocks, i.e. if σ_{ε}'s are large. This is important because large shocks to output are common in developing countries, including the ones studied in the following sections.

The third line of (7) shows the nonstochastic component of the net welfare function. This line is composed of two parts. The first part is positive when $\bar{c}_{-i} - \bar{c}_i < 0$, implying that welfare increases for a country if it enters into monetary union with countries having a lower expected preference for stimulating output. Thus, this part of the welfare function captures the benefits of imported monetary credibility. From (7) we also see that:

$$\frac{\partial E(NW)}{\partial \bar{c}_{-i}} = \frac{-(1-w_i)b^2}{a}[\bar{c}_{-i}(1-w_i) + w_i \bar{c}_i] < 0 \qquad (10)$$

Thus (10) says that a higher expected preferences for the other member countries decreases country i's net welfare. The second part on the third line in (7), which is always negative, shows the loss from diverging output preferences in a monetary union. The greater the difference between the expected output preferences of country i and that of partner countries the greater the loss. Note also that the first line in (7) is zero when the expected output preferences of country *i* are the same as in the rest of the union, i.e. $\bar{c}_{-i} = \bar{c}_i$.

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

The following sections use the model developed here to study the expected net benefits from forming a currency union for the East African countries. This group of countries is an ideal choice for study since they have made a significant effort towards monetary union. Given that none of these countries has a long or particularly successful history of monetary policy their experience fits neatly our theoretical model.

4.0 The Welfare Effects Of An East African Monetary Union: An Application

4.1 Calibration

In this section we estimate the welfare effects of a move to monetary union for five East African countries; Burundi, Kenya, Rwanda, Tanzania and Uganda. To achieve this we need to derive estimates of the parameters in (7). We use the approach in (Swank 1997) which presents a simple model of stabilization policy.[6] In Swank's model, the policy maker chooses nominal output so as to minimize a quadratic loss function, describing his preferences for real output

[6] Only a few other studies have developed methods to derive the preference parameter (c_i) e.g. Krause and Mendez (2005), Cecchetti et al. (2002) and Favero and Rovelli (2003).

growth and price stability, subject to economic constraints which are based on a short-run Phillips curve (Ball, Mankiw et al. 1988). From this optimization problem a reaction function is derived which contains information about both the policy maker's preferences and the economic constraints. To disentangle this information, the Phillips curve is first estimated and then the reaction function is estimated, making use of the estimates of the Phillips curve. We adapt this method to the loss function in (2) in the main text to estimate c_i and the marginal output gain from unexpected inflation b. This procedure is shown in appendix C.

Next, we need to identify the supply shocks faced by these countries. A popular approach that has been used in the literature is the Structural Vector Autoregression method. For example (Buigut and Valev 2005) study the symmetry of supply shocks for the EA countries decomposed using the aggregate demand –aggregate supply identification framework of (Blanchard and Quah 1989 and Bayoumi and Eichengreen 1992). In this study the supply shocks for the East African countries and EMU countries are decomposed from a VAR, using the (Sims 1986) restriction method. This allows us to estimate variances $\sigma^2_{\varepsilon_i}, \sigma^2_{\bar{\varepsilon}_{-i}}$ and covariance $\text{cov}(\varepsilon_i, \bar{\varepsilon}_{-i})$ of the shocks for each country.

4.2 Data

To estimate the trade-off and preference parameters annual data for the five East African countries and EMU is sourced from the World Bank's *World Development Indicators* and IMF's *International Financial Statistics CD-Rom* and African Development Bank *Country Statistics*. The data obtained is the real GDP and nominal GDP. For Burundi, Kenya, and Rwanda the data covers the period 1975-2003, 1967-2001 for Tanzania and 1970-2001 for Uganda. First, regression results for the sub-sample covering the period up to 1994 are obtained. These are

rolled, one year at a time, to obtain a series for the trade-off and preference parameters. For example the first regression for Kenya covers the sub-period 1975-1994, the second regression 1976-1995, and so forth. The trade-off parameter (α_4) is obtained from (C3) while the preference parameter (c_i) is obtained from (C6) (see appendix C). These rolling regression results are useful in obtaining the covariances for the preferences. The weights (w_i) are obtained from a four year average (from 2000-2003) of the real GDP in US dollars.[7]

The data used in identifying the supply shocks from the VAR is also sourced from IMF's *IFS,* the World Bank's *WDI,* and supplemented from the African Development Bank *Country Statistics*. Annual data for the five Eastern African countries cover the sample period from 1970 to 2001. Real GDP growth is used to measure changes in output, while changes in the implicit GDP deflator represent price changes, both rebased to 100 in 1995 for all countries. For each country we use the first difference of the natural logs of real GDP and the implicit GDP deflator for estimation.

