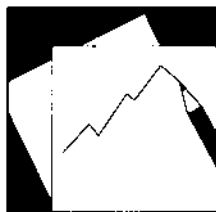


# Working Paper

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Should African Monetary Unions Be Expanded?  
An Empirical Investigation of the Scope for  
Monetary Integration in Sub-Saharan Africa

*Xavier Debrun, Paul R. Masson, and  
Catherine Pattillo*

## IMF Working Paper

European and Strategy, Policy and Review Departments

### **Should African Monetary Unions Be Expanded? An Empirical Investigation of the Scope for Monetary Integration in Sub-Saharan Africa**

Prepared by **Xavier Debrun, Paul R. Masson, and Catherine Pattillo**<sup>1</sup>

July 2010

#### Abstract

**This Working Paper should not be reported as representing the views of the IMF.**

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

This paper develops a full-fledged cost-benefit analysis of monetary integration, and applies it to the currency unions actively pursued in Africa. The benefits of monetary union come from a more credible monetary policy, while the costs derive from real shock asymmetries and fiscal disparities. The model is calibrated using African data. Simulations indicate that the proposed EAC, ECOWAS, and SADC monetary unions bring about net benefits to some potential members, but modest net gains and sometimes net losses for others. Strengthening domestic macroeconomic frameworks is shown to provide some of the same improvements as monetary integration, reducing the latter's relative attractiveness.

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## I. INTRODUCTION

Africa is the continent with the largest number of countries, and, despite the existence of currency (or monetary) unions that share the CFA franc,<sup>2</sup> also the largest number of currencies. Since many of the countries are small, both in population and economic terms, it is natural to ask whether greater regional integration—including monetary integration—is in Africa's interest. Over the decades since independence, various regional groupings have been involved in free trade arrangements, in some cases continuing or reviving those that existed under the colonial regimes. The CFA franc zones and the Common Monetary Area (CMA) in Southern Africa are the only monetary integration arrangements that are still in place. However, several regional currency union projects are actively being planned at present, and a common currency for Africa remains a long-term goal of the African Union.

This paper discusses the conditions for monetary integration to be beneficial and attempts to give a quantitative assessment of the costs and benefits of the currency unions currently pursued in Africa. There have already been many studies of monetary union proposals for Africa, most of them illustrating the potential costs of a one-size-fits-all monetary policy for the members of those prospective unions. Regardless of the methodology, these studies mainly conclude that African economies are too different on too many counts to allow for sustainable monetary unions. Problematic asymmetries range from production structures (and hence different shocks to the terms of trade and output) to institutional effectiveness—such as democratic accountability, control of corruption, and government efficiency—all contributing to major disparities in economic performance, including public finances, inflation, and growth.

This paper, which updates and extends earlier work (Debrun, Masson, and Pattillo, 2005, and Masson and Pattillo, 2005), aims at providing a full-fledged cost-benefit analysis of selected monetary union projects in a coherent theoretical framework. Our contribution is to integrate traditional arguments against monetary unions—i.e., the costs of a one-size-fits-all monetary policy in a heterogeneous region deprived of fiscal federalism—with potential benefits in terms of enhanced policy credibility. These benefits were extensively debated in the European context; they are in our view even more relevant in Africa; but they have been consistently ignored by the literature on African integration. The novel elements of the present paper include a more coherent calibration of the theoretical model based on more robust and updated empirical estimates, and an explicit modeling of the substitutability between monetary integration and domestic institutional reforms. Our approach goes beyond traditional illustrations of disparities in output and price behaviors,

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<sup>2</sup> Actually two separate currencies, the CFA francs issued by the West African and Central African central banks (BCEAO and BEAC, respectively). A survey of the monetary regimes in Africa is provided in Masson and Pattillo (2005).

and establishes the relevance of asymmetries in institutional quality and credibility of national commitments to macroeconomic stability.

That said, the analysis remains focused on the implications of monetary unification for macroeconomic policies, neglecting certain gains that are microeconomic in nature, such as lower transaction costs, greater price transparency, and enhanced cross-border competition. Our model also ignores the potentially large trade-creation effect of monetary unification (Masson, 2008). Because savings on transaction costs are expected to be negligible in Africa (they did not exceed 1 percent of GDP in the euro area), we can safely leave them for a discussion outside the model. Besides, the qualitative impact of trade creation on our results is straightforward to assess.

Although the simulation results are slightly more favorable to monetary union projects than in our earlier work, net gains still appear uncomfortably small or even negative for a number of potential members in all envisaged groupings. These results reflect the slow convergence in fiscal policy performance and the persistently low degree of regional trade integration. We also show that improved monetary policy credibility and effectiveness—the key source of gross benefits from monetary union—could be obtained by strengthening domestic fiscal frameworks and enacting greater central bank independence without incurring any of the costs of monetary unification.

Certain grey areas and limitations of our model underscore the importance of further research in at least two important dimensions. The first is the proper measure of institutional strengths and weaknesses, and of the extent to which governments already facing tremendous and multiple challenges can be expected to design and implement credible monetary and fiscal reforms on their own. Having a better grasp of these aspects would help us refine the institutional benchmark against which monetary unions are compared. In particular, it would be important to better understand the scope for scale economies in institution building, as effective institutions inevitably absorb scarce human and financial resources. Scale economies would put a premium on regional vs. national efforts to build such institutions. A second avenue of fruitful research would be to better model the dynamics of monetary integration itself, and in particular the conditions under which sub-regional unions can serve as building blocks for larger unions. Although our model emphasizes the importance of these issues, a full analysis is beyond this paper's scope.

The rest of the paper is structured as follows. Section II reviews the existing literature on African currency unions, concluding that it is generally biased toward an analysis of the costs and that it often lacks sound theoretical foundations. The model and its analytical solutions are discussed in Section III. Section IV describes the status of the three major regional monetary union projects in Africa, namely the East African Community (EAC), the Southern Africa Development Community (SADC, including the CMA), and the

Economic Community of West African States (ECOWAS). These are projects that would lead to an enlargement of existing monetary unions, or reestablishment and expansion of an earlier monetary union. The section suggests that official timetables seem ambitious, even in ECOWAS where monetary union among a subset of countries has already been postponed several times. Section V provides a quantitative update of fiscal and institutional convergence in the above-mentioned sub-regions. In Section VI, we calibrate the theoretical model to assess the viability of the monetary union projects in terms of their net economic benefits. Although none of the projects is found to be severely detrimental to its potential members, net gains only appear significant for a minority of them. Section VII discusses the potential for domestic institutional reforms and the substitutability with country-specific incentives to pursue regional integration. Finally, Section VIII draws policy implications and identifies topics for further research.

## II. DESIRABILITY OF AFRICAN MONETARY UNIONS: A SURVEY

There is an extensive literature assessing the advantages and disadvantages of monetary unions—actual and proposed—in Sub-Saharan Africa (SSA).<sup>3</sup> Broadly speaking, this literature has developed three main empirical approaches for considering the desirability of monetary unions: (1) attempts to measure the asymmetry of shocks, inspired by optimum currency area (OCA) theory pioneered by Mundell (1961); (2) studies comparing macroeconomic performance of existing monetary unions with that of non-members; and (3) measures of the convergence of various macroeconomic indicators among countries of the region, viewed as criteria for membership. The first approach considers whether shocks hitting the economies of members of a monetary union are sufficiently similar to allow a common monetary policy to fit every member needs. The second strand is more heterogeneous, and is importantly influenced by the institutional structure of the two existing monetary unions on the continent, namely the two CFA franc zones in western and central Africa. In particular, a series of articles compares the performance of CFA countries with others in SSA—in particular, growth, intra-regional trade, and synchronicity of business cycles. The third strand, inspired by the convergence criteria established in Europe for membership in the euro zone, is not grounded in any specific theory and simply monitors indicators that African regions have themselves adopted as entry criteria. However, some sophisticated econometric techniques have been applied to measuring convergence along various dimensions.

These three traditional approaches all have their drawbacks. They do not provide any way of assessing whether benefits exceed costs, or whether joining monetary union would be better than strengthening domestic institutions. Moreover, they do not properly capture

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<sup>3</sup> This literature is too large to be exhaustively surveyed here. A comprehensive survey of the literature for Southern Africa is Tavlas (2009).



the dynamic nature of economic performance. A few recent papers deal with some of these issues in the African context, and are surveyed in the last sub-section below.

### **A. Studies of Exogenous Shock Asymmetry**

Focusing on the problems that asymmetric shocks among participants create for a monetary union, this approach requires identifying the exogenous shocks to output. Many studies have used vector autoregressions (VARs) to explain the systematic fluctuations in output, the residuals being the shocks that may or may not be correlated across countries. Estimating two equations (or more), one for output and the other for the price level—using method of Blanchard and Quah (1989)—permits decomposing shocks into demand and supply shocks. The latter pose greater problems for a monetary union because demand shocks can be expected to become more similar with a common monetary policy, while supply shocks cannot.

Bayoumi and Ostry (1997) estimate a VAR on output alone because of problems in getting the price data needed for the Blanchard-Quah decomposition. They provide a comprehensive empirical study of the asymmetry of shocks to real GDP hitting African economies. They calculate the correlation of shocks to GDP growth affecting countries in the two CFA franc zones, ECOWAS, COMESA, and SADC. Because of its focus on the costs, the OCA theory cannot provide a threshold to evaluate whether correlations are high enough to justify a monetary union. Bayoumi and Ostry (1997) thus use the correlations among the three largest industrial countries (Germany, Japan, and the United States) as a benchmark. They conclude that since correlations between African countries are lower, there is little case to be made purely on the basis of similarity of shocks for the existence or creation of monetary unions in Africa.

Horváth and Grabowski (1997) reach a broadly similar conclusion for Africa, using a Blanchard-Quah decomposition of shocks into demand and supply. In particular, supply shocks—which pose the greatest problem for a currency union—are highly asymmetric. However, they do find that there are groups of countries in Northern Africa (the Maghreb and Egypt), Western Africa (principally the CFA countries), and Southern Africa (South Africa, Zimbabwe, Madagascar, and Mauritius) for which the correlation of demand shocks is relatively high.

Fielding and Shields (2001) propose a more detailed analysis focused on the CFA franc zones. Their decomposition of shocks (using Blanchard-Quah) identifies price shocks and output innovations. Price shocks are quite positively correlated, and the correlations are as high across the two CFA zones as within them—making the existence of two different zones unnecessary. The only exception is Niger, which has a lower correlation. For output shocks, in contrast, there are pairs of countries with negative correlations. Grouping countries with positive correlations would divide up the CFA zones quite differently: a first group would include most of the countries in both zones, except for

Côte d'Ivoire, Mali, and Congo Republic, which would constitute the second group. Thus, this study also identifies lack of correlation of real shocks as a potential problem for the existing CFA franc zones.

More recent studies have echoed the broad conclusion that real shocks hitting African economies, including those in the same region, are highly asymmetric, due in part to very different mixes of commodity production. Buigut and Valev (2006) confirm this conclusion for Eastern and Southern Africa, though they do find a few sub-regional clusters that may benefit from a currency union. Houssa (2008) provides an alternative to VAR models for identifying demand and supply shocks for West African countries, namely dynamic structural factor analysis. This technique can account for other shocks in addition to aggregate demand and supply disturbances, including measurement error, because unlike VAR models, it does not require the estimation of a large number of parameters. He finds negative and low positive correlations of supply shocks, and concludes that countries would find forming a monetary union challenging.

Debrun, Masson, and Pattillo (2005) follow a different approach in that they identify the shocks to real output with terms of trade shocks. A small open economy faces exogenous terms of trade, so that the endogeneity of output fluctuations does not need to be filtered out. They found that terms of trade correlations were low, and sometimes negative, for pairs of ECOWAS countries, while Masson and Pattillo (2005) found a similar result for other regions. Wang and others (2007) found that even the CMA countries, with tight trade links and long-standing exchange rate union, do not exhibit consistently positive terms of trade correlations.

### **B. Comparison of Macroeconomic Performance and Fiscal Discipline in Currency Unions with other SSA Countries**

Studies of this type assess the desirability of monetary unions by comparing economic performance in existing unions to that of countries that have retained national monetary autonomy. Some of these studies are purely empirical, in particular many of those that compare the CFA franc zone to similar comparator countries. Other studies attempt to understand the complex interaction between monetary and fiscal policies in monetary unions, and whether membership enhances fiscal and monetary discipline.

Early literature concluded that the two CFA zones provided better real economic performance than the rest of SSA (Guillaumont and Guillaumont, 1984; Devarajan and de Melo, 1987), but the overvaluation of the currency deteriorated economic growth, requiring a large devaluation in 1994. However, it remains that inflation rates have been unambiguously lower over the past 5 decades than in the rest of SSA (Masson and Pattillo, 2005, chapter 4).

The reasons why a monetary union in SSA might provide better economic performance are discussed in a series of articles. Collier (1991) suggests that it provides an “agency of restraint” for fiscal policies, and in particular, the French treasury enforced that discipline for the CFA franc zone, via the exchange rate peg to the franc and statutory limits on lending associated with the treasury’s guarantee of the peg. Guillaume and Stasavage (2000), however, conclude that the two CFA central banks did not in fact discipline fiscal policies because they evaded the statutory limits, and that these lapses contributed to the problems that CFA countries faced in the late 1980s and early 1990s. Masson and Pattillo (2002) argue that a monetary union in ECOWAS would be insufficient in itself to exert fiscal discipline, and would have to be supported by effective institutions of regional surveillance over fiscal policies.

Even if the regional central bank does not necessarily discipline fiscal policy, it does have a different status relative to national finance ministries than does a national central bank. In essence, the power of each country’s fiscal policy to extract financing from the central bank is weakened in a regional context. The model used in Debrun, Masson, and Pattillo (2005) and Masson and Pattillo (2005) incorporates that feature, while also including the asymmetry of shocks (highlighted by the OCA literature) in the welfare calculus. Despite this, those two studies were relatively pessimistic that extending monetary unions beyond the CFA to ECOWAS, or the creation of new African monetary unions, would enhance welfare.

### **C. Regional Convergence as a Precondition to Membership**

Prospective monetary unions have also been evaluated on the basis of largely ad-hoc convergence criteria.<sup>4</sup> Drawing on the EU experience, these studies have concentrated on convergence of inflation to a low value, and the reduction of public deficits and debt ratios below some critical values. In addition, since the range of levels of development is much greater than in Europe, some proxy for them, such as per capita income, has sometimes been applied. These studies have been too numerous to be surveyed; indeed, regional groupings like the CFA franc zone, ECOWAS, and SADC do a regular updating of success in meeting the criteria. Generally, these studies highlight the challenges of achieving regional convergence: there are large initial differences, and partial success in narrowing them is often reversed subsequently.

Jenkins and Thomas (1996) for instance concluded that SADC had not reached sufficient convergence to plan for a monetary union, a conclusion echoed by Masson and Pattillo

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<sup>4</sup> While structural and fiscal variables can give a good sense of an economy’s resilience to shocks, purely nominal variables (interest rates, inflation, exchange rate fluctuations) are less informative on the fitness to join a given union because much of these nominal discrepancies are precisely due to the absence of such a union in the first place (Wyplosz, 1997).

(2005) almost a decade later. Agbeyegbe (2008) estimates a model with time varying parameters and concludes that there is lack of convergence of nominal exchange rates and consumer prices among SADC countries. However, Burgess (2009) found that the SADC countries, except for Zimbabwe, had made solid progress in macroeconomic convergence, so that prospects for proceeding to monetary union were more favorable. Moreover, Rossouw (2006) argues with reference to the European Union that convergence should be viewed as a permanent goal rather than a precondition for membership.

In West Africa, data using the convergence criteria adopted by WAEMU showed that a period of convergence toward fiscal discipline in the aftermath of the 1994 devaluation was followed by a relaxation of efforts and divergence in these countries (Doré and Masson, 2002). As for the non-CFA countries in the region that are preparing for a monetary union—the West African Monetary Zone—the most recent convergence report (WAMZ, 2008) concluded that “the pace of progress has been slow” in achieving the convergence criteria that were to have led to a monetary union in 2009, now postponed until 2015.

In addition to assessing success on meeting convergence criteria, there is a literature that uses cross-country dispersion and time series analysis to examine convergence of macroeconomic variables. A recent study for the EAC found some evidence of convergence of monetary policy variables, no evidence for fiscal variables, and mixed results on other macroeconomic indicators (Opolot and Luvanda, 2009).

#### **D. Alternatives to the Traditional Approaches**

The shortcomings of the traditional approaches—OCA theory, comparison of macroeconomic performance, and convergence criteria—have generated a search for more comprehensive alternatives. First, none of the traditional approaches gives a precise criterion for when joining a monetary union would be preferable to retaining one’s own currency. Instead, they typically evaluate similarity with reference to other countries already in a monetary union. However, as Mundell emphasizes, the problem is multidimensional since labor mobility and other structural factors can compensate for shock asymmetry. Second, the criteria are not sufficiently dynamic. As Rose (2000) argued, membership in a monetary union may increase trade and hence synchronicity of business cycles. Finally, institutional features of monetary unions need to be given more attention, including whether there is an anchor able to provide the credibility for monetary policy, like the Bundesbank in the EU. Tavlas (2009) devotes considerable attention to the endogeneity of OCA criteria and also the possibility of importing monetary policy credibility, in a survey of the literature on possible monetary unions in Southern Africa.

