Andrew Young School of Policy Studies
Research Paper Series

Working Paper 06-54
May 2006

Department of Economics

Monetary Union and Central Bank Independence

Steven Buigut
Georgia State University

Neven Valev
Georgia State University

Georgia State University | Andrew Young School of Policy Studies

MONETARY UNION AND CENTRAL BANK INDEPENDENCE

by

Steven Buigut and Neven T. Valev

Abstract

We study the consequences of forming a monetary union among a group of countries where the central banks lack independence and are pressured frequently to accommodate government objectives. This is a common situation in the developing countries. As it is common in the literature, we show that forming a monetary union yields net benefits if output shocks are similar across the member countries and if one or more countries in the union can serve as anchors. Our framework highlights an additional gain from monetary union. We show that the opportunistic objectives of one country's policymakers are kept in check at the union level by other members with disparate objectives. Hence, monetary union can improve the monetary policy for its members if the pressures on the individual central banks are dissimilar. We calibrate the model to evaluate the proposed monetary union in the East African Community.

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

We would like to thank Stefan Krause, Jorge Martinez, Felix Rioja, and Yongsheng Xu for their valuable comments and suggestions.
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.

MONETARY UNION AND CENTRAL BANK INDEPENDENCE

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 the recent literature is the credibility argument. Monetary unions create the potential for some countries to "import monetary credibility" from other member countries with reputation for prudent monetary policy, e.g. Germany in the euro-zone (Herrendorf 1997). Time wise this is a more efficient way to improve credibility than earning it through the alternative time consuming way of building a track record (Blinder 2000).

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

monetary policy.[1] Some authors, e.g. Mundell (2002), have argued that monetary unions could provide a means for credible commitment to sound macroeconomic policies. For example, Guillaume and Stasavage (2000) provide evidence that African countries that participate in monetary unions tend to pursue more credible monetary policies.

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

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

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

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

As an application to the theory, we investigate the feasibility of monetary union in the East African Community. The three member countries: Kenya, Tanzania, and Uganda, recently signed a customs union treaty and have officially declared their goal to form a currency union. Two neighboring countries, Rwanda and Burundi, have indicated an interest to join and are included in the analysis. None of the five countries has a long or particularly successful history of monetary policy. Thus, their experience fits neatly our theoretical model. We parameterize the model to provide a welfare analysis for this monetary union based on a tradeoff between the loss of independent monetary policy and the gain from checks on monetary policy provided by member states. In this sense, we also extend a small but growing literature on monetary unions in Africa, 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 5 presents the results of the analysis and Section 6 concludes.

2. Model

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

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

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 central bank sets inflation to maximizes the following quasi-linear utility function as in Debrun et al. (2005) and Muscatelli (1998):

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

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

The second term in (2) shows that deviations of inflation from the ideal level $\tilde{\pi}_i(\varepsilon_i)$ are increasingly costly. 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 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. However, once the shocks occur they are perfectly observable by all. The solution for optimal inflation[2] 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 $\bar{c}_i b$.

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

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 functions:

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

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 the CCB is under the same pressures as a national central bank would be, except that in a monetary union individual pressures on the CCB are diluted according to the weight of the country in the joint decision process.[3] 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.

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

3. 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:

$$E(NW_i) = EU_i\Big|_{mu} - EU_i\Big|_{autonomy} \tag{6}$$

The workings for (6) are provided in appendix A. By bringing together equations (A5) and (A8) we obtain:

$$\begin{aligned} E(NW_i) = &-\frac{b^2}{2}\left[(w_i{}^2 - 1)\sigma_{c_i}^2 + (1-w_i)^2\sigma_{c_{-i}}^2 + 2w_i(1-w_i)\rho_c\sigma_{c_i}\sigma_{c_{-i}}\right] \\ &-\frac{\eta^2(1-w_i)^2}{2}[\sigma_{\varepsilon_i}^2 + \sigma_{\bar{\varepsilon}_{-i}}^2 - 2\rho_\varepsilon\sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}}] \\ &-(1-w_i)b^2\bar{c}_i\left[\bar{c}_{-i} - \bar{c}_i\right] - \frac{b^2(1-w_i)^2}{2}\left[\bar{c}_{-i} - \bar{c}_i\right]^2 \end{aligned} \tag{7}$$