5.0 Results

Table 1 shows the results for the set of trade-off parameters (α_4) for the East African countries. These are obtained from rolling regressions from 1994 through 2003. The values of α_4 indicates that for a unit change in the nominal output only a very small portion is reflected in the real output, while the larger portion shows up in inflation. Rwanda has the highest trade-off parameter followed by Burundi. The reason it is much higher for Rwanda (and to a lesser extend Burundi) than the other East African countries could be attributed to the 93/94 civil war that

[7] We also try out alternative weights such as equal weighting of all member countries.

destroyed these countries production systems. The high value mostly will reflect recovery rather than new expansion in output.

Table 1: Trade-off parameters (α_4) for EA countries

Sample	Burundi	Kenya	Rwanda	Tanzania	Uganda
1994	0.227	0.119	0.237	0.055	0.016
1995	0.290	0.119	0.265	0.052	0.016
1996	0.321	0.104	0.413	0.047	0.016
1997	0.371	0.070	0.505	0.041	0.015
1998	0.341	0.072	0.424	0.040	0.010
1999	0.279	0.072	0.295	0.039	0.013
2000	0.216	0.006	0.285	0.043	
2001	0.218	0.049	0.274	0.044	
2002	0.052	0.056	0.277		
2003	0.060	0.057	0.292		
Average	0.238	0.072	0.328	0.045	0.014

Table 2 shows the values for the marginal output gain from unexpected inflation (b). These are obtained from the values of (α_4) in Table 1 as in (C7′) of appendix C. Since these are assumed similar across the countries, we take the weighted average value. This value is 0.052 for the three core EAC countries (Kenya, Tanzania and Uganda) and 0.09 for all the five countries.

Table 2: Marginal output gain parameter (b) for EA countries

Sample	Burundi	Kenya	Rwanda	Tanzania	Uganda
1994	0.294	0.135	0.311	0.058	0.016
1995	0.408	0.135	0.361	0.055	0.016
1996	0.473	0.116	0.704	0.049	0.016
1997	0.590	0.075	1.020	0.043	0.015
1998	0.517	0.078	0.736	0.042	0.010
1999	0.387	0.078	0.418	0.041	0.013
2000	0.276	0.006	0.399	0.045	
2001	0.279	0.052	0.377	0.046	
2002	0.055	0.059	0.383		
2003	0.064	0.060	0.412		
Average	0.334	0.079	0.512	0.047	0.015

Table 3 shows the preference parameters for EA countries. These values reflect the weight placed on output stimulation relative to inflation by these countries. The most striking

thing about Table 3 is that the output preferences for the EA countries are diverse. Uganda, followed by Tanzania, puts a much higher weight on output relative to inflation compared to the other EA countries. We would expect from this that a currency union would be beneficial in terms of improving the credibility for these two EA countries. Of the three key EAC countries Kenya, Uganda, and Tanzania, Kenya has the lowest preference for output relative to inflation.

Table 3: The output preference parameters c_i for EA countries

	Bur	Ken	Rwa	Tan	Uga
1994	0.197	0.711	0.368	3.807	19.904
1995	0.190	0.713	0.401	3.995	20.198
1996	0.207	0.828	0.148	4.400	20.659
1997	0.178	1.261	0.098	5.086	21.42
1998	0.185	1.236	0.126	5.233	32.337
1999	0.233	1.230	0.210	5.325	25.98
2000	0.350	15.10	0.220	4.790	
2001	0.341	1.845	0.228	4.762	
2002	1.551	1.766	0.222		
2003	1.344	1.746	0.208		
Average*	0.478	2.644	0.223	4.675	23.42

*This is the average for the rolling regressions 1994-2003

Table 4 gives the variances and covariances of the preferences shown in Table 2.