In order to address the multidimensional nature of the problem, several studies have used cluster analysis to group countries together into potential monetary unions. Bénassy-Quéré and Coupet (2005) use variables suggested by both the OCA and “fear of floating” literatures to group countries in West and Central Africa. They find that the existing CFA franc zone as a whole cannot be viewed as an optimum currency area, since WAEMU and CEMAC do not belong to the same cluster. They also find that the WAMZ monetary union is not supported by the clustering analysis. Tsangarides and Qureshi (2008) also apply clustering analysis to these subregions, using variables suggested by convergence criteria and OCA literature. Again, they find that the CFA countries do not all belong to the same cluster, and they throw doubt on the ECOWAS monetary union since WAEMU and WAMZ countries have the greatest dissimilarity within the sample. However, there is greater similarity between WAMZ and CEMAC, possibly reflecting the fact that both groups include oil producers.

A substantial literature has mushroomed around the seminal work of Andrew Rose, developing the idea that the extent of intra-regional trade is not a good measure of the potential benefits of monetary union, since joining a monetary union is likely to increase trade and also reduce the asymmetry of shocks. Masson and Pattillo (2005) tend to confirm the somewhat surprising estimates of Rose (2000) that suggest that trade in African monetary unions is about three times greater than it would be if member countries did not share the same currency, after controlling for some of the factors that the gravity model suggests should matter—though there is continuing doubt that all relevant features of the CFA franc zone have been taken into account. Tsangarides et al (2006) estimate that a monetary union increases intra-union trade by a factor of 1.7 in Africa, controlling for the effect of a free trade agreement. Tapsoba (2009) finds that monetary integration increases trade intensity and business cycle synchronization, but less so in Africa than among industrial countries. While these studies suggest that static criteria are biased against accepting countries into monetary unions, they fail to provide any way to evaluate whether trade intensity and synchronization will increase enough to make monetary union worthwhile—especially given the very low initial level of African trade. Masson (2008) shows that even a doubling of intra-regional trade would not be sufficient to make most African monetary unions desirable, using the model in Debrun, Masson, and Pattillo (2005) and Masson and Pattillo (2005) that embodies a welfare criterion.

Yehoue (2005) also applies a dynamic approach to the formation of monetary unions, based on the endogeneity of the trade externality and a threshold on the amount of trade needed to make a country join a monetary union. He finds that the size and configuration of an existing union affects its attractiveness for new members: the integration path matters. He finds nevertheless that this analysis does not suggest ultimate convergence to a single African currency.

In order to go beyond merely assessing the costs (i.e., the asymmetries) of monetary unions, several studies have attempted to assess benefits as well, comparing them to costs. Khamfula and Tesfayohannes (2004) discuss in an informal way the various factors affecting costs and benefits of monetary union in Southern Africa. Karras (2007) takes the main benefit to be enhanced price stability, while the main cost is higher business cycle volatility due to shock asymmetry. Though he does not have a metric for comparing the two, his empirical work, using African data for 1960–2000, finds that the costs and benefits are sometimes positively correlated: those countries that have a lot to gain from a monetary union (Uganda, Ghana, and Guinea) also have a lot to lose from it, since they face asymmetric shocks. Conversely, those which would have little benefit would also not find joining very costly (Morocco, Côte d’Ivoire, and Gabon).

A full welfare analysis with a general equilibrium model provides a comprehensive approach to costs and benefits. This requires, of course, numerical values for parameters including those for preferences. Debrun, Masson, and Pattillo (2005) and Masson and Pattillo (2005) provide such a calibrated model whose costs reflect the OCA and fiscal asymmetries, while the benefits derive from reduced temptation in a monetary union to use monetary policy to achieve “beggar-thy-neighbor” output stimulation. The model is described further below, and a new, more comprehensive and consistent calibration of parameters is provided. A more dynamic general equilibrium model is developed in Batte and others (2009), and applied to Nigeria and WAEMU; preliminary results suggest that the optimal policy regime differs between the two, with Nigeria preferring a flexible exchange rate.

### **III. A COMPREHENSIVE FRAMEWORK FOR EVALUATING MONETARY UNIONS**

The eventual formation of a mutually beneficial currency area ultimately depends on the capacity of the common monetary policy to provide adequate macroeconomic stability both in terms of cushioning national economies against shocks and of securing appropriately low inflation. While the traditional OCA literature and the related approaches emphasize the first dimension, pointing to the need for economies to be sufficiently similar or integrated, institutional changes accompanying monetary unification have received considerable attention since the early 1990s and the EMU debate. In particular, it was shown that countries with different records of macroeconomic stability and policy credibility could agree on a set of common institutions that would make a monetary union among them desirable. The possibility that a group of heterogeneous countries failing most OCA tests could nevertheless form a sustainable currency union is particularly relevant in the African context.

#### **A. Modeling Strategy: Combining Credibility and Stabilization Issues**

The main objective of our model is to incorporate in a tractable analytical framework the impact that monetary integration has on strategic interactions between monetary and

fiscal authorities. These interactions are essential in establishing credibility and in shaping the policy response to shocks. Attention to credibility dominated narrow OCA arguments in the debate leading to European monetary unification (Beetsma and Giuliodori, 2009), and those arguments are likely to apply with even greater strength in the African context (Debrun, Masson, and Pattillo, 2005).<sup>5</sup> Although our analysis is more comprehensive than many existing studies, the approach nevertheless remains traditional in the sense that we examine the adequacy of the macroeconomic policy mix with or without a common currency.

Despite considerable progress in recent years, reflected in more sustainable fiscal positions, macroeconomic policies in many African countries remain vulnerable to institutional weaknesses that undermine the credibility of commitments to low inflation and sustainable public finances. Although institutional reform is often high on policymakers' agendas, effective implementation can suffer from capacity and political-economy constraints. One important source of risk to credibility is related to the combination of weak tax mobilization (Keen and Mansour, 2009) and strong expenditure pressure, leading to excessive deficits (Debrun and Kumar, 2007) and undue reliance on the inflation tax (Catão and Terrones, 2005).

Combining the traditional OCA dimension with credibility and institutional issues (including the fiscal determinants of inflation) involves difficult modeling choices. On the one hand, full-fledged dynamic stochastic general-equilibrium (DSGE) models lack the flexibility needed for a simple treatment of strategic interactions between monetary and fiscal authorities, including the analysis of time-inconsistency and various institutional solutions to it. It is also difficult to calibrate these models to analyze policy interactions among a large group of heterogeneous, low-income countries.<sup>6</sup> On the other hand, models focusing on credibility and institutions—in the Barro-Gordon (1983) and Rogoff (1985) tradition—fail to properly capture economic dynamics, complicating efforts to identify realistic parameter values. Yet these models allow for a simple and intuitive analysis of strategic interactions under a variety of institutional arrangements. Given the importance of these aspects in recent and current discussions about monetary integration in various parts of the world, we opted for such a model.

In the spirit of Beetsma and Bovenberg (1998, 1999) and Martin (1995), our model—a variant of Debrun, Masson, and Pattillo (2005), hereafter DMP—incorporates (i) the role

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<sup>5</sup> Admittedly, policymakers' incentives to form (or to stay in) a currency union often go beyond macroeconomic stability and include factors such as history—e.g., the legacy of colonial monetary arrangements—and regional integration objectives of a largely political nature; but we will not consider these motivations here, focusing instead on strictly economic arguments.

<sup>6</sup> Note, however, that Bayesian estimation has been applied to overcome data scarcity and find plausible calibrations of these models for individual low-income countries (Peiris and Saxegaard, 2007).

of macroeconomic institutions in cementing the credibility of a commitment to low inflation, (ii) the implications of financing beneficial public expenditure through the inflation tax vs. other distortive taxes, and (iii) the role of monetary policy in stabilizing output (as in the OCA literature).

The model, however, does not account for the microeconomic gains of using a common currency, including, reduced transaction costs, increased price transparency, enhanced competition, and ultimately, trade-creation effects.<sup>7</sup> One reason is that these aspects are particularly difficult to introduce in our model in a theoretically sound manner. They could also be problematic to calibrate. A second reason is that their impact on our own estimates is qualitatively straightforward to assess so that they could be discussed on their own merits outside the model. Finally, one noteworthy methodological caveat is that our welfare analysis is not explicitly derived from microeconomic foundations and therefore remains suggestive. The utility functions nevertheless capture fairly uncontroversial trade-offs, and should therefore give a plausible assessment of the net gains (or losses) from forming a monetary union or expanding an existing one.

## B. Structure of the Model and Equilibrium Policies under Autonomy

### The Model

DMP depicts a static,  $n$ -good,  $n$ -country region assumed to be small vis-à-vis the rest of the world so that strategic interactions with governments outside the region can be ignored (Table 1).<sup>8</sup> Economic activity responds to macroeconomic policies through an open-economy Philips curve with traditional new-classical features (equation (1)). Unexpected inflation thus raises output, while distortive taxation reduces it. Spillovers from monetary policies elsewhere in the region are negative, in line with the presumption that depreciations boost competitiveness at the expense of trade partners. Debrun, Masson and Pattillo (2005) derive possible micro-economic foundations for equation (1), including the proportional value-added tax at a rate  $\tau_i$ , and negative monetary spillovers proportional to the intensity of trade relations between two countries ( $\theta_{i,k}$ ).<sup>9</sup> To further simplify, we ignore direct fiscal policy spillovers.

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<sup>7</sup> In the case of transaction costs, the estimated gains for members of the euro area are as low 0.1 percent of GDP for some countries, and never exceed 1 percent of GDP. These gains are likely to be much smaller in the context of African currency unions. As far as the trade creation effect is concerned, existing estimates are usually quite large, but remain to subject to significant uncertainty and methodological controversy.

<sup>8</sup> See also Debrun, Masson, and Pattillo (2008).

<sup>9</sup> Complete derivations are available from the authors upon request. Loungani, Razin and Yuen (2002) derive a New-Keynesian, open-economy Phillips curve which includes foreign output and consumption as well as surprises in the real exchange rate.



In addition to their joint impact on output, monetary and fiscal policies are linked through an instantaneous budget constraint forcing government expenditure to match revenue (equation (2)).<sup>10</sup> Introducing public debt would significantly complicate the strategic analysis without qualitatively affecting our conclusions. Equation (2) also introduces two important elements affecting the conduct of fiscal policy. First, each government is assumed to have a certain propensity to spend public resources on socially wasteful projects, creating a wedge  $\delta_i$  between actual spending and the socially-beneficial items entering  $g_i$ . Second, the budget constraint accounts for the possibility that the government extracts a rent  $\bar{\rho}_i$  from natural resource endowments. To preserve tractable analytical solutions, we ignore any “Dutch-disease” type of distortion possibly related to resource wealth so that  $\bar{\rho}_i$  is equivalent to a lump-sum tax instrument.

Under monetary autonomy, the authorities of each country  $i$  (government and a politically dependent central bank) set policy instruments so as to maximize an explicit utility function (equation (3)). The authorities dislike deviations of public expenditure and inflation from specific targets ( $\tilde{g}_i$  and  $\tilde{\pi}_i$ , respectively), as well as the variability in distortive tax rates—over and above the induced output loss. In contrast to conventional (fully quadratic) utility functions, output enters linearly—as in Barro and Gordon (1983)—indicating that the authorities welcome increases in output with a constant marginal utility. Linearity in output greatly simplifies the notation of equilibrium policies and amounts to assume that macroeconomic instruments are used to stimulate activity beyond the natural level  $y^N$ , the key assumption underlying the expansive bias of time-consistent policies. To introduce the usual trade-off between the *variability* of inflation and that of output without adding a quadratic output term, we use equation (4). Indeed, offsetting supply shocks with macroeconomic policies requires that higher inflation be tolerated in the face of an adverse shock, and lower inflation be targeted in case of a positive shock.

Under monetary union with membership  $M$ , a common central bank (CCB) chooses monetary policy to maximize a GDP-weighted sum of individual members’ utilities. The CCB faces steeper *national* Phillips curves (equation (1’)) than a national central bank by a factor  $1 - \sum_{k \in M} \theta_{i,k}$  in each country  $i$  because unlike national monetary policy, the common monetary policy cannot operate through bilateral exchange rates vis-à-vis other members of the union. As  $\pi$  is effectively the monetary instrument—we do not model the money market—this means that a given monetary impulse will affect output by less if it is decided by a CCB, than if it is implemented by a national central bank in isolation.

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<sup>10</sup> See Alesina and Tabellini (1987).

Before turning to the equilibrium policy mix, two additional properties of the model are worth emphasizing. First, we allow for cross-country heterogeneity along 5 important dimensions: the size of the economy ( $y_i$ ), random terms-of-trade shocks ( $\varepsilon_i$ ), public sector inefficiencies ( $\delta_i$ ), desired provision of public goods and services ( $\tilde{g}_i$ ) and budgetary impact of resource endowments ( $\bar{\rho}_i$ ). Second, the model treats inflation as any other source of distortive taxation, implying that for any positive target of socially-beneficial public spending ( $\tilde{g}_i$ ), the socially-optimal inflation rate will be positive (Alesina and Tabellini, 1987).

### **Equilibrium Policies under Monetary Autonomy**

Our benchmark institutional setting assumes that fiscal and monetary policies are decided by national governments. Equilibrium (time-consistent) policies differ from the social optimum, the key feature being an inflation bias described in equation (7).<sup>11</sup> That bias reflects policymakers' preference for pushing output beyond its potential ("natural") level (Barro and Gordon, 1983) and the impact of public sector inefficiencies  $\delta_i$  on the financing need at any given level of valuable expenditure. The classic Barro-Gordon bias is magnified by the fact that for given expenditure, inflation substitutes for the costly turnover tax, and that for given tax revenues, it allows higher spending (Alesina and Tabellini, 1987). Also, greater inefficiencies lead to higher inflation and tax rates, and lower productive expenditure, *ceteris paribus*. Excessive inflation is an equilibrium because rational agents fully understand policymakers' motivations, allowing them to anticipate the rate of inflation from which the latter have no incentive to deviate. Any ex ante promise to keep inflation below that level is not credible.

The inflationary bias distorts the level and financing structure of expenditure, as higher inflation boosts seigniorage revenues. In comparison to the social optimum, the government can thus spend more and tax less, with some beneficial repercussions on potential output. However, these second-order gains are more than offset by the first-order impact of excessive inflation on welfare.

In sum, equilibrium policies are shaped by two key elements: the level of tax and seigniorage revenues required to deliver the socially optimal productive expenditure (i.e.,  $\tilde{g}_i + \delta_i - \bar{\rho}_i$  or "financing need" [FN]), and the stabilizing response of monetary policy to shocks. Correspondingly, the country-specific costs of a common monetary policy will be

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<sup>11</sup> See Debrun, Masson, and Pattillo (2005, 2008) for more extensive discussions. The socially-optimal solution (first best) assumes that policymakers can make credible pre-commitments on any policy and enact structural fiscal reforms ensuring that public resources are spent only on socially beneficial items (equation (6)). Unless the natural resource rent (or revenues from lump sum taxes) is very large, first-best inflation is positive on average, reflecting the optimal inflation tax.

related to the imperfect correlation of shocks between the country and the rest of the union—the OCA dimension—and divergences in financing needs. We now turn to an explicit cost-benefit analysis of monetary unification in the model.

### C. Institutional Change and the Gains from Monetary Unions

The inflationary bias described above triggered a vast literature suggesting that certain institutional reforms can help cement a credible commitment to socially desirable policies. Institutions can reduce policy bias to the extent that (i) they effectively modify policymakers’ incentives in a durable way, (ii) and that they are more difficult to change than policies themselves (Jensen, 1997). Participation in a currency union arguably satisfies these two conditions. First, a regional central bank inevitably has different motivations than national monetary authorities, which in turn affects the strategic interplay between monetary and fiscal decision makers. Second, any decision to exit is likely to entail significant political and reputational costs. These costs are not explicitly modeled here—this would only be required if we were to explore reputational equilibria—but they are implicitly assumed to be arbitrarily large.

As excessive inflation is rooted in short-term incentives of elected policymakers, the proposed reforms of macroeconomic institutions generally aim at a strict separation of tasks and prerogatives between the government and the central bank. While the latter is often mandated to set monetary policy in line with specific ex-ante objectives for inflation,<sup>12</sup> rules-based fiscal frameworks seek to discourage the former from abusing fiscal discretion by establishing clear numerical benchmarks and enhancing democratic accountability and transparency.

In the remainder of this section, we first discuss the impact of monetary unification on equilibrium inflation, assuming that political interference remains. Second, we explore the possibility for governments to set up legal guarantees against such interference at the regional and national levels.

#### Monetary Unification as a Substitute for National Reform

Participation in a currency union necessarily implies a separation of monetary and fiscal powers, as monetary policy is centralized while fiscal policy is not. In DMP, the CCB maximizes the GDP-weighted sum of national governments’ utilities so that regional and

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<sup>12</sup> See Svensson (1997). Rogoff (1985) is the first to show that the Barro-Gordon inflationary bias can be reduced if monetary policy is *delegated* to a non-politicized agency that is not subject to the same motivations as policymakers themselves. The inflation bias can also be reduced through reputational mechanisms if policymakers face penalties for undue monetary expansions. Based on repeated games, that approach exhibits multiple equilibria. We prefer the analytically simpler route of a “one-shot” interaction in alternative institutional set-ups.

national objectives can only coincide if all member governments have identical preferences and financing needs. Hence in contrast to a purely national monetary reform, this setup does not presume formal independence from politics. Specifically, regional monetary authorities remain subject to the influence of member governments proportionally to their respective economic size.