where subscript *–i* indicates a *w*-weighted average of all countries in the union excluding country *i*. Note that $\text{cov}(c_i, c_{-i}) = \rho_c\sigma_{c_i}\sigma_{c_{-i}}$ with $-1 \le \rho_c \le 1$ being the coefficient of correlation of the central bank preferences across countries. Similarly, $\text{cov}(\varepsilon_i, \varepsilon_{-i}) = \rho_\varepsilon\sigma_{\varepsilon_i}\sigma_{\varepsilon_{-i}}$ where $-1 \le \rho_\varepsilon \le 1$ is the correlation coefficient of the supply shocks across countries. A positive value for (7) means that welfare for country i is enhanced in a monetary union.

The first and second lines in (7) account for the stochastic components of the net welfare function. The first line of (7) shows the effects of the uncertainty associated with the policymakers' preferences for stimulating output. The key result regarding this part of the net welfare function is the effect of the correlation of these preferences across countries:

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

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

The second line of (7) shows the loss of welfare resulting from the reduced ability of individual central banks to react to economic shocks. This line is unambiguously negative, and is zero only if $\sigma^2_{\varepsilon_i} = \sigma^2_{\varepsilon_{-i}}$ and $\rho_\varepsilon = 1$, i.e. if the countries face the same shocks. This is the typical cost associated with monetary unions. Note that from (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, the smaller is the cost associated with the loss of independent monetary policy. From (9), the synchronicity of supply shocks is particularly important if the member countries are prone to experience large shocks, i.e. if the σ_ε's are large.[4]

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

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

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

The second part of 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 third 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. when $\bar{c}_{-i} = \bar{c}_i$.

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

The following sections use the model developed here to study the expected net benefits from forming a currency union for the East African countries. This group of countries is an ideal

choice for study since they have made a significant effort towards monetary union. Given that none of these countries has a long history of independent monetary policy their experience fits our theoretical model well.

4. Welfare Effects of an East African Monetary Union: An Application

In this section we estimate the welfare effects of a move to monetary union for five East African countries: Burundi, Kenya, Rwanda, Tanzania, and Uganda. To derive estimates of the parameters c_i and b in (7), we adapt the approach in Swank (1997) to our welfare framework.[5] In Swank's model, the policy maker chooses nominal output to balance the objectives of low inflation and high output subject to a constraint based on the short-run Phillips curve (Ball et al. 1988). The reaction function derived from this optimization problem contains information about both the policy maker's preferences and the economic constraint. To disentangle this information, the Phillips curve is first estimated and then the reaction function is estimated making use of the estimates of the Phillips curve. We adapt this method to the loss function in (2) to estimate the preferences parameter c_i and the marginal output gain from unexpected inflation b. The procedure is described in appendix B.

To perform the estimations we use data on real and nominal GDP from the World Bank's *World Development Indicators* and the IMF's *International Financial Statistics*. The length of the data series, covering the period from 1990 onward, was kept short deliberately to capture relatively more recent developments in the five countries.[6] We start obtaining regression results

[5] 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).

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

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

Next, with the same data series we identify the output shocks faced by the East Africa countries using the approach in Bayoumi and Ostry (1997). In particular, we regress the growth of real output (in logs) on its two lags. The residuals from this regression are taken to represent the underlying output disturbances.[7] This allows us to estimate the variances $\sigma^2_{\varepsilon_i}$ and $\sigma^2_{\bar{\varepsilon}_{-i}}$ and the covariance $\text{cov}(\varepsilon_i, \bar{\varepsilon}_{-i})$ of the shocks for each country. Finally, the weights (w_i) are obtained from a four year average (from 2000-2003) of the real GDP in US dollars. We also try out alternative weights such as equal weighting of all member countries.

5. Results

Table 1 shows the summary results for the various coefficients required to estimate the net welfare (7) for each of the five countries. The table lists results for two scenarios. The first case is when the three core EAC countries (Kenya, Tanzania and Uganda) form a monetary union on their own and the second scenario is when all the five EA countries join in the union.