Table 4: Variance and covariances of preferences

	$\sigma^2_{c_i}$	Covariance (c_i, c_{-i})	$\sigma^2_{c_{-i}}$
Variances and covariances of preferences[a]			
Kenya	17.40253	-8.2122	29.95954
Tanzania	0.276878	0.534634	16.53652
Uganda	20.07218	1.349387	6.029999
Variances and covariances of preferences[b]			
Burundi	0.240766	-1.19509	8.510641
Rwanda	0.00838	-0.04473	9.26766
Kenya	17.40253	-7.05358	21.9368
Tanzania	0.276878	0.457173	12.2086
Uganda	20.07218	1.170936	4.682839

[a)]: when the three core EAC countries form monetary union on their own; [b)]: when five EA countries form monetary union.

Again it turns out that Uganda has the highest variance, followed by Kenya. The values for these are huge compared to those of the other three countries. This implies these countries are likely to gain from monetary union since they would face less uncertainty in a union.

The preferences dominate the welfare function, compared to the supply shocks. Table 5 shows that the values of variances and covariances for the supply shocks are much smaller. The net value of (7) would then be dominated by preferences. Thus the benefits of monetary union will depend mostly on improvements in credibility and uncertainty of preferences, rather than from the suboptimal stabilization of supply shocks traditionally recognized. Note also that (Debrun, Masson et al. 2005) found that in West Africa the governments' financing needs dominate the welfare function over the supply shocks. This gives credence to literature that argues for monetary union as a means of achieving more commitment to sound macroeconomic policies.

Table 5: Variances and covariances of supply shocks

	$\sigma^2_{\varepsilon_i}$	Covariance $(\varepsilon_i, \varepsilon_{-i})$	$\sigma^2_{\varepsilon_{-i}}$
Variances and covariances of supply shocks[a]			
Kenya	0.000181	8.15E-06	6.79E-05
Tanzania	6.77E-05	3.05E-06	8.38E-05
Uganda	7.1E-05	3.66E-05	6.8E-05
Variances and covariances of supply shocks[b]			
Kenya	0.000181	1.14E-07	6.77E-05
Tanzania	6.77E-05	2.8E-05	7.01E-05
Uganda	7.1E-05	3.43E-05	5.88E-05
Burundi	0.000391	-2E-05	5.43E-05
Rwanda	0.001495	-2.4E-05	5.43E-05

[a)]: when the three core EAC countries form monetary union alone; [b)]: when all the five EA countries form monetary union.

The net welfare effects of a monetary union are given in Table 6. We give the results when the 3 core EAC countries form a monetary union on their own and when all the five EA countries join in the union. We also show results when the union countries are gdp-weighted and when all have equal weights in the union. The net welfare effect of monetary union differs across

the five countries. In all cases Uganda seems to be the one that would benefit the most, largely because of the size and variance of its preferences. On the other hand Tanzania looses out due to low variance of its preferences and positive correlation with other preferences. Thus while Uganda gains mostly from less uncertainty in the union, Tanzania looses from lower mean inflation preference in the union and similarity of preferences with those of other countries.

Table 6: Net Welfare for EA Countries

5 EA Countries	Net Welfare: (η=1,b=0.052), gdp weights	Net Welfare: (η=1 ,b=0.052) equal weights (w=0.2)
Burundi	0.014	0.006
Kenya	0.003	0.002
Rwanda	0.020	0.009
Tanzania	-0.018	-0.018
Uganda	1.39	1.144
EAC only	Net Welfare: (η=1,b=0.09) gdp weights	Net Welfare: (η=1, b=0.09 equal weights (w=0.333)
Kenya	0.003	-0.002
Tanzania	-0.027	-0.029
Uganda	1.47	1.25

If the three EAC countries alone form a monetary union, with equal weights two countries (Kenya and Tanzania) come out worse off from the union. In this case Uganda with its high output preference gains enough weight to influence the optimal inflation to the detriment of the other countries. These results thus suggest a monetary union with all the five countries and gdp-weighting rather than equal weighting.

6. Conclusions

The paper studies the implications of uncertainty of policy maker preference for monetary union. Based on a Baro-Gordon type frame work we develop a model where the preferences of policymaker are subject to shocks not known a priori to him. Such shocks could come from pressure to accommodate government objectives. We find that the net gain from

monetary union for country *i* is greater if it joins in a union with other countries that have greater credibility for low inflation; if its output shocks are more highly correlated with those of the other union members; and if the shocks to its central bank's preferences are correlated less with those of other member countries. This happens because the supranational bank is able to even out the preferences across the member countries. While the literature has discussed the first two, it has not identified the third one. From a policy perspective this is important because a number of monetary unions have been proposed among groups of developing countries that lack a history of stable prices or simply have a short history of independent monetary policy.