The constraints facing the CCB also differ in comparison to national monetary policies, as the CCB perceives a steeper Phillips curves than a national central bank. The steepening of the Phillips curves is measured by  $\theta_A^M$ . Since the CCB's marginal utility from a given monetary stimulus is lower than that of a national central bank, equilibrium inflation in the union is lower than the average equilibrium inflation rate under national currencies. The higher is  $\theta_A^M$  (reflecting extended membership or more intense trade linkages among member states), the greater is the induced reduction in the average Barro-Gordon bias. As the average gain in terms of lower credible inflation arises only from steeper Phillips curves, the public finance motives to generate inflation remain, including the trade-off between distortive taxation and seigniorage ( $\gamma\mu\Lambda^{-1}c$ ). However, the level of the inflation tax in each country will now reflect the average  $FN$  in the Union ( $FN_A^M$ , including the average of political distortions), instead of the strictly national  $FN_i$  under monetary autonomy.

Overall, the model thus predicts that *ceteris paribus*, a large group of high-inflation countries with strong regional trade linkages is more likely to form a mutually beneficial monetary union than a small group of low-inflation countries with limited regional trade. Interestingly, heterogeneity in financing needs has an ambiguous effect on the desirability of monetary unification for individual members of a given group. On the one hand, different  $FN$ s may hinder the formation of the union because the regional inflation rate will only by chance coincide with a country's desired composition of government revenues. On the other hand, differences in  $FN$ s may also be a source of gains for governments with relatively high  $FN$ , as low- $FN$  partners exert a restraining influence on the CCB.

The sustainability/feasibility of a fiscally-heterogeneous union could be at risk if low- $FN$  countries were better off keeping national currencies. This will be the case if  $\theta_A^M$  is too small to offset the destabilizing influence of high- $FN$  members. As shown by Debrun (2001), countries could still bargain over a mutually beneficial mandate for a regional central bank. The CCB's utility function consistent with such a mandate would then be biased towards the preferences of the most disciplined country. However, introducing a non-utilitarian CCB in the model would imply an assumption that countries—and especially large, high- $FN$  members—can offer credible guarantees not to interfere with the CCB's decisions.

The possibility for the CCB to pursue specific objectives independently of political interference raises two questions. First, if guarantees of CB independence are at least somewhat credible at the national level, to what extent could this affect the size and number of sustainable currency unions in the region? Second, does the credibility of these guarantees vary with the institutional level to which they apply (regional vs. national)?

### **Independent Central Banks: Regional or National?**

As the separation of monetary and fiscal powers allows the central bank to maximize its own utility function under constraints that may also differ from the government's, one has to wonder what maximization problem would deliver a time-consistent inflation rate as close as possible (or identical) to the socially optimal rate? Here, we consider the two dimensions of the inflation bias. First, to remove the Barro-Gordon bias, the central bank would have to refrain from trying to push output beyond its potential level and focus only on its stabilization. That would require the maximization of a utility function  $U_i^C$  (where  $C$  stands for "commitment") defined as:  $U_i^C \equiv U_i^G - y_i$ . The second dimension concerns fiscal policy: an independent central bank would have to ignore the government's desire to finance useless projects, therefore internalizing a *non-distorted* government's budget constraint:  $g_i = \bar{\rho}_i + \mu\pi_i + \tau_i$ .

In practice, however, even legally independent central banks remain under pressure to accommodate society's desire to maximize output, especially when institutional weaknesses prevent or complicate an effective separation of powers. To account for that possibility, we define the central bank's utility function as  $U^{CB} \equiv \lambda_i U^G + (1 - \lambda_i) U^C = U^C + \lambda_i y_i$ , while the government budget constraint perceived by the bank is  $g_i = \bar{\rho}_i + \mu\pi_i + \tau_i - \lambda_i \delta_i$ . Clearly, if the central bank is under complete political control ( $\lambda_i = 1$ ), then the optimal control problem and the corresponding solutions are the same as in sub-section B above. On the contrary, a completely independent central bank ( $\lambda_i = 0$ ) would manage to credibly eliminate the Barro-Gordon bias, but it would still have to partly account for the government's desire to finance wasteful spending.<sup>13</sup>

Equation (9) characterizes equilibrium inflation for all intermediate levels of political interference. Comparing that result with equation (8) formally establishes that participation in a currency union  $M$  has the same effect on the Barro-Gordon bias as

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<sup>13</sup> This is because the bank values public finance objectives. Should it ignore them ( $b = \gamma = 0$ ), or should it be indifferent to the fact that higher spending is financed with higher distortive taxes ( $b = \gamma$ ), it would not respond to  $\delta_i$  and deliver the socially optimal inflation rate.

making the national central bank formally independent under a level of political interference  $\lambda_i = 1 - \theta_A^M$ . One additional effect of independence is that the political inflation bias is also reduced as  $\lambda_i$  decreases below 1.

Our model thus shows that the country-specific incentives to form a monetary union among a given set of countries are affected by the capacity of individual governments to build credible monetary institutions at home. As this capacity increases, the relative attractiveness of monetary integration becomes increasingly dominated by shock-stabilization/OCA arguments rather than credibility gains. That said, supranational institutions are arguably more credible than national efforts: international treaties are more difficult to reverse than national law, and supranational institutions are more difficult to influence because that requires ex-ante coordination efforts. We could for instance develop a scenario where a formally independent CCB would by definition face a lower  $\lambda_A^M$  than the individual  $\lambda_i$ 's achievable with purely national reforms. This would then shift the balance back to credibility considerations in the cost-benefit analysis of a monetary union among the members of  $M$ . We leave a formal analysis of these aspects for future research, as it requires a detailed assessment of individual countries' capacity to enact credible reforms.

#### IV. STATUS OF MONETARY UNION PROJECTS IN AFRICA

The 1991 Abuja Treaty establishing the African Economic Community (which became effective in May 1994 after the required number of signatures) outlines six stages for achieving an integrated economic and monetary zone for Africa that were set to be completed by approximately 2028. The strategy for African integration is based on progressive integration of the activities of the regional economic communities, which are regarded as building blocks for Africa. We will briefly sketch out the status of monetary union projects for the regions that are actively making preparations for monetary integration. The timetables appear overly ambitious, particularly as the history of the EU demonstrates the very long time that was needed to reach the final stage of a common currency. We will not consider here the ultimate goal of a single currency for Africa.<sup>14</sup>

##### A. East African Community (EAC)

The 1999 treaty establishing the EAC (founding members Kenya, Tanzania, and Uganda), formally launched in 2000, provides for the formation of a customs union, to be followed by a common market, monetary union and ultimately a political federation. While monetary union was seen in the early years of the EAC as a rather distant goal, a number of successful steps in the economic integration process have put monetary union

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<sup>14</sup> See Masson and Pattillo (2005), chapter 9.

plans higher on the agenda. The customs union was successfully launched in 2005 after a long period of difficult negotiations, and is to become fully fledged in 2010 after phasing out asymmetric internal tariffs that Tanzania and Uganda were allowed to continue applying on selected Kenyan imports. Rwanda and Burundi joined the EAC in 2007 and will take commensurate action on the common external tariff and internal tariffs by 2010 according to the accession schedule. The protocol for establishment of the planned 2012 common market, including free movement of goods, services, labor and capital was signed by the heads of state at a November 2009 summit.<sup>15</sup> In August 2007, the heads of state decided to fast-track implementation of the monetary union, advancing the targeted launch date from 2015 to 2012.

While it is relatively early, so far the customs union does not appear to have contributed to a significant increase in intra-regional trade, which has remained in the same range, registering 17.5 percent of total exports, and 7 percent of imports in 2007 (Burundi and Rwanda source 20 percent of their imports from other EAC countries, and over 20 percent of Kenya and Uganda's exports go to EAC partners, Figure 1). Understanding and application of the rules of origin has been a problematic issue, compounded by the problem of overlapping memberships in other regional economic communities.<sup>16</sup> While EAC members have been working to remove non-tariff barriers to internal trade, particularly as these measures could be partly offsetting the effects of internal tariff reduction, the planned full removal of these barriers as part of making the customs union fully operational in 2010 seems unlikely.

In this first decade anniversary year of the EAC, and following the progress on other regional integration steps, some of the first stages for monetary union planning are beginning. Commissioned by the EAC Secretariat, the European Central Bank, working with the EAC central banks completed in January 2010 a study on preparedness for a monetary union: the legal, institutional framework and the monetary union's structure, including for the East African Monetary Institute which will precede creation of an East African central bank; a mechanism for monitoring and enforcement of the macroeconomic convergence criteria; and a protocol for negotiations. Proposals relating to the road map to the establishment of the monetary union are being considered by the relevant EAC organs. It should be noted that the currencies are convertible, and some progress has been made in harmonizing banking regulations, as well as institutional steps

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<sup>15</sup> On a range of contentious issues, relating to aspects of labor mobility, trading of services, and acquisition of land, the countries seem to have agreed to disagree and not include these in the protocol. See "East Africa economy: in your own time," Economist Intelligence Unit, May 29, 2009.

<sup>16</sup> Tanzania is a member of SADC, while Kenya, Tanzania, Burundi, and Rwanda are members of COMESA. While in October 2008 ministers from the EAC, COMESA and SADC announced their intention to merge the blocs into a large free trade area, no specific plans for this merger have been developed yet.

to support a more integrated capital market (IMF, 2009a). Finance ministers conduct pre- and post-budget consultations, there is regular sharing of budget information, and the budget statements are read on the same day.

Primary and secondary convergence criteria have been set for Stage 1 (2007–10) and Stage 2 (2011–12) of the convergence process (Table 3). While none of the countries has consistently met all the criteria, macroeconomic performance has been relatively strong in the region. On the fiscal deficit targets, the countries which do not receive sizeable donor assistance, i.e., Kenya, have done well on the fiscal deficit excluding grants, while those that do, i.e., the other countries, have done well on the fiscal deficit including grants. These criteria were missed in 2008/09, however, as the countries adopted countercyclical policies to lessen the impact of the global financial crisis. Inflation has generally exceeded the 5 percent ceiling, with large slippages during the 2007–08 global food and fuel price shock, as expected. Most countries have met the minimum reserve cover criteria, although the target for Stage 2 will be more challenging.

In addition to progress toward macroeconomic convergence, the extent to which monetary and exchange rate policies operate similarly is an important practical factor affecting the compatibility of future members of a monetary union. The EAC central banks all operate *de jure* flexible exchange rate regimes, target reserve money, and use similar domestic money market instruments for liquidity management (Dunn, 2009). In addition to the ongoing task of sterilizing the liquidity arising from donor budget support, monetary policy operation has faced common issues in recent years including dealing with a sharp increase in portfolio inflows in 2007, and controlling inflation in light of the spike in global food and fuel prices in 2007–08 (IMF 2008a, IMF 2009a). Turning to the asymmetry of terms of trade shocks, the most important external shocks for primary commodity exporters, the average of correlations between the EAC countries (1990–2007) is higher than that for WAEMU or CMA, the existing African monetary/exchange rate unions. However, the average correlations have decreased in the most recent period (2006–08), likely reflecting differential patterns as commodity prices began to decline.

Political momentum for further regional integration in the EAC is clearly on the upswing. Translating this into the political will to work toward macroeconomic convergence, harmonized policy frameworks, and the complex institutional process of adopting a common currency will be the next challenge. However, similar to plans in other SSA regions, the current timetable appears overly ambitious.

## **B. Southern African Development Community (SADC)**

SADC, the largest regional economic community in SSA, adopted a Regional Indicative Strategic Development Plan (RISDP) in 2003. The plan sets out a timetable for deepening regional integration, calling for the creation of a free trade area (FTA) by 2008, a customs



union by 2010, a monetary union by 2016, and a single currency by 2018. While the FTA was launched in August 2008, only part of the 85 percent reduction of internal trade barriers that was specified to occur in the previous 8 years has taken place to date, given members' concerns about risks and differentiated schedules (Braude and Sekolokwane, 2008).

The way forward on economic integration in the region appears quite murky, with calls for different directions from a number of quarters. SACU has been called the anchor and potential driver of deeper integration in SADC, and weak production structures identified as the constraint to more balanced trade in a wider SADC free trade area. However, SACU is currently experiencing serious strains due to the global crisis, consequent sharp declines in output and the revenue pool, and reportedly South Africa may propose another change in the revenue-sharing formula.<sup>17</sup> This follows the 2000–08 period when revenue surged from 13 to 21 percent of GDP for Botswana, Lesotho, Namibia, and Swaziland, driven by strong economic growth in South Africa and an earlier revenue-sharing formula change that increased the share of the smaller countries (IMF, 2009b). There are concerns that the 2010 target date for a customs union is not feasible, while the floated idea of a SADC-COMESA-EAC free trade area has also sparked some interest. Finally, some tensions have arisen over the EU Economic Partnership Agreement. Botswana, Lesotho, Namibia, and Swaziland have signed interim agreements on trade in goods, but South Africa argues that the agreements (in which SADC members are in five separate negotiating configurations) will complicate regional integration by creating market-opening obligations to the EU before the region builds its own rules in new areas such as services and investment.<sup>18</sup>

There are wide disparities in per capita incomes and economic structures across SADC's 15 economies. They can be grouped into middle countries—SACU countries Botswana, Namibia, Swaziland, and South Africa, plus Mauritius, and Seychelles which just rejoined SADC in 2008; low-income countries—Lesotho (SACU), Madagascar, Malawi, Mozambique, Tanzania, and Zambia; fragile countries—Democratic Republic of Congo and Zimbabwe; and an oil exporter—Angola. Intra-regional trade flows account for about 20 percent of total trade, but only 5 percent if South Africa is excluded (Figure 2, Burgess, 2009). These trade flows vary significantly across countries, with South Africa a major source of imports for most countries, particularly SACU neighbors, and a market for exports for some countries, including Namibia, Swaziland, Zambia, and Zimbabwe. FDI from South Africa accounts for around 6 percent of the total FDI stock in

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<sup>17</sup> "Trade-So Africa: Effort Afoot to Save Ricketty Customs Union," Inter Press Service, October 5, 2009.

<sup>18</sup> "South Africa wants proper integrated, competitive regional market," by Rob Davies, South African Minister of Trade and Industry, Business Report, July 17, 2009.

SADC (Burgess, 2009). The average of the correlations of terms of trade changes among member countries is quite low.

SADC governments have agreed to a set of macroeconomic convergence indicators, focusing on maintaining a low inflation rate. While a memorandum of understanding established the convergence criteria, and the SADC Macroeconomic Subcommittee monitors performance on these policies, the institutional framework for regional surveillance could have a higher profile in the region. Still, progress on macroeconomic performance has been relatively good in most countries (with the notable exception of Zimbabwe) and a good proportion of countries met the government budget balance, public debt, and current account targets in 2008 (Table 4). Only two of the countries met the 10 percent inflation target, heavily influenced by the global food and fuel price shocks, and growth was close to 7 percent in only around one-third of the countries (Burgess, 2009; Economic Commission for Africa, 2007).<sup>19</sup>

At the beginning of the decade, the SADC Committee of Central Bank Governors, chaired by South Africa, began work in a number of areas that could lay the institutional groundwork for moving toward monetary union. While the momentum on some of these initiatives may have slowed, other signals suggest that regional monetary union has become a higher priority. The former governor of the Reserve Bank of South Africa noted that proposals were being developed for a common central bank for the Common Monetary Area (CMA, the currency area comprised of South Africa, Lesotho, Namibia, and Swaziland), where the smaller countries would participate in formation of monetary policy, and this could serve as a springboard for regional integration, and in particular a SADC central bank.<sup>20</sup> While no formal proposal has been made for CMA expansion, recent press reports have suggested that Zimbabwe may be considering discussions on joining the CMA.<sup>21</sup> In March 2009, the rand was made the reference currency in Zimbabwe, following official adoption of a set of hard currencies for transactions, given the de facto dollarization of Zimbabwe's economy in the face of a hyperinflation (IMF, 2009c).

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<sup>19</sup> Inflation has since eased in many countries, for example in the CMA inflation fell to single digits in 2009.

<sup>20</sup> Former Reserve Bank of South Africa Governor Tito Mboweni's CR Swart Memorial Lecture at the University of the Free State in Bloemfontein on "Seeking greater political and economic regional integration in Southern Africa in challenging and turbulent financial times," reported in "South Africa Reserve Bank chief proposes common financial institution to unite region," BBC Monitoring Africa, August 29, 2009.

<sup>21</sup> "Zimbabwe's finance minister says country 'must push' for regional currency," BBC Monitoring Africa, September 20, 2009. The finance minister has publicly stated that CMA membership is one possible option for a future currency regime.