The first row of Table 1 shows the estimated values for the marginal output gain from unexpected inflation (b). These are obtained as in (B7′) of appendix B. The values of b do not differ much among the countries ranging from around 0.1 to less than 0.2. The second row of

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

Table 1 shows the average output preference parameters ($\bar{c}_i$) for the EA countries. These values reflect the weight placed on output stimulation relative to inflation. It is striking how different these preferences are among the EA countries. Uganda, and to a lesser extent Tanzania, places much higher weight on output relative to inflation compared to the other EA countries. Furthermore, row three in Table 1 shows that Uganda and Tanzania exhibit a much greater variation of their output preferences compared to the other three countries. The tolerance for high inflation (high $\bar{c}_i$) along with the high variability of the preferences for inflation (high $\sigma^2_{c_i}$) for Uganda and Tanzania suggest that these two countries are likely to gain from monetary union since they would face less inflation uncertainty in a monetary union than under autonomy.

The fourth row of Table 1 shows that the output shocks are substantially smaller compared to the shocks to preferences for each of the EA countries, i.e. most of the economic fluctuations in these countries are the result of policy shocks rather than output shocks. Therefore, the benefit of implementing more stable policies in a monetary union may outweigh the costs of losing independent monetary policy.[8] Looking at the remaining results in Table 1, notice that the correlations of the preferences shocks (ρ_c) across the three EAC countries (Kenya, Tanzania, and Uganda) are positive. However, the covariances $\text{cov}(c_i, c_{-i})$ are not particularly large. For the remaining two countries, Burundi and Rwanda, the correlations of the preferences shocks are actually negative. Therefore, overall a monetary union may provide a useful instrument for checks on the pressures to raise inflation in individual countries.

The net welfare effects of a monetary union are presented in Table 2. We give the results when only the 3 EAC countries form a monetary union and when all the five EA countries join in

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

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

The net welfare effect of monetary union differs across the five countries. In all scenarios Uganda and Tanzania benefit from the union whereas Kenya, Burundi, and Rwanda seem to lose from a monetary union.[9] Table 3 provides further insight into these results. The table decomposes the net welfare (7) into three effects: the effect of the correlation of the shocks to preferences, the effect of the correlation of the shocks to output, and the effect of differences in the average output preferences across the countries. Essentially, the table provides the estimated numerical values for the three lines in equation (7). Summing up the numbers from one row in Table 3 gives the overall net gain in Table 2.[10] Decomposing the net welfare allows us to investigate which of the effects influence it most strongly. The results are for the case of GDP-weighted decision making in the monetary union.

Table 3 shows that the most important factor determining net welfare are the strong preferences for output stimulation in Uganda. This shows in the third column of Table 3 where the value for Uganda is positive and large indicating that Uganda would benefit from a monetary union with countries that display stronger aversion to high inflation. Conversely, most of the

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

[10] For example, the net gain from monetary union for Uganda is 0.1228 – 0.0001 + 0.2572 (in Table 3) = 0.38 (in Table 2).

remaining countries would lose from a monetary union with a country that has a relatively poor inflationary record.

Table 3 also highlights the importance of the correlation of the shocks to preferences that is the main focus of this paper. Consider the case of Tanzania as an example. If the net benefit from a monetary union for Tanzania was determined only considering the cost of losing monetary policy (value -0.0001 in the second column of Table 3) and the "imported" credibility argument (value -0.0041 in the third column of Table 3) the overall net gain for Tanzania would be negative (-0.0001-0.0041 = -0.0042). Adding the consideration of checks on individual countries' policies by the union (value 0.0141 in Table 3) reverses this result into a positive net gain of 0.010.[11]

6. Conclusions

This paper studies the implications of uncertainty regarding the central banks preferences for monetary union. We develop a model where the preferences of the central banks of potential member countries in a monetary union are subject to shocks (such as unexpected pressures to accommodate government objectives). We find that the net gain from monetary union for a country is greater if it joins in a union with other countries that have greater credibility for low inflation; if its output shocks are more highly correlated with those of the other union members; and if the shocks to its central bank's preferences are correlated less with those of other member countries. The latter result occurs because the supranational central bank is able to even out the

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

preference shocks across the member countries. While the literature has discussed the first two effects, it has not identified the third one.