Using EA data to calibrate the model we find that policy maker preferences dominate supply shocks in determining net gains and losses from potential monetary union. In this sense stability in monetary policy is the more crucial for these countries. Simulating the scenario when all the five EA countries form a monetary union, and when only the three EAC countries form a union using gdp-weights, we find that only Tanzania loose out from the union. However the results are sensitive to the weight the countries wield in the union. In all cases Uganda seems to be the one that benefits the most, largely because of its high variation in preferences. Tanzania looses out due to the low variance of its preferences for output and its positive correlation with preferences of other countries.

References

Alesina, A. and R. Barro (2002). "Currency Unions." The Quarterly Journal of Economics **117**(2): 409-436.

Alesina, A., R. Barro, et al. (2002). Optimal currency areas, NBER working paper No. 9072.

Ball, L. N., G. Mankiw, et al. (1988). "The new Keynesian economics and the output-inflation trade-off." Brookings Papers on Economic Activity **1988**(1): 1-65.

Barro, R. and D. B. Gordon (1983). "Rules, discretion and reputation in monetary policy." Journal of Monetary Economics **12**: 101-121.

Bayoumi, T. and B. Eichengreen (1992). Shocking aspects of European monetary unification. NBER Working paper series, working paper No 3449. Cambridge, MA, NBER.

Beetsma, R. and A. Bovenberg (1999). "Does monetary unification lead to excessive debt accumulation?" Journal of Public Economics **74**: 299-325.

Blanchard, O. J. and D. Quah (1989). "The dynamic effects of aggregate demand and supply disturbances." American Economic Review **79**(4): 655-673.

Blinder, A. S. (2000). "Central bank credibility: Why do we care? How do we build it?" American Economic Review **90**(5): 1421-1431.

Bottazzi, L. and P. Manasse (2002). "Credibility and seigniorage in a common currency area." Journal of Money, Credit, and Banking **34**(4): 1034-46.

Buigut, S. K. and N. T. Valev (2005). "Is the proposed East African monetary union an optimal currency area? A structural vector autoregression analysis." World Development **33**(12): 2119-2133.

Cecchetti, S. G., M. M. McConnell, et al. (2002). "Policymaker's revealed preferences and the output-inflation variability trade-off: Implications for the European system of central banks." The Manchester School **70**(4): 596-618.

Debrun, X., P. Masson, et al. (2005). "Monetary union in West Africa: Who might gain, who might lose and why?" Canadian Journal of Economics **38**(2): 454-481.

Demertzis, M. and A. H. Hallett (2003). Three models of imperfect transparency in monetary policy. Centre for Economic Policy Research, CEPR, London. **CEPR Discussion paper No. 4117**.

Demertzis, M. and A. H. Hallett (2004). Rational ambiguity and monitering the central bank. De Nederlandsche Bank, De Nederlandsche Bank. **Working paper No. 759**.

Dixit, L. and L. Lambertini (2003). "Symbiosis of monetary and fiscal policies in a monetary union." Journal of International Economics **60**: 235-247.

Favero, C. A. and R. Rovelli (2003). "Macroeconomic stability and the preferences of the Fed: A formal analysis, 1961-98." Journal of Money, Credit, and Banking **35**(4): 545-556.

Guillaume, D. M. and D. Stasavage (2000). "Improving policy credibility: Is there a case for African Monetary Unions." World Development **28**(8): 1391-1407.

Herrendorf, B. (1997). "Importing credibility through exchange rate pegging." Economic Journal **107**(442): 687-94.

Honohan, P. and P. R. Lane (2000). Will the Euro trigger more monetary unions in Africa? World Bank. **Policy Research working paper No. 2393**.

Khamfula, Y. and H. Huizinga (2004). "The Southern African Development Community: Suitable for a monetary union?" Journal of Development Economics **73**(2): 699-714.

Krause, S. and F. Mendez (2005). "Policy makers' preferences, party ideology and the political business cycle." Southern Economic Journal **71**(4): 752-767.

Masson, P. and C. Pattillo (2005). The monetary geography of Africa. Washington, D.C, Brookings Institution Press.