### **C. Economic Community of West African States (ECOWAS)/ West African Monetary Zone (WAMZ)**

The plan for monetary union in West Africa is a proposed common currency among the members of ECOWAS that are not presently part of the West African Economic and Monetary Union, or WAEMU.<sup>22</sup> The non-WAEMU countries,<sup>23</sup> in particular Nigeria, Ghana, the Gambia, Guinea, and Sierra Leone, intend to create a common currency area (WAMZ) and eventually to merge it with the WAEMU to form a single-currency area for the whole of ECOWAS. The launch date for the WAMZ's common currency, initially set for 2003, was postponed to July 2005, and subsequently postponed until December 2009. At a June 2007 ECOWAS Summit, leaders requested a study of the feasibility of WAMZ and WAEMU members forming a single monetary union by 2009, thus skipping the intermediate stage of two parallel monetary unions. However, in June 2009 the WAMZ heads of state agreed to further postpone the start date for the WAMZ common currency until 2015 (and the ECOWAS currency to 2020), citing the global financial crisis. The decision also appears compelled by lack of sufficient macroeconomic convergence, and the reality that completing all the legal and institutional steps for a common central bank is still a long way off.

Would a single currency in West Africa be important in saving transactions costs from intraregional trade? Trade among WAMZ countries, at around 2 percent of their total trade in 2007, is much lower than trade among WAEMU countries, even though GDP of the former group is higher (Table 5). However, as found in some studies and as demonstrated by WAEMU, monetary unions tend to endogenously create trade (Tsangarides et al., 2006). ECOWAS countries face asymmetric terms of trade shocks, particularly since Nigeria is the only oil exporter. Terms of trade shock correlations are higher among WAEMU countries (Table 10), while on average the correlations among WAMZ countries have become even more negative in recent periods.

The zone has set four primary convergence criteria that are prerequisites for entry into the monetary union: single digit inflation; a fiscal deficit to GDP ratio (excluding grants) of 4 percent or less; central bank financing of the fiscal deficit as a percent of the previous year's tax revenue of 10 percent or less, and gross international reserves equal to 3 months of imports or more. Six secondary criteria are designed to facilitate achievement of the primary criteria and do not have to be met for the launch to take place. These include a positive real interest rate, a stable real exchange rate, the

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<sup>22</sup> Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo. Guinea-Bissau joined WAEMU in 1997. Data availability for that country is poor, and hence we do not analyze its impact on proposed monetary unions.

<sup>23</sup> Liberia has declined to participate, while the remaining member of ECOWAS, Cape Verde, is pegged to the euro.

settlement of all public domestic arrears, targets for public investment and tax collection, and a ceiling on public wage expenditure.

The West African Monetary Institute (WAMI), the precursor to the planned West African Central Bank, monitors the macroeconomic convergence program. According to a WAMI report only the Gambia met all the four primary criteria for three years from 2006 to 2008, Nigeria met four primary criteria for two years between 2006 to 2007 but only three in 2008, Guinea met only two primary criteria in 2007 to 2008, Sierra Leone met only two criteria since 2004, while Ghana met two criteria in five years up to 2007, but failed to make any criteria in 2008.

WAMI has made some progress toward developing the institutional framework necessary to underpin a monetary union. Draft statutes for the planned West African Financial Supervisory Authority, WAMZ payments system, and the Banking Statute which would harmonize WAMZ member country banking acts have been prepared. The Gambia, Guinea and Sierra Leone are developing a joint payments system, which would form the basis for a WAMZ system. There are ongoing efforts to integrate the Nigeria and Ghana stock exchanges, which would be a significant step in capital market integration.

Of the three monetary union expansion/revival projects, the WAMZ is the most advanced in terms of institutional, legal and regulatory preparation, although some observers have noted that the political commitment has been limited. An important question is whether three postponements of the common currency start date will cause the project to lose momentum, or instead now establish a more realistic timetable, recognizing as the director of WAMI noted, that the journey towards a monetary union is a marathon not a sprint race.<sup>24</sup>

## V. THE STATE OF FISCAL AND INSTITUTIONAL CONVERGENCE

As progress is being made on setting up regional institutions and convergence strategies, actual fiscal and institutional convergence among the potential members of a given monetary union remains essential to reduce the likelihood that more stability-oriented countries drag their feet in regional negotiations out of fear to lose out from membership. Hence the prospect for expanded or even new sustainable currency unions in the SSA region depends in part on the existence of effective convergence dynamics in these domains. This section briefly documents recent trends in that regard.

We first look at key indicators of fiscal outcomes over the last 15 years, namely the overall fiscal balance (including grants), the level of public spending, and a measure of

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<sup>24</sup> “West African Monetary Zone (WAMZ)—The journey towards a monetary union is a marathon...” Business Day, June 4, 2009.

seigniorage revenues, all in percent of GDP.<sup>25</sup> For data availability reasons, the coverage of these indicators is limited to the central government. Although this may affect the density of certain clusters—e.g., Nigeria’s government size is underestimated by that measure—it should not bias our assessment of convergence over time. Each chart plots the average value of the indicator over the period 2000–05 against its average value over 1995–99.<sup>26</sup> The regression line depicts the rate of convergence in the SSA region and in selected sub-regions (ECOWAS, EAC, and SADC): convergence exists if its slope is flatter than 45 degrees.

The data generally point to at least some fiscal convergence for all indicators and almost all sub-regions—the exception being expenditure in the EAC, which is essentially constant in these countries over the period. Interestingly, convergence is more evident within EAC and ECOWAS sub-regions than across the complete sample, or within SADC, where the appearance of convergence is created by fiscal performance in Angola. Also, the EAC and the ECOWAS countries are clearly more fiscally similar among themselves (they form a more compact cluster in the charts) than SADC countries. Fiscal convergence is more pronounced for the fiscal balance than for (the inherently more persistent) expenditure, suggesting that revenue efforts, grants and, in some countries, natural resource revenues contributed to fiscal convergence. Reliance on seigniorage revenues also markedly declined in the SSA region as a whole, in line with the global disinflation trends during the period.

The continuation of these trends and correspondingly, the prospect of further monetary integration in Africa, depend in large part on the institutions shaping policymakers’ actions. We therefore assess the extent to which institutions likely to affect the design and execution of macroeconomic policies have changed over the period under review and whether they exhibited convergence patterns comparable to fiscal variables. The analysis is based on selected institutional quality indicators arguably related to the “public spending inefficiency” variable  $\lambda_i$  in our model, namely government effectiveness, control of corruption, and voice and accountability.

The descriptive evidence gathered in Figures 6 to 8 is generally consistent with the view that the quality of national institutions also tended to converge over the last decade. However, convergence is not systematically associated with absolute improvements in poor performers, as many countries are actually located below the 45-degree lines (indicating a worsening of institutional quality). Only the EAC exhibits across-the-board

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<sup>25</sup> Seigniorage is proxied as the increase in the money stock (cash in circulation and demand deposits—IFS line 34) in percentage of GDP.

<sup>26</sup> We do not extend the analysis beyond 2005 because the budgetary impact of the MDRI in several countries creates temporary divergence in the indicators.

improvements in institutional quality, although convergence is not seen for the control of corruption and democratic accountability indicators.

Overall, raw data on fiscal and institutional variables points to two broad conclusions. First, EAC and ECOWAS exhibit both a greater convergence and a stronger convergence dynamics which, according to the first-order principles underlying our theoretical model, increases the likelihood that regional currency unions might be desirable for all potential members. Second, these present and trend convergence indicators for a SADC-wide currency union are much less favorable.

## **VI. APPLICATION OF THE MODEL TO STUDY THE CREATION OR SELECTIVE EXPANSION OF MONETARY UNIONS**

We now turn to a full-fledged analysis of the costs and benefits of monetary unification in the sub-regions studied in Sections IV and V, using the DMP model presented in Section III. As described above, the model combines an emphasis on the role of fiscal discipline to provide an underpinning for low inflation with the traditional OCA criteria of symmetry of shocks to evaluate possible gains and losses from monetary unions. Welfare comparisons can be made of the decision of a country to retain its own currency against the alternative of adopting the currency of another country or joining a currency union with others. Welfare is measured in percent of GDP equivalents, so is scaled by the size of the country. It is assumed to depend positively on output growth, and negatively on deviations from targets for inflation, tax revenues, and government spending (the latter two as ratios to GDP). The calibration of the model's parameters is described in the appendix. In most cases, parameters have been chosen to fit cross-country fiscal and institutional data over 1994–05,<sup>27</sup> and the variance-covariance matrix of terms of trade and output over 1990–08.

It is worth noting that estimated equilibrium relationships derived from the model provide a reasonably good explanation of inflation and fiscal variables across Sub-Saharan African countries, including those in monetary unions. As detailed in section III above, the model implies that inflation ( $\pi_i$ ) should depend on a country's financing need ( $FN_i$ ), or, if it is a member of a monetary union, on the average  $FN$  of the union's members, which we denote by  $FNA$ . We let  $FNA$  be a cross-sectional variable that combines those two possibilities, if the country has its own currency or is in a monetary union. Moreover,

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<sup>27</sup> Data up to 2005 were used because some of the data series (for example, the World Bank governance indicators) were not available for some countries after 2005, and to exclude the one-off impact of the 2006 multilateral debt relief. Contrary to expectations terms-of-trade correlations were not higher using more recent data, i.e., extending the period until 2008. Clearly, however, the pattern of trade shocks may not be stationary; for example the correlations between Nigeria and other West African countries may rise as more countries (Ghana, Niger) develop oil resources.

the model implies that the level for inflation (i.e., the bias towards too expansionary monetary policy) will be reduced in a monetary union by the amount of intra-union trade, which we capture in the variable  $\theta_{A,i}$ . Further, the model explains tax revenues as ratios to GDP ( $rev$ ) by financing needs (with positive impact), and also on the difference between a member of a monetary union's financing needs relative to the average (since seigniorage revenues depend only on the average). In a monetary union, tax revenues will also have to be higher to compensate for the lower inflation bias. We estimated these two equations using a cross-section of 45 SSA countries, with data for each country averaged over 1994–2005, yielding the following results (standard errors in brackets):

$$\pi_i = -2.812 + 0.399FNA_i - 0.577\theta_{A,i} \quad R^2 = 0.207$$

$$(9.717) \quad (0.218) \quad (0.319) \quad \text{p-value}=0.0028$$

and

$$rev_i = -1.173 + 0.547FN_i + 0.137(FN_i - FNA_i) + 0.109 \theta_{A,i} \quad R^2 = 0.473$$

$$(4.969) \quad (0.111) \quad (0.185) \quad (0.162) \quad \text{p-value}=0.0000$$

It can be seen that despite including countries with a wide range of inflation outcomes (for instance, Angola and Zimbabwe at the high end and the CFA franc zone countries at the low end), the model has decent explanatory power. Financing need has the expected positive effect, and membership in a monetary union the expected negative effect. Government tax revenues are well explained by financing needs and the additional effects of monetary union membership mentioned above. These estimates, together with estimates of the trade internalized in monetary union, are used to calibrate the model's utility-function parameters, as described in detail in the appendix. Variances of terms of trade shocks and of output and inflation are used to calibrate two other key parameters that capture the stabilization role of monetary policy and the effect of the latter on output. Note that to account for the significant under-recording of intraregional trade flows, recorded trade is scaled up by 25 percent to produce the estimates of internalized trade.

Rather than examining all possible combinations of countries as candidates for monetary unions, we consider a more focused question, namely whether several proposed regional groupings of countries into monetary unions discussed in the previous section seem to increase welfare for the countries involved. In particular, we consider the creation of a monetary union among EAC countries; the formation of a SADC monetary union, and monetary union among all ECOWAS countries, or a selective expansion of the existing WAEMU, which uses the CFA franc.

### A. The EAC

As shown in Table 6, there are major differences among the EAC countries. Aside from the correlations between terms of trade shocks of Burundi and Uganda, and Tanzania and

Uganda, other shock correlations are generally not very high (though higher typically than within ECOWAS or the CMA).

Model simulations suggest that a monetary union among all five countries would significantly improve welfare for Burundi and Kenya, but leave Rwanda and Uganda with modest gains (less than 1 percent of GDP) and Tanzania with a small net loss (Table 7). The latter is related to Tanzania's better record of macroeconomic stability, and in particular, a lower financing need. Rwanda's losses, reflecting low or negative shock correlations, would be more than offset by greater imported monetary stability.

## B. SADC

SADC is composed of a large and diverse set of countries.<sup>28</sup> A subset of SADC countries comprise an exchange rate union centered around South Africa's rand, the CMA. Given the size of South Africa's economy, that country would likely dominate any SADC monetary union. Indeed, within the CMA it sets monetary policy. Thus, Table 8 highlights correlations between other countries' and South Africa's terms of trade shocks. Several countries, including an existing CMA member (Namibia), have negative correlations. As documented earlier, fiscal and institutional convergence is low among SADC countries so that financing needs vary considerably. Tanzania and all CMA members except Lesotho have low *FNs*, whereas Angola, Lesotho, and Zimbabwe have high *FNs*. Angola also has a considerably higher standard deviation of terms of trade shocks than other SADC countries, reflecting the large weight of oil in the country's exports.

Consistent with this assessment, welfare calculations of a SADC monetary union including all these countries are mixed, suggesting sizeable net gains only in those more profligate countries that would benefit from greater union-wide discipline. Net losses are obtained for Angola and Mauritius, reflecting considerable shock asymmetry in the former case, and a likely loss of credibility in the latter case (Table 9). As for Tanzania, it would have a small net gain from membership in this monetary union, unlike the EAC's, because a SADC monetary union would be largely anchored by a country, South Africa, with a reasonable degree of fiscal discipline. These calculations assume that the SADC central bank would reflect the average financing need of all member countries.

The other countries including the largest, South Africa, would record only modest net gains (of less than half a percent of GDP) from such a monetary union. Thus, expansion of the CMA would not seem to be economically harmful for many potential participants, despite limited macroeconomic convergence and trade integration, but not particularly

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<sup>28</sup> The Seychelles are omitted from our calculations because its high per capita income gives implausible figures for its financing need variable (*FN*).



beneficial. The results hold irrespective of whether the simulations assume that South Africa's Reserve Bank retained sole responsibility for monetary policy or not. A selective expansion of the CMA (not reported), is generally mutually beneficial for the country concerned (except for Angola and Mauritius) and for existing CMA members.

### C. ECOWAS

ECOWAS is composed of two groups of countries: those in WAEMU,<sup>29</sup> which have shared a common currency, the CFA franc, since before independence, and the remaining countries, which have a project of first creating a regional monetary union among themselves, the West African Monetary Zone (WAMZ),<sup>30</sup> and then combining it with WAEMU to create a full regional monetary union. Table 10 summarizes some key features of the two groups of countries. While WAEMU countries have relatively more similar production structures, with reasonably high correlations of their terms of trade, the WAMZ countries have much lower correlations among themselves (and with WAEMU).

Nigeria, in particular, faces very different terms of trade shocks when compared to its neighbors, reflecting the particular importance of oil exports (though Côte d'Ivoire produces a modest amount of oil). Nigeria's terms of trade shocks are negatively correlated with all the other ECOWAS countries (with an unweighted average correlation of -0.37 with WAEMU countries and -0.27 vis-à-vis other WAMZ countries). In contrast, all the WAEMU countries except Senegal have positive correlations against the average of other WAEMU countries, and each of them has stronger correlations against WAEMU than against the WAMZ average. Ghana is the one exception among WAMZ countries, since it is strongly correlated with WAEMU, its terms of trade shocks exhibiting correlations of 0.58, 0.70, and 0.74 with those of Benin, Burkina Faso, and Cote d'Ivoire, respectively.

The key fiscal variable in our model, the average financing need (*FNA*), does not differ markedly between WAEMU and WAMZ, unlike in our previous work which applied to an earlier period when fiscal discipline was markedly lower in WAMZ. In fact, due to the deterioration in the finances in some WAEMU countries, in particular Côte d'Ivoire, and the marked improvement in Nigeria's fiscal position, WAEMU's average *FN* (weighted by GDP) is 38.5 percent of GDP, compared to 33.4 for WAMZ. Nevertheless, among the WAMZ countries there is wide variation, with Nigeria having a figure of 31.5 and Ghana 45.8.

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<sup>29</sup> We do not include Guinea-Bissau in our tables, since it is a member of WAEMU only since 1997.

<sup>30</sup> We do not include in our set of countries Liberia or Cape Verde, which have not participated in WAMZ.

Table 11 reports the welfare gains or losses from a full ECOWAS monetary union, with the WAEMU members' welfare compared to the status quo of their current membership in WAEMU, and the WAMZ countries compared to their retention of independent currencies. As in other sub-regions, gains in terms of greater credibility usually more than offset losses that would arise from asymmetric shocks, so that only the Gambia is found to be a net loser. Two of the WAMZ countries would reap net gains in excess of 2 percent of GDP, while gains for WAEMU countries would be roughly 1 percent, or less. Decompositions of the net gains<sup>31</sup> suggest that shock asymmetries are an important part of the story for several countries, helping to explain the loss for the Gambia, and also the very modest gain for Côte d'Ivoire. The latter country would go from a monetary union in which it was the largest country, and hence had the most influence on monetary policy, to one in which the union's policy would be more strongly influenced by others with different terms of trade shocks. Nigeria, on the other hand, would dominate the monetary union as its largest member and hence would have terms of trade shocks similar to the average. Despite the fact that the ECOWAS average *FN* was higher than its own, our model indicates that Nigeria would gain enough from the monetary externality to more than offset the impact of shock asymmetry and extract a small net gain.