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

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

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.

Bayoumi, T. and J. D. Ostry (1997). "Macroeconomic shocks and trade flows within Sub-Saharan Africa:
Implications for optimum currency arrangements." Journal of African Economies **6**(3): 412-444.

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.

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 monitoring 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 APENDIX A:

The Welfare Effects of Monetary Unification

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

$$E\left(NW_i^G\right) \equiv EU_i^G\left|_{MU} - EU_i^G\right|_{Autonomy} \quad \text{(A1a)}$$

This can be written as:

$$\{-\frac{1}{2}(E[\pi^*_{mu} - \tilde{\pi}_i(\varepsilon_i)]^2)\} - \{-\frac{1}{2}(E[\pi^*_{i,Aut} - \tilde{\pi}_i(\varepsilon_i)]^2)\} \quad \text{(A1b)}$$

Using, $E(Q^2) = [E(Q)]^2 + Var(Q)$, we can rewrite (A1b) as:

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

$$-[-\frac{1}{2}\{[E[\pi^*_{i,aut} - \tilde{\pi}(\varepsilon_i)]]^2\} - \frac{1}{2}\{Var(\pi^*_{i,aut} - \tilde{\pi}(\varepsilon_i))\}] \quad \text{(A2b)}$$

STOCHASTIC COMPONENT

Net welfare for the stochastic component (SW) of (A2b) is given by:

$$E(SW_i) = -\frac{1}{2}\{Var(\pi_{mu} - \tilde{\pi}(\varepsilon_i)) - Var(\pi_{i,aut} - \tilde{\pi}(\varepsilon_i))\} \quad \text{(A3)}$$

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

$$E(SW_i) = -\frac{1}{2}\{Var\left[bc_A + \tilde{\pi}(\varepsilon_A) - \tilde{\pi}(\varepsilon_i)\right] - Var\left[bc_i\right]\} \quad \text{(A4)}$$

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

This gives $\varepsilon_A = w_i\varepsilon_i + (1-w_i)\sum_{k=1,k\neq i}^{n}(\frac{w_k}{1-w_i})\varepsilon_k = w_i\varepsilon_i + (1-w_i)\varepsilon_{-i}$ (A4a)

Similarly we can write $c_A = w_i c_i + (1-w_i)c_{-i}$ (A4b)

where ε_{-i} (c_{-i}) is the weighted average of supply shocks (output preference) across the $n-1$ other union members. Thus writing the cross-country aggregate shock ε_A and the shocks to preferences c_A as in (A4a) and (A4b), and assuming that the preferences and the supply shocks are not correlated we obtain:

$$SW_i = \frac{-\eta^2(1-w_i)^2}{2}[\sigma^2_{\varepsilon_i} + \sigma^2_{\bar{\varepsilon}_{-i}} - 2\,\mathrm{cov}(\varepsilon_i, \varepsilon_{-i})] - \frac{b^2}{2}\left[(w_i{}^2 - 1)\sigma^2_{c_i} + (1-w_i)^2\sigma^2_{c_{-i}} + 2w_i(1-w_i)\,\mathrm{cov}(c_i, c_{-i})\right] \quad \text{(A5)}$$

NONSTOCHASTIC PART

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

$$E(NSW_i) = -\frac{1}{2}\{[E[\pi^*_{mu} - \tilde{\pi}_i(\varepsilon_i)]]^2 - [E[\pi^*_{i,aut} - \tilde{\pi}_i(\varepsilon_i)]]^2\} \quad \text{(A6)}$$

which reduces to:

$$-\frac{1}{2}\{[b\bar{c}_A]^2 - [b\bar{c}_i]^2\} = -\frac{b^2}{2}\{[\bar{c}_A]^2 - [\bar{c}_i]^2\} \quad \text{(A6´)}$$