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

Mundell, R. A. (2002). Does Africa need a common currency? Keynote presentation. Development Forum III, March 3-8, Addis Ababa, UNECA.

Muscatelli, A. (1998). "Optimal inflation contracts and inflation targets with uncertain central bank preferences: Accountability through independence?" The Economic Journal **108**(447): 529-542.

Sims, C. (1986). "Are forecasting models usable for policy analysis?" Federal Reserve Bank of Minneapolis Quarterly Review **10**: 2-16.

Swank, O. H. (1997). "Some evidence on policy makers' motives, macroeconomic performance and output-inflation trade-offs." Applied Economics **29**(2): 251-258.

TECHNICAL APPENDIX A

Comparing Expectations under Autonomy and Monetary Union

Denote $A_{x,i}$ as the expected deviation of an objective variable x_i from its socially desired value $\tilde{x}_i$ under a regime of monetary autonomy;

$$A_{x,i} \equiv E[(x_i^*) - \tilde{x}_i] \, where \, x_i \in \{\pi_i, y_i\} \qquad \text{(A1)}$$

Also define $\Delta_{x,i}$ as the difference between the equilibrium value of x_i under monetary union and under monetary autonomy;

$$\Delta_{x,i} \equiv E[x_{i,MU}^* - x_i^*] \qquad \text{(A2)}$$

We apply these definitions to equations (1), (3) and (5) in the text.

Under autonomy, from (3) and (1) we obtain;

$$A_{\pi,i} = b\bar{c}_i \text{, and } A_{y,i} = 0 \qquad \text{(A3)}$$

For the difference $\Delta_{x,i} \equiv E[x_{i,MU}^* - x_i^*], x_i \in \{\pi_i, y_i\}$ in (A2), we obtain from (5), (3), and (1);

$$\Delta_{\pi,i} = b(\bar{c}_A - \bar{c}_i) \text{, and } \Delta_{y,i} = 0 \qquad \text{(A4)}$$

TECHNICAL APENDIX B:

Welfare Effects of Monetary Unification

The expected Net Welfare (NW) of monetary union is given by;

$$NW_i^G \equiv EU_i^G\big|_{MU} - EU_i^G\big|_{Autonomy} \qquad \text{(B1a)}$$

This can be written as;

$$\{-\frac{1}{2}(E[\pi_{mu}^* - \tilde{\pi}_i(\varepsilon_i)]^2) + \bar{c}_i E[y_{i,mu}^*]\} - \{-\frac{1}{2}(E[\pi_{i,Aut}^* - \tilde{\pi}_i(\varepsilon_i)]^2) + \bar{c}_i E[y_{i,Aut}^*]\} \qquad \text{(B1b)}$$

Given the functional form adopted for the utility, the expected utility of each regime can be split into two parts as follows;

$If\ Q = [\pi_i^* - \tilde{\pi}_i(\varepsilon)]$;

Then $Var(Q) = E(Q^2) - [E(Q)]^2 \Rightarrow E(Q^2) = [E(Q)]^2 + \text{var}(Q)$ (B2a)

The expected utility is given by the mean deviations of inflation variable from its social optimal and the variance of the deviation. This is true for inflation but not output which is not squared. So the expected net welfare in (B1b) can be written as;

$$NW_i^G = [-\frac{1}{2}\{[E[\pi_{mu}^* - \tilde{\pi}(\varepsilon_i)]]^2\} + \bar{c}_i E[y_{i,mu}^*] - \frac{1}{2}\{Var(\pi_{mu}^* - \tilde{\pi}(\varepsilon_i))\}]$$

$$-[-\frac{1}{2}\{[E[\pi_{i,aut}^* - \tilde{\pi}(\varepsilon_i)]]^2\} + \bar{c}_i E[y_{i,aut}^*] - \frac{1}{2}\{Var(\pi_{i,aut}^* - \tilde{\pi}(\varepsilon_i))\}] \quad \text{(B2b)}$$

STOCHASTIC COMPONENT

Net welfare for the stochastic component (SW) is given by;

$$E(SW_i) = -\frac{1}{2}\{Var(\pi_{mu} - \tilde{\pi}(\varepsilon_i)) - Var(\pi_{i,aut} - \tilde{\pi}(\varepsilon_i))\} \quad \text{(B3)}$$

Using the stochastic components of (3) and (5) we have;

$$-\frac{1}{2}\{Var[bc_A + \tilde{\pi}(\varepsilon_A) - \tilde{\pi}(\varepsilon_i)] - Var[bc_i]\} \quad \text{(B4)}$$

We can write the aggregate stochastic variable $\varepsilon_A = \sum_{i=1}^{n} w_i \varepsilon_i$, $\sum_{i=1}^{n} w_i = 1$.