To illustrate further the key drivers of the welfare effects associated with monetary unification in DMP, we look at the addition of a single country to the existing WAEMU. Such a scenario reduces both the credibility effect stemming from the internalization of the monetary externality and the increased asymmetry of shocks coming from a full ECOWAS union. These calculations, reported in Table 12, suggest that no WAMZ country would both increase its welfare by joining, and also increase the welfare of all existing WAEMU members. The Gambia and Guinea would not gain from membership in these more restricted monetary unions. While Ghana and Sierra Leone would gain if they could join WAEMU, their relatively large *FN* would put pressure on the central bank to raise inflation, thus lowering the welfare of existing members. Nigeria's membership would reduce the welfare of the existing largest member of WAEMU, Côte d'Ivoire, because its output shocks would no longer be positively correlated with the union's average. It should be noted that the current composition of WAEMU is calculated to be an improvement over the hypothetical case of independent currencies for all members (first column), while WAMZ is calculated to be worse than retention of independent currencies by the Gambia and Guinea (last column). This latter result calls into question the strategy of first creating a WAMZ monetary union, since on its own it

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<sup>31</sup> The three components are: the reduced temptation for inflationary policies of a (larger) monetary union due to internalizing the monetary externality (this is the same for all the WAEMU countries, and for all of the WAMZ countries), a gain or loss due to fiscal asymmetries (recalling that a country would like the monetary union's fiscal discipline to be somewhat better than its own), and finally loss of welfare due to the asymmetry of shocks to output.

would produce little benefit, and even with the advent of a WAMZ common currency the path toward a full ECOWAS monetary union would remain uncertain.

#### **D. Sensitivity to Parameter Values**

As described in the appendix, the parameterization is subject to considerable uncertainty. To gauge how the results would be affected by changes to the parameters, we therefore mechanically halve or double in turn the key parameters  $a$ ,  $b$ ,  $\gamma$ ,  $c$ ,  $\eta$  and investigate what doing so would imply for the gainers and losers from two monetary unions: the actual WAEMU, and the proposed full ECOWAS monetary union—both of which are discussed above. While these changes are arbitrary, they span a considerable range of values.

Admittedly, conventional confidence intervals may point to even wider ranges for some parameters, including negative values. However, such extremes would not make sense in theory.

Table 13 shows that the net gain or loss of welfare is more sensitive to some of the changes than to others. In particular, halving any parameter, except  $c$ , produces welfare gains that are qualitatively similar to those for the base case, where both WAEMU and ECOWAS are deemed welfare-improving for (almost) all members. Similarly, doubling each of the parameters except  $a$  and  $\eta$  also has little effect. The remaining cases are related to each other, since increasing  $a$  and  $\eta$  increases the value to keeping inflation at its target on the one hand and makes the target more sensitive to the terms-of-trade (output) shocks on the other. Conversely, lowering  $c$  (while keeping other parameters unchanged) makes monetary policy less effective in affecting output, requiring more active use of monetary policy and more variation in inflation. All of these considerations make the retention of an independent currency and an independent monetary policy more valuable, for a given levels of shock asymmetries. In contrast, the two parameters that quantify the welfare effects of fiscal policy,  $b$  and  $\gamma$ , have less impact on the welfare comparisons for these two monetary unions.

### **VII. WIDER CONSIDERATIONS AFFECTING THE ATTRACTIVENESS OF MONETARY UNIONS**

Model simulations discussed above exhibit two shortcomings that warrant a broader discussion of the plausible dynamics of monetary integration in Africa. The first is that simulations can only give a static picture of monetary unions likely to be sustainable given the current state of macroeconomic and institutional convergence. The second is that for obvious tractability reasons—and in particular the need to use objective benchmarks for welfare comparisons—we ignored the possibility for countries to enact credible institutional reforms aimed at containing policy biases and enhancing macroeconomic stability. Such reforms include the adoption of medium-term fiscal frameworks that impose binding numerical constraints on budgetary aggregates, and the

formal delegation of monetary policy responsibilities to an independent central bank, including an explicit mandate to deliver monetary stability and strong guarantees against political interference. While the institution-building capacity certainly varies across countries—and should therefore matter for our analysis—the credibility of improved policy outcomes associated with such reforms cannot be measured and is inevitably judgmental. It was to avoid such arbitrariness that our simulations assumed that central banks were equally subject to the influence of governments.

As indicated earlier, the extent to which national central banks can be formally insulated from policy bias matters for the relative attractiveness of monetary union membership. In fact, data suggest that central banks in Sub-Saharan Africa received greater legal independence since the end of the 1980s, very much in line with the trend observed elsewhere (Figure 9).<sup>32</sup> It also appears that SSA central banks for which data are available enjoy levels of legal independence comparable to the rest of the sample. If legal independence as measured by the index displayed in Figure 9 effectively goes along with lesser government influence on monetary policy decisions (i.e.,  $\lambda_i$  goes down in terms of our model), then the relative attractiveness of a regional currency as a way to establish monetary credibility could be reduced. The reason is that the marginal welfare gain from lower inflation would decrease. Although it is difficult to quantify the contribution of improved monetary institutions to the global disinflation of the last 15 years, it is noticeable that Africa was no exception to these trends, suggesting that domestic reforms can deliver appreciable benefits in terms of monetary stability in a wide variety of countries. In the presence of “domestic substitutes” to credible regional institutions, it is unclear whether many of the countries envisaged in our analysis would still experience net welfare gains from monetary integration.

One could argue, however, that domestic institutions are only imperfect substitutes for regional ones because (i) regional institutions enjoy economies of scale from pooling scarce human and financial resources, and (ii) guarantees against interference are inherently more credible for regional bodies. While it is difficult to assess the importance of economies of scale, it is worth noting that central bank independence indices for the existing regional banks (BEAC and BCEAO) are comparable to other central banks in the SSA sample. So the strength of the argument relies solely on the greater difficulty for a single government to influence a supranational decision maker. One important reason may be that it would take costly coordination efforts among member governments either to influence the CCB or to repeal these guarantees. Moreover, countries aware that they could not credibly implement legal guarantees protecting domestic institutions may find

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<sup>32</sup> Data are from Crowe and Meade (2007) who calculated the Cukierman-Webb-Neyapti index for 142 countries, including 27 SSA countries and the two regional banks of the Zone Franc (BCEAO and BEAC).

it in their best interest to endorse a CCB with institutional guarantees close or equivalent to the most independent national central bank among potential members.<sup>33</sup>

That said, supranational constraints are not necessarily difficult to lift if a critical mass of member states find it in their interest to do so. This was demonstrated by the suspension and subsequent watering down of EU's rules-based fiscal framework (the Stability and Growth Pact) in November 2003. Similar regional coordination failures have been frequent in Africa and suggest caution when working on the assumption of the inherently greater credibility of supranational institutions. As for the advantages of pooling resources and the economies of scale involved in creating regional institutions, they may not result if new monetary unions supplement national central banks with a supranational one, rather than replacing them.

Another important dimension about which our model is silent is the regime governing financial flows between the union and the rest of the world. As discussed earlier, the economic impact of the two existing currency unions has to a large extent been shaped by the hard peg between the CFA francs and the euro and the related guarantee of the French Treasury. Such an integration model—marked by history—seems hardly conceivable today. Even the development of the WAEMU itself into a wider ECOWAS union will lead to questions whether the guaranteed peg to the euro remains a credible nominal anchor. Overall, it seems reasonable to argue that, like in Europe, the attractiveness and sustainability of new or expanded regional unions in Africa will essentially depend on institutional design of the regional central bank, and whether it is a more promising strategy than building domestic institutions offering comparable credibility gains. At the same time, the DMP model suggests currency unions should be accompanied by enhanced regional surveillance of fiscal developments to minimize the risk of coordinated pressures on the regional banks by cash-constrained governments.

Following on the points above, there are of course a number of wider considerations related to the desirability and feasibility of particular monetary unions. For a potential ECOWAS monetary union, the likelihood that the French Treasury's guarantee of convertibility of the CFA franc to the euro at a fixed parity would be extended to the wider union has been questioned. Weighing heavily on the calculus would be the question of a new anchor for the region's monetary policy and the impact of a dissolution of the current WAEMU, a union with significant institutional development, integration, and more similar economic structures across the countries. Since the model simulation results question the net benefits of WAMZ for some members, this raises doubts about

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<sup>33</sup> Debrun (2001) establishes that argument in a game-theoretical setting where countries bargain over the type of central bank they would agree to establish at the regional level. The model is consistent with the fact EMU countries with weak macroeconomic institutions and performance embraced participation in a monetary union with a central bank looking very much like the German Bundesbank.

the charted path—that is, how would the countries be able to move to stage 2, an ECOWAS union, if stage 1, the WAMZ is not desirable? Finally, in the simulations the presence of Nigeria does not make potential unions infeasible, reflecting the relatively low weight of the terms of trade asymmetry and recent improvements in fiscal convergence in Nigeria. However, wider considerations suggest a cautious interpretation since Nigeria would likely have a dominant voice in a regional monetary policy given its GDP weight, and its track record with fiscal reforms is still relatively short.

Finally, an important additional consideration that is advanced for monetary integration is the pooling of risks. In the current financial crisis, for instance, European Union countries that were not part of the euro zone in some cases suffered from currency instability and greater fragility of their banking systems. This raises a number of issues related to the role of an international currency in providing a shock absorber. However, in reality, the direct impact of the financial shock on African countries was very limited, given the very low exposure to distressed products and financial institutions. They were, however, affected by the transmission effects of lower activity in the industrial economies on their own exports and their terms of trade. Nevertheless, the crisis has highlighted the importance of financial stability and international coordination of regulation. In turn, this raises the issue of whether currency unions can better provide the institutions to achieve those goals than countries working alone.

## VIII. CONCLUSIONS

Monetary integration remains an important policy issue in Africa, justifying further efforts to provide a comprehensive analysis of its costs and benefits. In this paper, we selectively surveyed the existing literature and expanded our own contribution to it. We have done so with a model that integrates the traditional optimum currency area criteria with the financing needs of governments, since fiscal discipline is a prerequisite for price stability. Disparities in fiscal discipline constitute a challenge to the construction of monetary unions, because they make it unattractive to admit countries whose large financing needs would put pressure on a common central bank. We also discussed institutional reforms that would make central banks more independent of government financing needs, and that would help improve government capacity to mobilize revenues and decrease unproductive spending.

We use cross-sectional regressions and other information to calibrate the model to African data, noting that historically, cross-country variations in inflation have reflected the considerations captured in the model. Despite the large asymmetries of shocks and of financing needs, the model gives a somewhat more agnostic assessment than in previous, mostly critical work (including our own) of the prospects for sustainable monetary unions in the three regions where they are being actively pursued: the EAC, ECOWAS, and SADC. With a few exceptions, the model suggests that the gains stemming from enhanced monetary stability tend to offset—albeit often by a very narrow margin—the

costs arising from the impossibility to stabilize idiosyncratic shocks with national monetary policy. However, the net gains tend to be quite small, suggesting that while the welfare impact may not be harmful, it may not be particularly beneficial. In addition, these results depend critically on a proper assessment of (i) policy preferences with regard to inflation and output stabilization, and (ii) the effectiveness of monetary policy.

Our analysis points to the need for further research in a number of areas. The first is the importance of developing similar cost-benefit assessments in models with richer economic dynamics. Ideally, we would like to estimate the model using panel data, to capture time-series as well as cross-sectional dimensions. To do so successfully, we would need to expand the model with a view to incorporate adequate leads and lags in the inflation process. The second task would be to account for the dynamic nature of the gains themselves, specifically the fact that economic structures and performance adjust to the new regime, making monetary unions (more) desirable only *ex post*. The third is to develop a better understanding of non-observable or hard to observe variables—such as policymakers' preferences and institutional quality—for which basic data are still limited for many African countries (e.g., the effectiveness of budgetary institutions in planning and implementing fiscal policy). Related to this is the important issue of how best to construct new, more effective institutions. In particular, there is only little formal analysis as to why regional institutions would be inherently more credible than national ones. So far, economists have mostly assumed that supranational bodies enjoy stronger political independence and economies of scale stemming from pooling scarce human and financial resources. Should such gains be substantial, one should study ways to marshal the political will to support the development of these regional institutions.

Beyond the scope of our modeling exercise, interesting research issues for African monetary unions arise from the global financial crisis. Studying Africa's experience with the crisis may provide insights on how well monetary unions can deal with large synchronized shocks. The crisis has also thrown up challenges to fiscal policy in monetary unions, including the effectiveness and coordination of fiscal stimulus measures, and the challenges posed by pro-cyclical private capital flows. Taking tail risks on board inevitably complicates the assessment of the costs and benefits of monetary unions. Finally, as financial development and integration continues across Africa, it will be important to avoid the pitfalls of an increasing gap between an integrated financial area and fragmented financial and prudential supervision. The failure to do so would expose African monetary unions to the kind of unsustainable internal imbalances that are now causing much concern in the European Monetary Union. All these questions will need to be addressed as the various monetary integration initiatives progress further.

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Table 1. The DMP Model

National Policy-making	
Open-economy Phillips curve	$y_i = y_N + c(\pi_i - \pi_i^e - \tau_i) - \sum_{k \neq i, k=1}^n \theta_{i,k} c(\pi_k - \pi_k^e) + \varepsilon_i, \quad i = 1, \dots, n \quad (1)$
Government budget constraint (no debt)	$g_i = \bar{\rho}_i + \mu \pi_i + \tau_i - \delta_i, \quad (2)$
Government's utility function	$U_i^G = \frac{1}{2} \left\{ -a(\pi_i - \tilde{\pi}_i)^2 - b\tau_i^2 - \gamma(g_i - \tilde{g}_i)^2 \right\} + y_i, \quad (3)$
Trade-off between output and inflation variability	$\tilde{\pi}_i = -\eta \varepsilon_i \text{ with } \eta > 0 \quad (4)$
Supranational Monetary Policy	
Phillips curve faced by the common central bank for each member of M	$y_i = y_N + c(1 - \theta_i^M)(\pi_M - \pi_M^e) - c\tau_i - \sum_{k \neq M} \theta_{i,k} c(\pi_k - \pi_k^e) + \varepsilon_i, \quad (1')$ $\forall i \in M, \text{ with } \theta_i^M = \sum_{k \in M} \theta_{i,k}.$
Key variables and parameters	
$\pi_i$	Inflation rate in country $i$ . A superscript "e" designates a rationally expected value.
$y_i$	Logarithm of output in country $i$ .
$y_N$	Logarithm of the natural level of output at zero taxation. Without loss of generality, we assume $y_N = 0$ .
$\tau_i$	Corporate income tax rate (also tax revenues in percent of output).
$\theta_{i,k}$	Marginal effect of monetary policy in country $k$ on output in country $i$ .
$\varepsilon_i$	Terms of trade shock (zero-mean, transitory, and with finite variance).
$g_i$	Socially beneficial government expenditure in percent of output.
$\mu$	Inflation tax base in percent of output.
$\bar{\rho}_i$	Permanent non-tax revenue from natural resource endowment in percent of output.
$\delta_i$	Funds diverted from socially beneficial government expenditure in percent of output.
$\eta$	Relative preference for output stability against inflation stability.

Table 2. Inflation Rates under Alternative Monetary Regimes

Monetary Regime	Equilibrium Inflation (country $i$ )
Autonomy	
<i>The equilibrium (time-consistent) inflation is...</i>	$\pi_i^* = \pi_i^{**} + \frac{\gamma\mu b}{\Lambda} \delta_i + \frac{(b+\gamma)}{\Lambda} c \quad (5)$
<i>...while the socially optimal rate is...</i>	$\pi_i^{**} = \underbrace{\frac{\gamma\mu b}{\Lambda} [\tilde{g}_i - \bar{\rho}_i]}_{\text{Size of financing requirement}} + \underbrace{\frac{\gamma\mu}{\Lambda} c}_{\text{Output cost of taxation}} - \underbrace{\frac{a(b+\gamma)\eta}{\Lambda} \varepsilon_i}_{\text{Output stabilization}},$ with $\Lambda = a(b+\gamma) + \gamma\mu^2 b > 0$ . <span style="float: right;">(6)</span>
<i>...so that the inflation bias is...</i>	$\pi_i^* - \pi_i^{**} = \underbrace{\frac{(b+\gamma)}{\Lambda} c}_{\text{"Augmented" Barro-Gordon inflation bias}} + \underbrace{\frac{\gamma\mu b}{\Lambda} \delta_i}_{\text{Public sector inefficiency}}, \quad (7)$
Monetary Union M (utilitarian CCB)	$\pi_i^{M*} = \frac{\gamma\mu b}{\Lambda} (FN_A^M) + \frac{(1-\theta_A^M)(b+\gamma) + \gamma\mu}{\Lambda} c - \frac{a(b+\gamma)\eta}{\Lambda} \varepsilon_A^M,$ for all $i \in M$ , with $x_A^M = \sum_{i \in M} \omega_i^M x_i$ , for $x \in \{FN, \theta, \varepsilon\}$ <span style="float: right;">(8)</span> (cross-country, output-weighted averages within M), and $FN_i = \tilde{g}_i + \delta_i - \bar{\rho}_i$ . Hence, $\pi_A^{M*} = \underbrace{\pi_A^*}_{\text{Average inflation under national policies}} - \underbrace{\frac{\theta_A^M (b+\gamma)}{\Lambda} c}_{\text{Average reduction in the Barro-Gordon bias}}.$
Legally independent national central banks.	$\pi_i^* = \pi_i^{**} + \frac{\lambda_i (b+\gamma)}{\Lambda} c + \frac{\gamma\mu (b - (1-\lambda_i)\gamma)}{\Lambda} \delta_i \quad (9),$ with $0 \leq \lambda_i \leq 1$ , the extent of political interference. If $\lambda_i = 0$ , the government has no influence on central bank's decisions; and if $\lambda_i = 1$ , the government effectively sets monetary policy (see (5)).