But $[E[\pi^*_{mu} - \tilde{\pi}(\varepsilon_i)]]^2 \equiv [E[\pi^*_{mu} - \pi^*_i + \pi^*_i - \tilde{\pi}(\varepsilon_i)]]^2$. Let $b\bar{c}_i = A_{\pi,i}$ and $b\bar{c}_A - b\bar{c}_i = \Delta_{\pi,i}$. Hence we can write (A6) as:

$$-\frac{1}{2}\{([\Delta_{\pi,i} + A_{\pi,i}]^2 - A^2_{\pi,i})\} = -\frac{1}{2}\{[2A_{\pi,i}\Delta_{\pi,i} + \Delta^2_{\pi,i}]\} \quad \text{(A7)}$$

The net welfare for the non-stochastic part becomes:

$-\frac{1}{2}\{2[b\bar{c}_i][b(\bar{c}_A-\bar{c}_i)]+[b(\bar{c}_A-\bar{c}_i]^2\}$, which using (A4b) yields;

$$NSW_i=-(1-w_i)b^2\bar{c}_i[\bar{c}_{-i}-\bar{c}_i]-\frac{b^2(1-w_i)^2}{2}[\bar{c}_{-i}-\bar{c}_i]^2 \qquad \text{(A8)}$$

Combining (A5) and (A8) yields equation (7) in the text.

TECHNICAL APPENDIX B:

Deriving the estimates of parameters b and c_i

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

$$W_i = c_i(y_{i,t} - \tilde{y}) - 1/2(\pi_{i,t} - \tilde{\pi}(\varepsilon_{i,t})^2 \quad \text{(B1)}$$

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

$$\Delta x_t = \Delta x_t^d + \varepsilon_{xt}, \quad \text{(B2)}$$

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

$$y_t = \alpha_1 + \alpha_2 t + \alpha_3 y_{t-1} + \alpha_4 \Delta x_t + \varepsilon_{yt} \quad \text{(B3)}$$

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

$$\Delta y_t = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) y_{t-1} + \alpha_4 \Delta x_t + \varepsilon_{yt} \quad \text{(B4)}$$

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

$$\pi_t = (1 - \alpha_4)\Delta x_t - h_t, \text{ where } h_t = \alpha_1 + \alpha_2 t + (\alpha_3 - 1) y_{t-1} + \varepsilon_{yt} \quad \text{(B5)}$$

The policy maker optimizes (B1) with respect to Δx_t^d, subject to (B2), (B4) and (B5) to yield:

$$\Delta x_t = \frac{c_i \alpha_4}{(1-\alpha_4)^2} + \frac{h_t^e}{(1-\alpha_4)} + \varepsilon_{xt}, \text{ where } h_t^e = \alpha_1 + \alpha_2 t + (\alpha_3 - 1)E(y_{t-1}) + E(\varepsilon_{yt}) \quad \text{(B6)}$$

Equation (B6) expresses the policy maker's reaction to the desired growth rate of real output and h_t^e which represents the past development of real output growth.

Following the two-step estimation procedure in Swank (1997), we first estimate the economic constraint (B3). From these estimates we calculate h_t^e, which then allows us to estimate the reaction function of nominal demand (B6) with the coefficient on h_t^e constrained to be $\frac{1}{1-\alpha_4}$. The results from (B6) 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 (B4) the value of b in (7) in the text can be approximated. By writing $\pi = \Delta p$ then from $\pi_t = \Delta x_t - \Delta y_t$ we get:

$$\frac{\Delta y}{\Delta x} = \alpha_4 = 1 - \frac{\Delta p}{\Delta x} \qquad \text{(B7)}$$

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

$$b = \frac{\Delta y}{\Delta p} = \frac{\Delta x}{\Delta p} - 1 = \frac{\alpha_4}{1-\alpha_4} \qquad \text{(B7′)}$$

Thus the value of b can be estimated from (B7′). The weighted average of these values for the five East African countries is used as an estimate of the cross-country b value.

Table 1: Estimates of model parameters for East Africa

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

Table 2: Net welfare from monetary union in East Africa

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

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

Table 3: Decomposing of the net welfare gain from monetary union in East Africa

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

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