This gives $w_i\varepsilon_i + (1-w_i)\sum_{k=1,k\neq i}^{n}(\frac{w_k}{1-w_i})\varepsilon_k = w_i\varepsilon_i + (1-w_i)\varepsilon_{-i}$ (B4a)

Similarly we can write $c_A = w_i c_i + (1-w_i)c_{-i}$ (B4b)

where ε_{-i} (c_{-i}) is the weighted average of supply shocks (output preference) across the $n-1$ other union members. Thus writing the cross-country aggregate shock ε_A and aggregate preferences c_A as in (B4a) and (B4b) and assuming preferences and supply shocks are not correlated we get;

$$SW_i = \frac{-\eta^2(1-w_i)^2}{2}[\sigma^2_{\varepsilon_i} + \sigma^2_{\bar{\varepsilon}_{-i}} - 2\,\mathrm{cov}(\varepsilon_i, \varepsilon_{-i})]$$
$$-\frac{b^2}{2}\left[(w_i{}^2 - 1)\sigma^2_{c_i} + (1-w_i)^2\sigma^2_{c_{-i}} + 2w_i(1-w_i)\,\mathrm{cov}(c_i, c_{-i})\right] \qquad \text{(B5)}$$

NONSTOCHASTIC PART

Net welfare for the non-stochastic part (NSW) is given by;

$$E(NSW_i) = -\frac{1}{2}\{[E[\pi^*_{mu} - \tilde{\pi}_i(\varepsilon_i)]]^2 - [E[\pi^*_{i,aut} - \tilde{\pi}_i(\varepsilon_i)]]^2\} + \bar{c}_i E[y^*_{i,mu}] - \bar{c}_i E[y^*_{i,aut}]\} \qquad \text{(B6)}$$

But $[E[\pi^*_{mu} - \tilde{\pi}(\varepsilon_i)]]^2 \equiv [E[\pi^*_{mu} - \pi^*_i + \pi^*_i - \tilde{\pi}(\varepsilon_i)]]^2$. Hence from (A1) and (A2) we can write (B6) as;

$$-\frac{1}{2}\{([A_{\pi,i} + \Delta_{\pi,i}]^2 - A^2_{\pi,i})\} + \bar{c}_i\Delta_{y,i} = -\frac{1}{2}\{[2A_{\pi,i}\Delta_{\pi,i} + \Delta^2_{\pi,i}]\} + \bar{c}_i\Delta_{y,i} \qquad \text{(B7)}$$

Using A_i and Δ_i derived in (A3) and (A4) the net welfare for non-stochastic part becomes;

$-\frac{1}{2}\{2[b\bar{c}_i][b(\bar{c}_A - \bar{c}_i)] + [b(\bar{c}_A - \bar{c}_i]^2\}$, which using (B4b) yields;

$$NSW_i = -(1-w_i)b^2\bar{c}_i[\bar{c}_{-i} - \bar{c}_i] - \frac{b^2(1-w_i)^2}{2}[\bar{c}_{-i} - \bar{c}_i]^2 \qquad \text{(B8)}$$

TECHNICAL APPENDIX C:

Deriving the parameters b and c_i

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

$$W_i = c_i(\Delta y_{i,t} - \Delta y^d) - \tfrac{1}{2}\pi_{i,t}^2 \qquad \text{(C1)}$$

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

$$\Delta x_t = \Delta x_t^d + \varepsilon_{xt}, \qquad \text{(C2)}$$

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

$$y_t = \alpha_1 + \alpha_2 t + \alpha_3 y_{t-1} + \alpha_4 \Delta x_t + \varepsilon_{yt} \qquad \text{(C3)}$$

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

$$\Delta y_t = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) y_{t-1} + \alpha_4 \Delta x_t + \varepsilon_{yt} \qquad \text{(C4)}$$

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

$$\pi_t = (1 - \alpha_4)\Delta x_t - h_t, \text{ where } h_t = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) y_{t-1} + \varepsilon_{yt} \qquad \text{(C5)}$$

The policy maker optimizes (1) with respect to Δx_t^d, subject to (C2), (C4) and (C5) to yield;

$$\Delta x_t = \frac{c_i \alpha_4}{(1-\alpha_4)^2} + \frac{h_t^e}{(1-\alpha_4)} + \varepsilon_{xt}, \text{ where } h_t^e = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) E(y_{t-1}) + \varepsilon_{yt} \qquad \text{(C6)}$$

Equation (C6) expresses policy maker's reaction to the desired growth rate of real output and h_t^e which represents the past development of real output growth.