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Note: complete solutions are available from the authors upon request.

Table 3. Macroeconomic Performance and Convergence under the Primary EAC Criteria<sup>1</sup>

AGGREGATES	EAC TARGETS	EAC PARTNERS	EAC - TIME FRAME	Stage I			
				2006/07	2007/08	2008/09 Est	2009/10 Proj
Budget Deficit (Excl. Grants) / GDP	Reduce overall budget deficit (Excl. Grants) as % of GDP to sustainable levels	Kenya	Stage I < 6%	<b>2.7</b>	<b>5.2</b>	<b>5.9</b>	8.0
		Tanzania		9.8	8.5	9.4	11.1
		Uganda	and	<b>6.0</b>	<b>4.7</b>	6.5	6.5
		Rwanda	Stage II < 5%	11.3	11.0	13.8	12.9
		Burundi		19.3	19.8	25.6	28.8
Budget Deficit (Incl. Grants) / GDP	Reduce overall budget deficit (Incl. Grants) as % of GDP to sustainable levels	Kenya	Stage I < 3%	<b>1.8</b>	3.9	4.8	6.6
		Tanzania		4.9	<b>1.6</b>	4.5	4.9
		Uganda	and	<b>1.5</b>	<b>2.1</b>	<b>2.6</b>	3.4
		Rwanda	Stage II < 2%	<b>1.5</b>	<b>-0.5</b>	<b>1.2</b>	3.1
		Burundi		5.7	3.3	3.9	4.1
Headline Inflation - Annual Averages	Achieve and maintain annual average inflation not exceeding 5%	Kenya	<5%	10.4	18.4	25.1	10.3
		Tanzania		6.5	8.1	11.7	8.2
		Uganda		7.5	7.2	16.7	12.5
		Rwanda		10.2	9.0	18.1	13.4
		Burundi		<b>4.4</b>	17.4	18.1	17.6
Gross Foreign Exchange Reserves in Months of Imports of Goods & Non-Factor Services	Build up foreign exchange reserves to a comfortable level	Kenya	Stage I > 4 months	3.5	3.3	3.6	3.6
		Tanzania		3.6	<b>4.2</b>	<b>4.5</b>	<b>4.6</b>
		Uganda	and	<b>5.4</b>	<b>6.3</b>	<b>5.5</b>	<b>5.3</b>
		Rwanda	Stage II > 6 months	<b>5.6</b>	<b>4.8</b>	<b>5.3</b>	<b>5.6</b>
		Burundi		3.3	3.8	<b>6.3</b>	<b>7.3</b>

Sources: Dunn and Gaertner (2010) from EAC Secretariat, Country Authorities, and Fund staff estimates and projections.

<sup>1</sup> Bold figure indicates met criterion.

Table 4. Performance of SADC Member States in relation to 2008 Convergence Criteria

	Consumer	Government Budgetary Position		Current Account	Real GDP
	Price Inflation	Overall Balance <sup>1</sup>	Public Debt	Balance	Growth
	(Annual average percent change)	(Percent of GDP)		(Percent of GDP)	(Annual percent change)
Reference Value	10	-5	60	-9	7
<b>Middle Income Countries</b>					
Botswana	12.6	-3.1	5.0 <sup>2</sup>	7.0	2.9
Lesotho	10.7	6.2	52.9	-3.2	3.5
Mauritius	8.8	-3.4	54.1	-8.7	6.6
Nambia	10.3	-3.3	23.7	2.3	2.9
South Africa	11.5	-0.6	26.9	-7.4	3.1
Swaziland	13.1	-0.1	19.4	-6.4	2.5
<b>Low Income Countries</b>					
Madagascar	9.2	-2.6	30.3	-24.4	5.0
Malawi	8.7	-5.8	10.6	-6.3	9.7
Mozambique	10.3	-4.0	59.8	-12.6	6.2
Tanzania	10.3	0.0	39.1	-9.7	7.5
Zambia	12.4	-1.5	20.0	-7.4	6.0
<b>Fragile Countries</b>					
DRC	18.0	-0.1	101.4	-15.4	6.2
Zimbabwe <sup>3</sup>	10452.6	-1.8	n.a.	-1.4	-6.1
<b>Oil Exporter</b>					
Angola	12.5	12.4	11.0	21.2	14.8
<b>SADC<sup>4</sup></b>	<b>11.6</b>	<b>1.5</b>	<b>26.9</b>	<b>-2.5</b>	<b>5.3</b>
Sub-Saharan Africa <sup>4</sup>	11.6	2.1	30.3	-1.3	5.4

<sup>1</sup> Overall balance including

<sup>2</sup> Financial year 2008-09

<sup>3</sup> Estimates for 2007

<sup>4</sup> Weighted averages, except for public debt figures which are median

Sources: IMF, African Development database and country desks.

Source: Burgess (2009)

Table 5. ECOWAS: Patterns of Trade, 2007  
(Percent of regional exports or imports)

	Exports	Imports
<b>ECOWAS</b>		
ECOWAS	7.7	9
Rest of the world	92.3	91
<b>WAEMU</b>		
WAEMU	15.2	7.3
WAMZ	12.1	7.8
Rest of the world	72.7	85
<b>WAMZ</b>		
WAMZ	1.8	2.8
WAEMU	2.7	3.1

Source: IMF Direction of Trade Statistics database (2009).



Table 6. East African Community: Selected Indicators, 1994-2005  
(In percent)

Correlations of Changes in Terms of Trade, with:								
	Burundi	Kenya	Rwanda	Tanzania	Uganda	Standard Deviation of TOT	Openness 1/ .5(X+M)/GDP	Adjusted Standard Deviation
Burundi	1.00	-0.27	0.07	0.12	0.54	8.66	15.82	1.37
Kenya	-0.27	1.00	0.01	0.10	-0.02	3.68	26.67	0.98
Rwanda	0.07	0.01	1.00	0.13	-0.17	7.89	39.38	3.11
Tanzania	0.12	0.10	0.13	1.00	0.53	5.64	20.32	1.15
Uganda	0.54	-0.02	-0.17	0.53	1.00	8.61	17.27	1.49

Sources: Authors' estimates.

1/ Average, 2000-06, as percent of GDP.

Table 7. EAC Monetary Union: Welfare Gains or Losses  
(In percent)

	Welfare Gain (% of GDP) 1/	Due to: (in percent)			GDP Share (in percent)	Shock Correlation	FNA/ FN
		Monetary Externality	Fiscal Asymmetry	Shock Asymmetry			
Burundi	2.90	0.81	2.36	-0.20	1.87	0.17	0.75
Kenya	1.40	0.81	0.67	-0.07	41.67	0.58	0.92
Rwanda	0.64	0.81	0.76	-0.91	5.26	0.22	0.91
Tanzania	-0.30	0.81	-1.09	-0.05	31.69	0.78	1.17
Uganda	0.52	0.81	-0.16	-0.14	19.51	0.62	1.02

Source: Authors' estimates.

1/ Welfare is expressed in percentage points of GDP.

Table 8. SADC Countries: Selected Indicators, 1994-2005  
(In percent)

	TOT Correlations with South Africa	Financing need (FN)	Standard Deviation of TOT Shocks	<i>Openness</i> .5(X+M)/GDP	Adjusted Standard Deviation of TOT
Angola	0.13	57.79	10.82	71.96	7.79
Botswana	0.35	42.17	3.83	44.09	1.69
Congo, DR	0.28	37.56	3.04	25.15	0.77
Lesotho	0.45	66.55	1.46	74.14	1.08
Malawi	0.14	46.71	5.91	32.57	1.92
Mauritius	0.32	27.58	1.34	59.66	0.80
Mozambique	-0.16	42.58	2.09	28.35	0.59
Namibia	-0.07	41.55	4.25	46.07	1.96
South Africa	1.00	33.34	1.81	25.64	0.46
Swaziland	0.23	44.43	1.78	79.87	1.42
Tanzania	0.05	31.06	5.64	20.32	1.15
Zambia	-0.08	46.58	5.08	35.78	1.82
Zimbabwe	-0.39	52.14	2.49	33.20	0.83

Source: Authors' estimates.

Table 9. SADC Monetary Union: Welfare Gains or Losses  
(In percent)

	Welfare Gain (% of GDP) 1/	Due to: (in percent)			GDP Share (in percent)	Shock Correlation	FNA/FN
		Monetary Externality	Fiscal Asymmetry	Shock Asymmetry			
Angola	-0.12	1.35	4.03	-5.30	5.07	0.80	63
Botswana	2.20	1.35	1.12	-0.22	2.99	0.49	87
Congo, DR	1.45	1.35	0.19	-0.08	2.68	0.09	97
Lesotho	0.24	0.89	-0.44	-0.02	0.43	0.27	55
Malawi	2.88	1.35	2.00	-0.38	0.97	0.09	78
Mauritius	-0.61	1.35	-1.91	-0.13	0.62	-0.39	133
Mozambique	2.45	1.35	1.20	-0.05	1.95	0.30	86
Namibia	0.34	0.89	-0.54	0.01	1.96	0.16	88
South Africa	0.34	0.89	-0.57	-0.02	71.61	0.68	110
Swaziland	0.38	0.89	-0.53	0.05	0.79	0.62	82
Tanzania	0.10	1.35	-1.16	-0.14	4.54	0.16	118
Zambia	2.86	1.35	1.97	-0.37	1.88	-0.07	79
Zimbabwe	4.09	1.35	3.02	-0.13	4.52	-36.00	70

Source: Authors' estimates.

1/ Relative to the CMA for Lesotho, Namibia, South Africa, and Swaziland; relative to independent currencies for the remaining countries.

Welfare is expressed in percentage points of GDP.

Table 10. ECOWAS Countries: Selected Indicators (averages, 1994-2005)  
(In percent)

	TOT Correlations with		Financing Need (FN)	Standard Deviation TOT Shocks	<i>Openness</i> .5(X+M)/GDP	Adjusted Standard Deviations TOT
	Other WAEMU	Other WAMZ				
<b>WAEMU</b>						
Benin	0.22	0.00	35.65	7.45	20.93	1.56
Burkina Faso	0.26	0.06	39.47	7.68	17.57	1.35
Cote D'Ivoire	0.03	0.07	37.91	7.75	38.87	3.01
Mali	0.18	-0.10	42.36	4.73	28.73	1.36
Niger	0.05	0.12	39.59	4.62	22.53	1.04
Senegal	-0.01	-0.06	37.22	1.55	32.84	0.51
Togo	0.20	-0.14	38.37	9.35	35.78	3.34
<b>WAMZ</b>						
Gambia	-0.05	-0.06	40.49	10.16	51.80	5.26
Ghana	0.36	-0.05	45.81	5.33	43.98	2.34
Guinea	0.07	-0.05	33.38	4.52	25.08	1.13
Nigeria	-0.37	-0.27	31.48	9.37	39.38	3.69
Sierra Leone	-0.04	0.03	43.00	4.27	25.08	1.07

Source: Authors' estimates.

Table 11. Full ECOWAS Monetary Union: Welfare Gains or Losses  
(In percent)

Country	Welfare Gain (% of GDP) 1/	Due to: (in percent)			GDP Share (in percent)	Shock Correlation	FNA/FN
		Monetary Externality	Fiscal Asymmetry	Shock Asymmetry			
Benin	0.73	0.62	0.69	-0.56	2.92	-0.56	0.98
Burkina	0.69	0.62	0.67	-0.56	3.42	-0.70	0.89
Cote D'Ivoire	0.06	0.62	0.68	-1.20	12.99	-0.39	0.92
Mali	1.08	0.62	0.66	-0.14	3.58	-0.04	0.83
Niger	1.06	0.62	0.67	-0.19	2.24	-0.39	0.88
Senegal	1.18	0.62	0.68	-0.09	5.95	-0.30	0.94
Togo	0.73	0.62	0.68	-0.53	1.64	0.00	0.91
Gambia	-0.31	1.75	1.10	-3.09	0.43	-0.07	0.87
Ghana	2.44	1.75	2.13	-1.30	7.48	-0.69	0.77
Guinea	0.96	1.75	-0.34	-0.48	3.64	-0.28	1.05
Nigeria	0.59	1.75	-0.73	-0.46	54.77	0.97	1.11
Sierra Leone	2.81	1.75	1.59	-0.43	0.93	-0.19	0.81

Source: Authors' estimates.

1/ Welfare gain is calculated relative to WAEMU for WAEMU members, and relative to independent currencies for WAMZ countries. Welfare is expressed in percentage points of GDP.

Table 12. Welfare Gains or Losses from Adding Single Countries to WAEMU 1/  
(In percent)

	Existing WAEMU	Country Added					Creating WAMZ
		Gambia	Ghana	Guinea	Nigeria	Sierra Leone	
Benin	0.38	0.03	-0.03	0.07	0.21	-0.04	
Burkina	1.17	0.03	-0.02	0.09	0.18	-0.04	
Cote D'Ivoire	0.71	0.01	-0.01	0.02	-0.51	-0.05	
Mali	1.60	0.02	-0.07	0.10	0.65	-0.04	
Niger	1.06	0.03	-0.04	0.11	0.60	-0.03	
Senegal	0.66	0.03	-0.06	0.11	0.73	-0.04	
Togo	0.30	0.01	-0.07	0.04	0.27	-0.06	
Gambia		-1.46					-1.52
Ghana			2.39				0.72
Guinea				-0.08			-0.37
Nigeria					0.44		0.18
Sierra Leone						1.79	1.49

Source: Authors' estimates.

1/ Relative to independent currencies for new members, relative to WAEMU for existing members, except for first. Column where the welfare from membership in WAEMU is evaluated. Welfare is expressed in percentage points of GDP.

Table 13. Sensitivity Analysis: Effect of Halving / Doubling Parameters on  
Countries Gaining / Losing from WAEMU/ECOWAS Monetary Unions

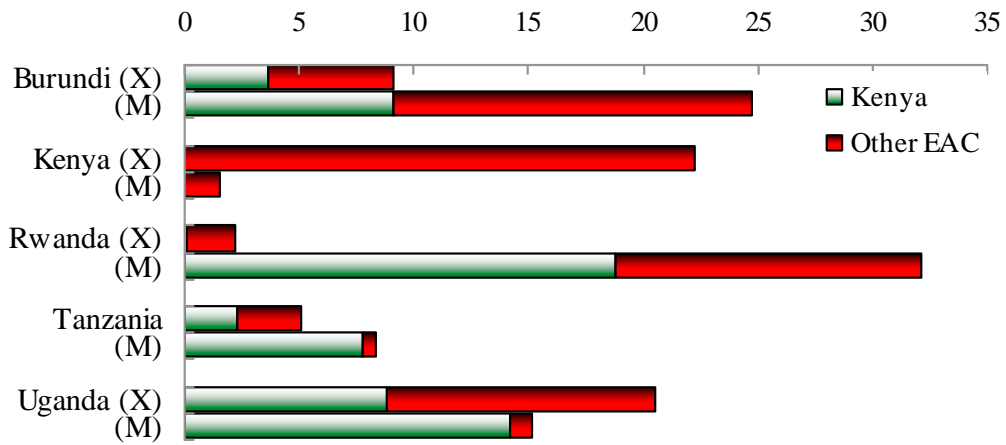
	(Number of Countries Gaining/Total)	
	WAEMU 1/	ECOWAS 2/
Base case	7/7	11/12
Parameter Halved		
a	7/7	12/12
b	7/7	10/12
c	3/7	5/12
$\gamma$	7/7	10/12
$\eta$	7/7	12/12
Parameter Doubled		
a	3/7	4/12
b	7/7	12/12
c	7/7	12/12
$\gamma$	7/7	12/12
$\eta$	3/7	4/12

Source: Authors' estimates.

1/ Gain or loss relative to independent currencies.

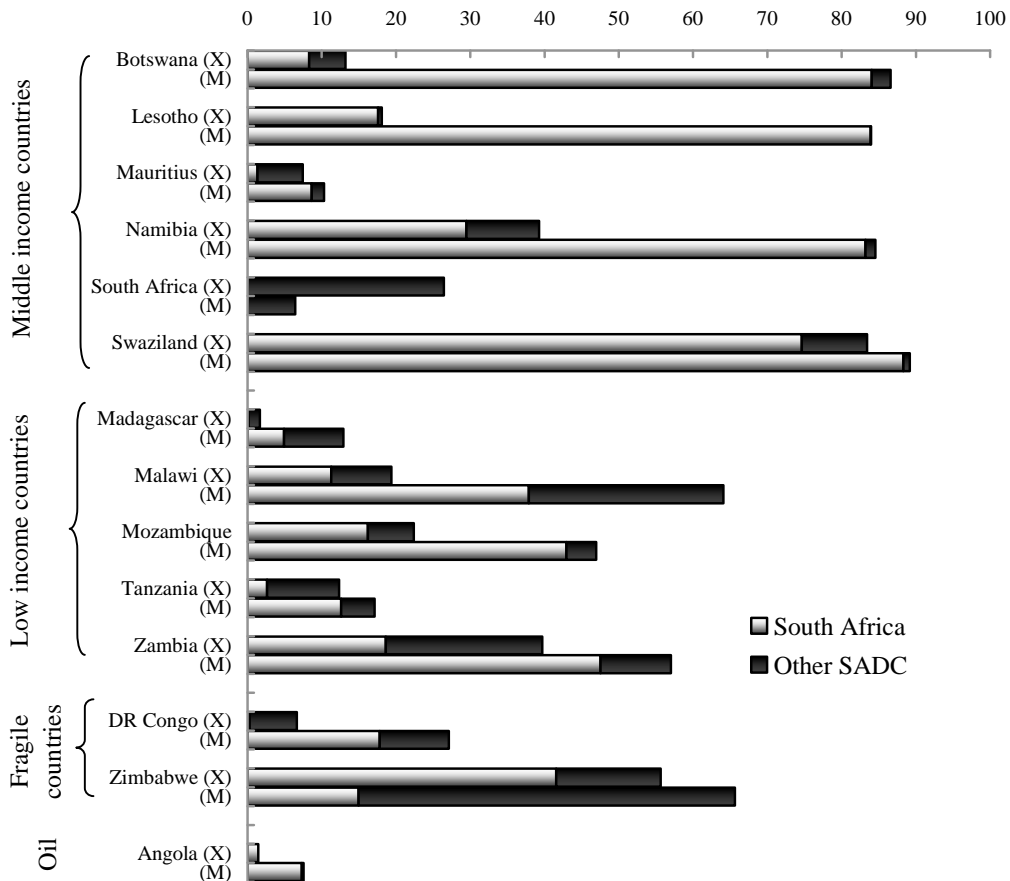
2/ Gain or loss relative to WAEMU for WAEMU countries, relative to independent currencies for others.

Figure 1. Importance of EAC Trade by Country, 2007  
(Percent of total exports and imports)



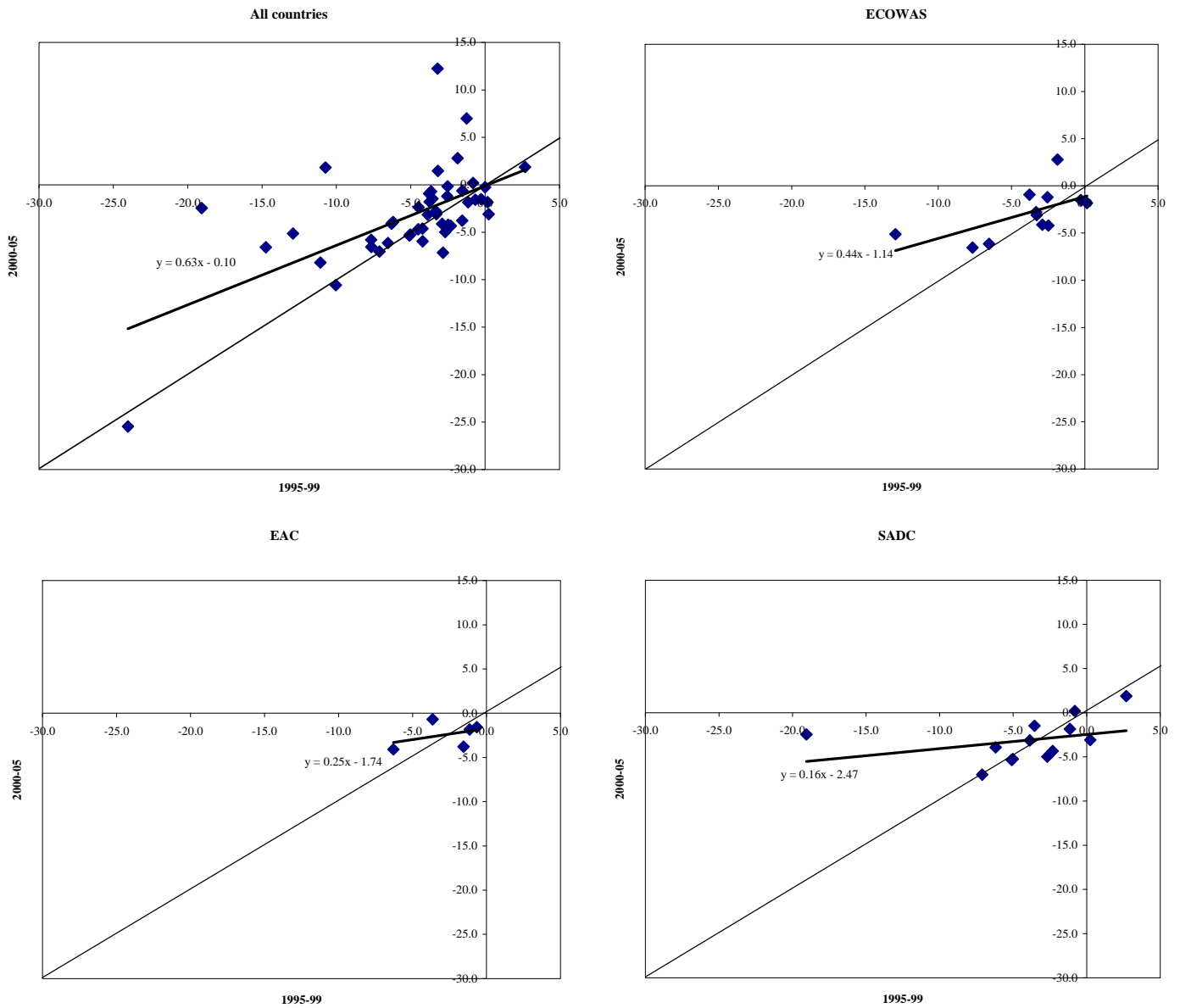
Sources: IMF Direction of Trade Statistics (2009) and authors' calculations.

Figure 2. Importance of SADC Trade by Country, 2005  
(In percent of total exports and imports)



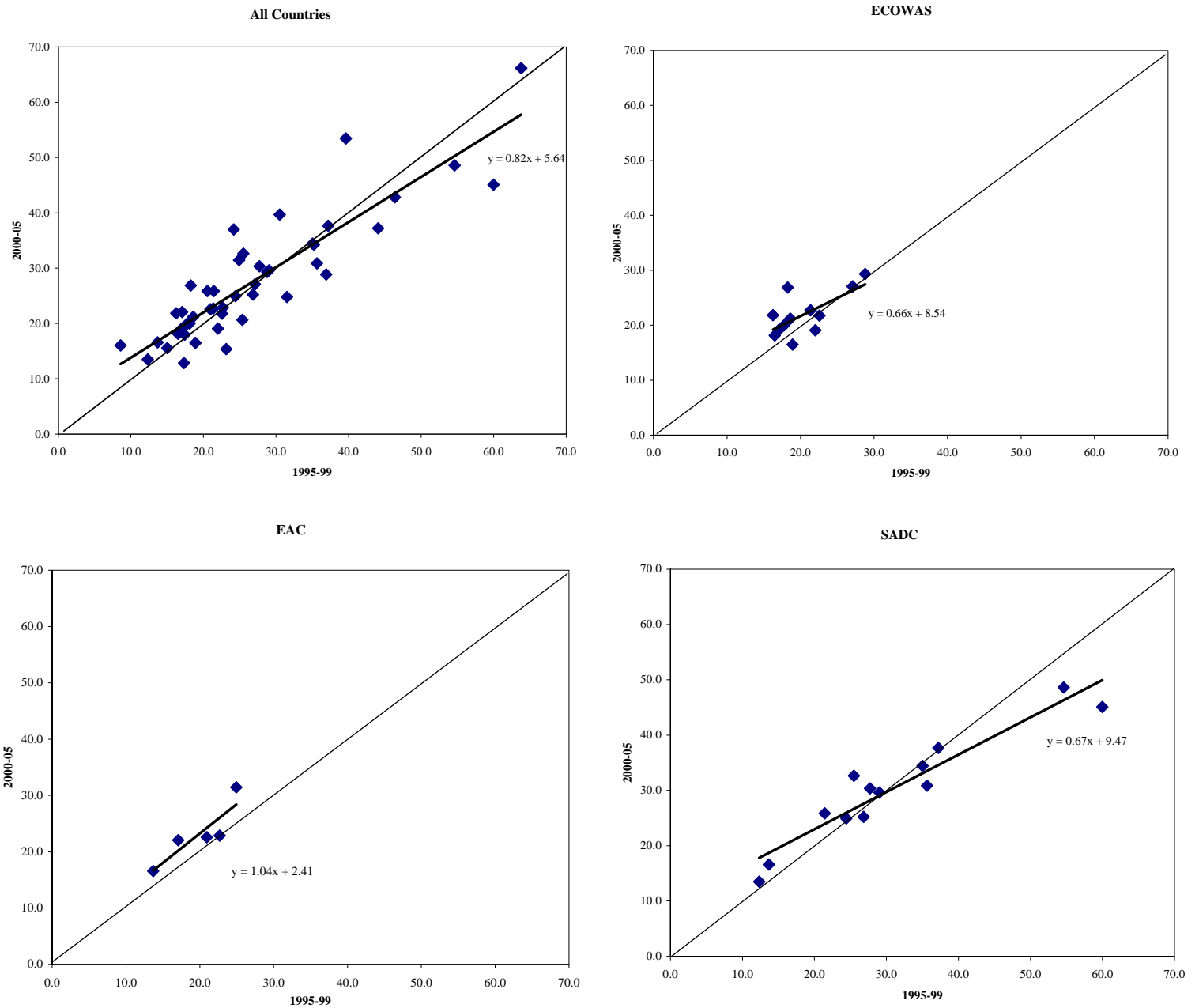
Sources: Burgess (2009).

Figure 3. Sub-Saharan Africa: Convergence in Central Government Balances (1995–2005)



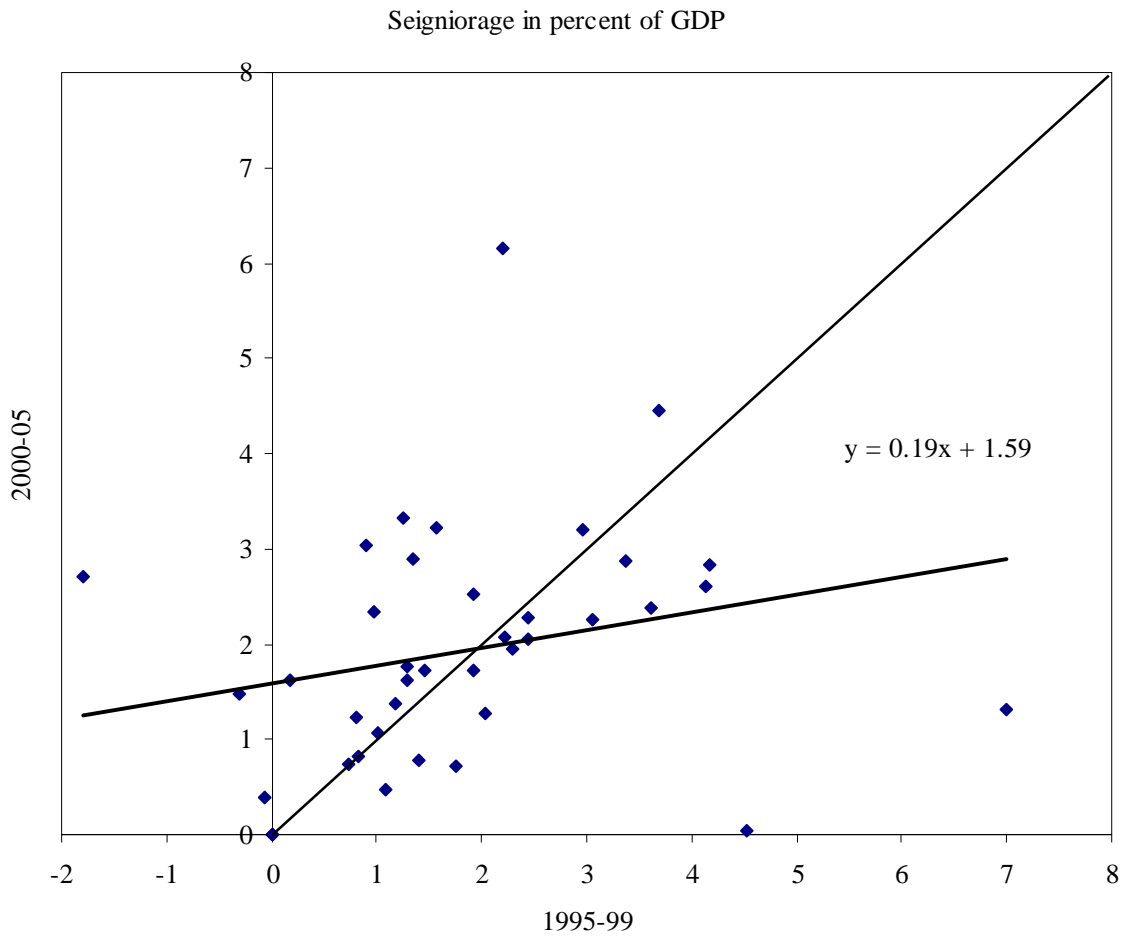
Sources: World Economic Outlook database and authors' calculations.

Figure 4. Sub-Saharan Africa: Convergence in Central Government Expenditure (1995–2005)



Sources: World Economic Outlook database and authors' calculations.

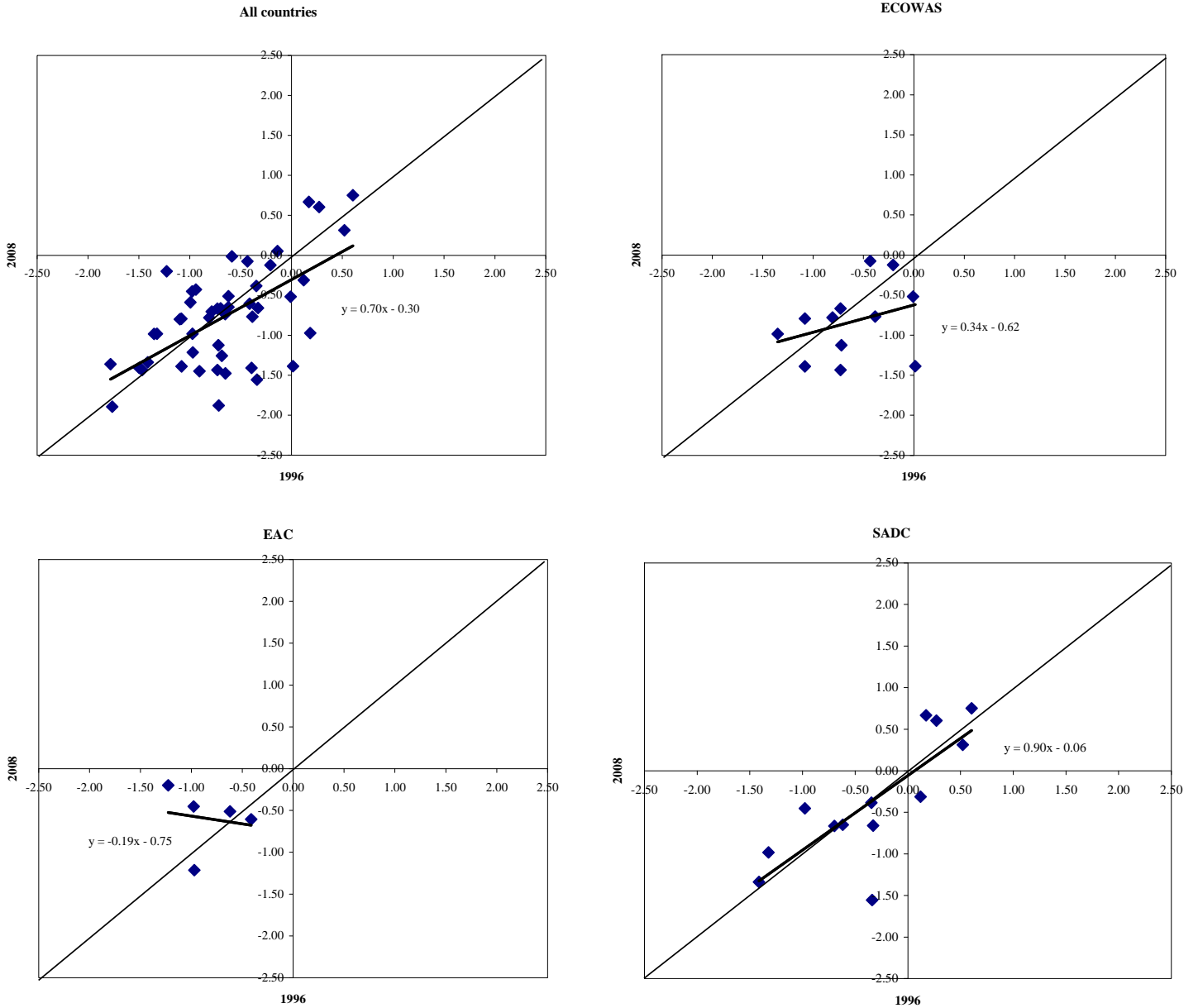
Figure 5. Sub-Saharan Africa: Convergence in Seigniorage (1995–2005)



Note: The chart does not include countries that experienced sustained hyperinflation over the period (Democratic Republic of the Congo and Zimbabwe).  
Sources: World Economic Outlook database and authors' calculations.