Following the two-step estimation procedure in (Swank 1997), we first estimate the economic constraint (C3). From this estimates we calculate h_t^e, which then allows us to estimate the reaction function of nominal demand (C6) with the coefficient on h_t^e constrained to be $\frac{1}{1-\alpha_4}$. The results from (C6) allow c_i to be calculated. This value allows us to estimate the $\bar{c}_i$, $\bar{c}_{-i}$, and $\text{cov}(c_i, c_{-i})$. In addition, from $\pi_t = \Delta x_t - \Delta y_t$ and (C4) the value of b in (7) can be estimated. By writing $\pi = \Delta p$ then from $\pi_t = \Delta x_t - \Delta y_t$ we get;

$$\frac{\Delta y}{\Delta x} = \alpha_4 = 1 - \frac{\Delta p}{\Delta x} \qquad \text{(C7)}$$

$$\text{Therefore } b = \frac{\Delta y}{\Delta p} = \frac{\Delta x}{\Delta p} - 1 = \frac{\alpha_4}{1-\alpha_4} \qquad \text{(C7′)}$$

Thus the value of b can be estimated from (C7′). The weighted average of these values for the five East African countries is used as an estimate of the cross-country b value.

Appendix D. Variances of inflation and output under autonomy and monetary union

Under autonomy	Under monetary union
$\pi_i^* = c_i b + \tilde{\pi}(\varepsilon_i)$	$\pi_{mu}^* = bc_A + \tilde{\pi}(\varepsilon_A)$
$Var(\pi_i) = b^2\sigma_{c_i}^2 + \eta^2\sigma_{\varepsilon_i}^2$	$Var(\pi_{mu}^*) =$ $b^2[w_i^2\sigma_{c_i}^2 + (1-w_i)^2\sigma_{c_{-i}}^2 + 2w_i(1-w_i)\mathrm{cov}(c_i, c_{-i})]$ $+\eta^2[w_i^2\sigma_{\varepsilon_i}^2 + (1-w_i)^2\sigma_{\varepsilon_{-i}}^2 + 2w_i(1-w_i)\mathrm{cov}(\varepsilon_i, \varepsilon_{-i})]$
$(y_i^*) = \bar{y}_i + b(\pi_i^* - \pi_i^e) + \varepsilon_i$ $E(y_i^*) = \bar{y}_i$	$y_{i,mu}^* = \bar{y}_i + b(\pi_{mu}^* - \pi_{mu}^e) + \varepsilon_i$, $E(y_{i,mu}^*) = \bar{y}_i$
$Var(y_i^*) =$ $\left[b^2\right]^2\sigma_{c_i}^2 + (b^2\eta^2 + 1 - 2b\eta)\sigma_{\varepsilon_i}^2$	$Var(y_{i,mu}^*) =$ $\left[b^2\right]^2[w_i^2\sigma_{c_i}^2 + (1-w_i)^2\sigma_{c_{-i}}^2 + 2w_i(1-w_i)\mathrm{cov}(c_i, c_{-i})] +$ $[b^2\eta^2 w_i^2 + 1 - 2b\eta w_i]\sigma_{\varepsilon_i}^2 + b^2\eta^2(1-w_i)^2\sigma_{\varepsilon_{-i}}^2 +$ $2b^2\eta^2 w_i(1-w_i)\mathrm{cov}(\varepsilon_i, \varepsilon_{-i}) - 2b\eta(1-w_i)\mathrm{cov}(\varepsilon_i, \varepsilon_{-i})$

Note: $\mathrm{cov}(c_i, c_{-i}) = \rho_c\sigma_{c_i}\sigma_{c_{-i}}$ where $-1 < \rho_c < 1$ is the coefficient of correlation.