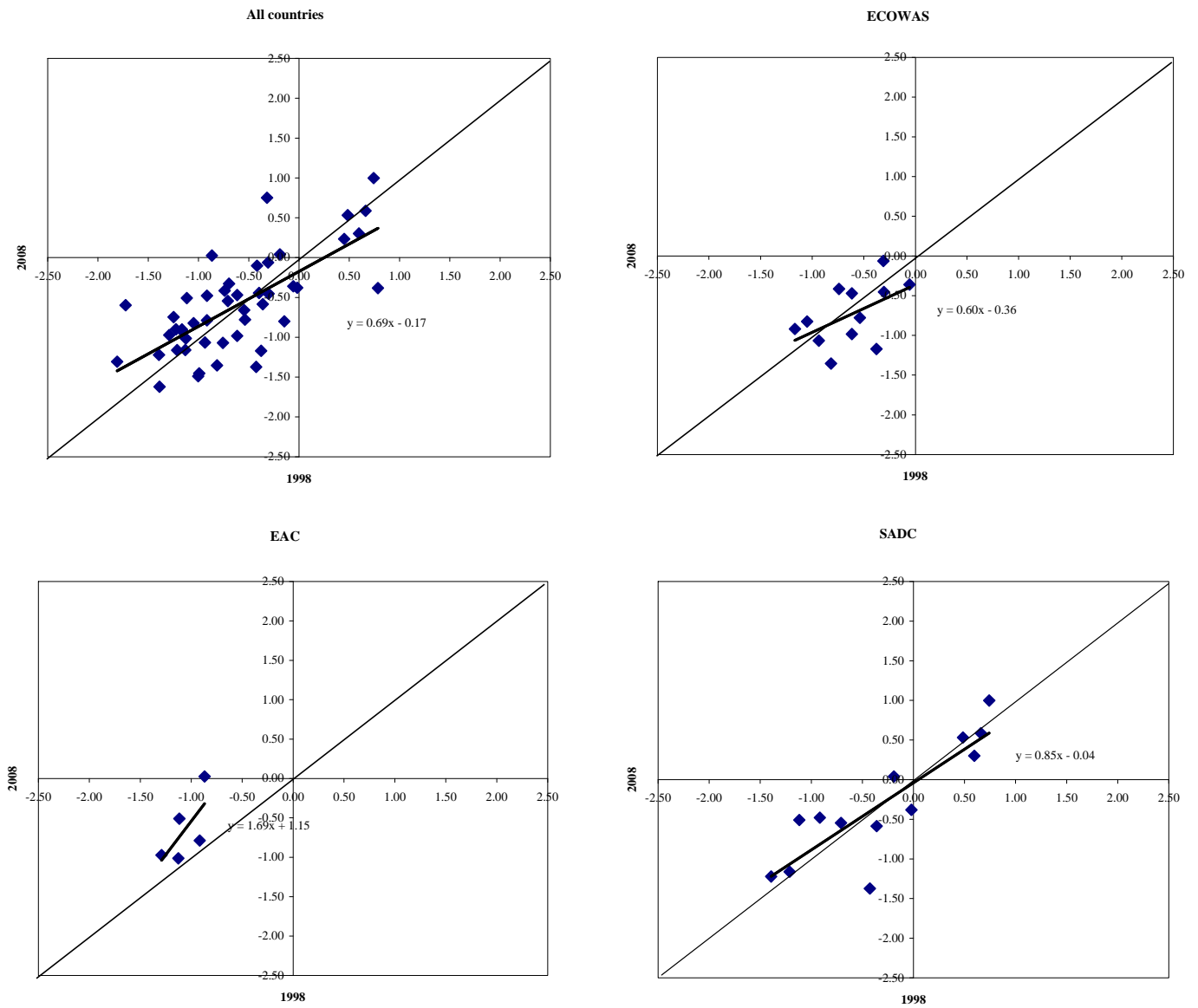


Figure 6. Sub-Saharan Africa: Government Effectiveness  
(1996–2008)



Sources: World Bank and authors' calculations.

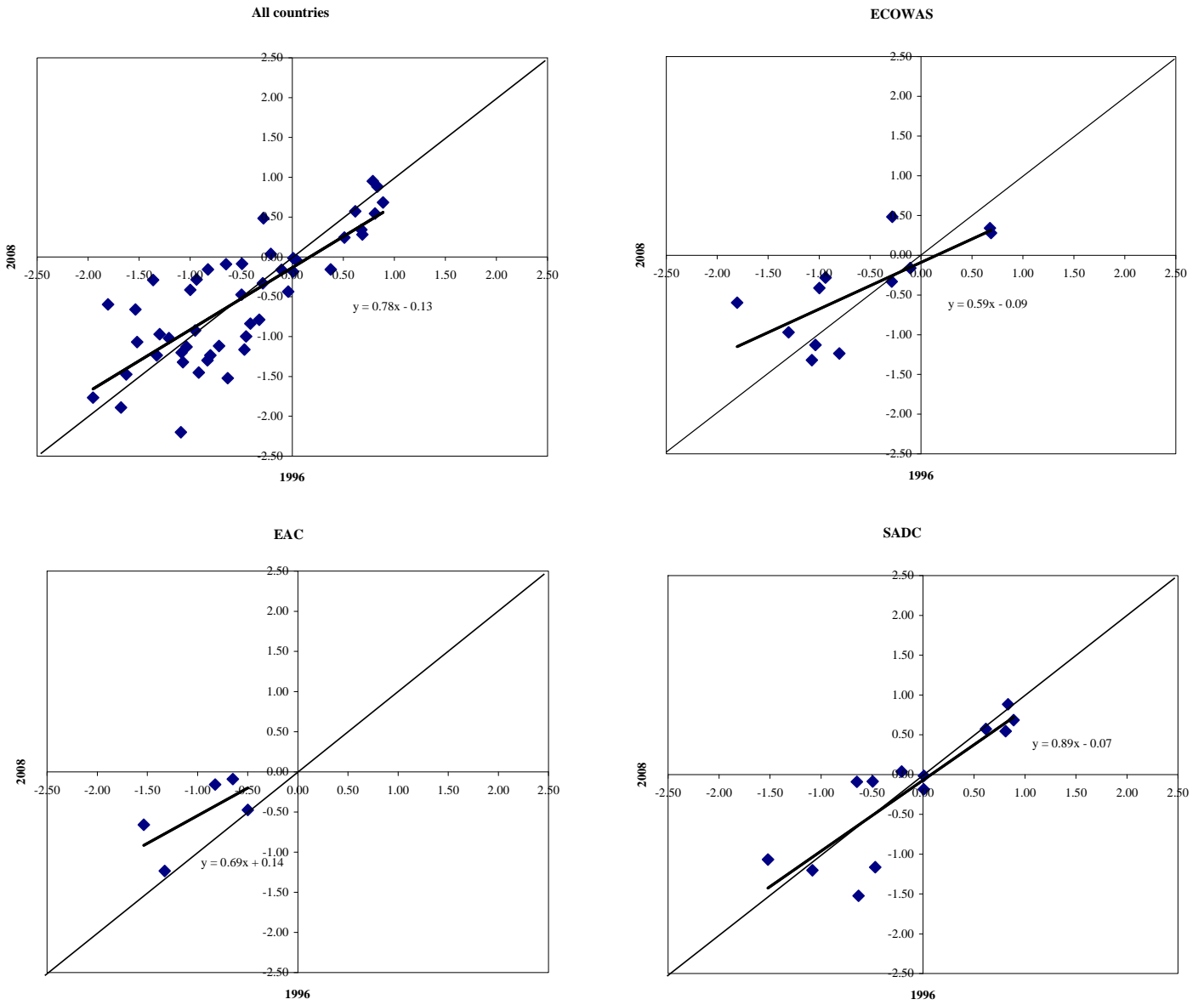
Figure 7. Sub-Saharan Africa: Control of Corruption



(1998–2008)

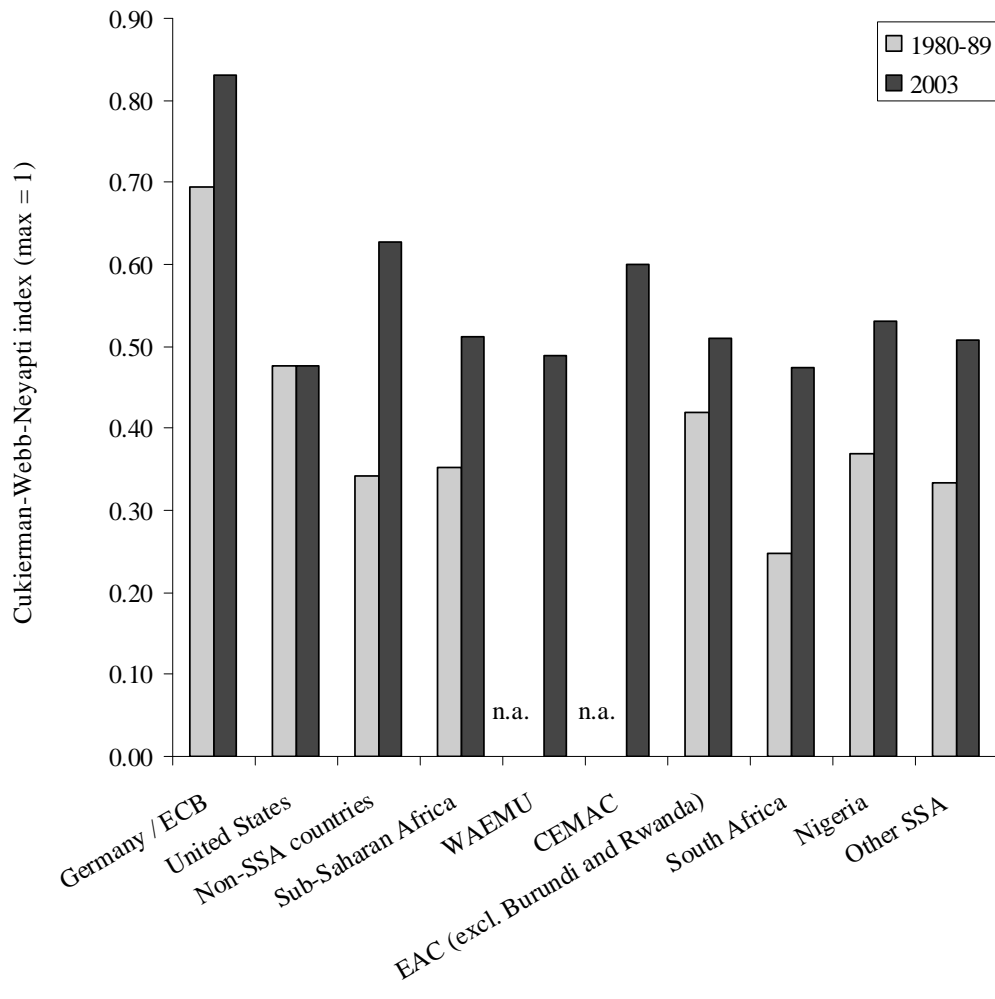
Note: For data availability reasons, the base year for this indicator is 1998.  
Sources: World Bank and authors' calculations.

Figure 8. Sub-Saharan Africa: Voice and Accountability (1996–2008)



Sources: World Bank and authors' calculations.

Figure 9. Index of Central Bank Independence (1980–9 vs. 2003)



Sources: Crowe and Meade (2007) and authors' calculations.

## Appendix 1. Calibration of the Model

The calibration involves four main steps: 1) calculating the Financing Need ( $FN$ ) variable, by regressing aggregate data for revenue and spending ratios on oil revenues, grants, and governance indicators; 2) estimating the key parameters  $\mu$  in the budget constraint ; 3) using the cross-section regressions of inflation and tax revenue on  $FN$  and the trade internalized in monetary unions to calculate utility function parameters  $a$ ,  $b$ ,  $\gamma$ ; and 4) estimating the desired stabilization role for monetary policy ( $\eta$ ) and the effect of monetary policy on output ( $c$ ) from the variances of the residuals in the inflation and output equations. The cross-sectional data used in most cases were averages for 1994–2005, with the number of Sub-Saharan African countries included ranging from 29 to 45, depending on data availability. The variances were calculated for a more limited country set, using output and terms of trade data over 1990–08.

### Financing need

$FN$  consists of two components: society’s target for government spending  $\tilde{g}$ , and a diversion wedge  $\delta$  due to inefficient tax collection and wasteful spending that adds to the amount that needs to be financed, without increasing welfare. In our previous work, we used data on government spending for health and education to estimate the extent to which spending was distorted: inadequate spending on these essential items was used as a measure of the wastage and inefficiency. In the current paper, we use aggregate government spending and revenues, and regress them on governance indicators to gauge directly what amounts of excess spending and tax losses are due to poor governance. We then set the governance indicators to their “ideal” levels: the resulting figures for ideal government spending give the estimate for  $\tilde{g}$ , and for the difference between the ideal and actual figures for the deficit provide the estimate for  $\delta$ . Thus,

$$FN = \tilde{g} + \delta = g | ideal + (\tau - g) | ideal - (\tau - g)$$

This can be further simplified as follows:

$$FN = \tilde{g} + \delta = \tau | ideal - (\tau - g) \quad (A.1)$$

The effects of poor governance were captured using ICRG indicators for the 29 Sub-Saharan African countries for which they and the other explanatory variables were available. Some experimentation was done to find those indicators with significant effects on revenues. Other factors were also included to explain the systematic variation in revenues across countries. In particular, revenues depend systematically on the level of per capita income, the share of oil production in GDP, and the ratio of grants to GDP. Since we used a 12 year average (1994–05), those variables were assumed to be at long-run, sustainable levels. Since grants are endogenous (depending on both governance indicators and per capita income), as are expenditures, three-stage least squares was used

to estimate a system of 3 equations—for revenues excluding grants ( $NR$ ), grants ( $GR$ ), and government expenditure ( $GOV$ ). These variables and the share of oil in GDP ( $OilSh$ ) are expressed as ratios to GDP. Per capita income ( $YPC$ ) is expressed in U.S. dollars, while the governance indicators are indexes ranging from 0 to 6—for corruption ( $CO$ ), law and order ( $LO$ ), and democratic accountability ( $DA$ )—or from 0 to 4 for bureaucratic quality ( $BQ$ ), with in each case higher values indicating better governance.  $YPC^2$  is per capita income squared. The results of estimation are given in Appendix Table 1.

The system of equations does a good job in explaining the cross-country variation in non-grant revenues, grants, and expenditures. Revenues are positively related to per capita income, but the relationship flattens out with higher income levels, reaching a maximum at per capita income equal to \$3300. An additional percentage point of oil GDP increases the government revenue ratio by about one-quarter of that amount. Better law and order and bureaucratic quality also increase revenues. Grants, in contrast, depend inversely on per capita income, as one would expect, and positively on control over corruption. Government spending is determined jointly with revenues: spending increases one-for-one with non-grant revenues, but more than one-for-one with grants. It also decreases with a rise in democratic accountability.

We use this system of equations to estimate the “ideal” revenues in equation (A.1), which determines the financing need, as follows. We first put all the countries on the same footing by adjusting revenues, expenditures, and grants to what they would be if all countries had the same per capita income and the same share of oil revenues in their GDP. In particular, we set each of those variables to the mean for SSA, namely \$1835 and 7.39 per cent, respectively, and use the estimates of Table 1 to calculate normalized values for our endogenous variables, which we will call  $NRN$ ,  $GOVN$ , and  $GRN$ . These variables include the residuals, so that they also include the cross-country variation which is not explained by our model. Symbolically,

$$\begin{aligned} NRN &= NR + .01(1835 - YPC) - 1.52 * 10^{-6} (1835^2 - YPC^2) + .236(7.39 - OilSh) \\ GRN &= GR - .00778(1835 - YPC) + 1.52 * 10^{-6} (1835^2 - YPC^2) \\ GOVN &= GOV + 1.012(NRN - NR) + 1.423(GRN - GR) \end{aligned}$$

Now, these variables replace the actual values in equation (A.1), while the ideal values go further: using the normalized values, there is a further adjustment which sets the governance indicators to ideal values.

$$\tau | ideal = NRN + 1.252(6 - LO) + 1.868(4 - BQ) + GRN + 1.435(6 - CO) \quad (A.2)$$

Thus, the financing need is calculated as

$$\begin{aligned}
FN &= \tau | ideal - (\tau - g) | normalized \\
&= NRN + 1.252(6 - LO) + 1.868(4 - BQ) + GRN + 1.435(6 - CO) - (NRN + GRN - GOVN)
\end{aligned}$$

So

$$FN = 1.252(6 - LO) + 1.868(4 - BQ) + 1.435(6 - CO) + GOVN \quad (A.3)$$

The results of applying equation (A.3) are given in Appendix Table 2. First, the ICRG data for a restricted set of countries was supplemented by simple regressions linking the ICRG variables to World Bank indicators, as follows: *CO* was regressed on Control of Corruption, *BQ* on Government Efficiency, *DA* on Voice and Accountability, and *LO* on Peace and Security. The explanatory power was reasonably high in each case, and the respective World Bank variable was always significant at the 1 percent level or better. Detailed results are available from the authors.

### Calibration of the Model's Parameters

As described section III and in Masson and Pattillo (2005, Appendix A), the equilibrium for inflation  $\pi_i$  and tax revenues  $\tau_i$  in country  $i$  can be summarized by the following two equations:

$$\pi_i = \frac{\gamma\mu b}{\Lambda} FN_A^M + \frac{\gamma(1+\mu)+b}{\Lambda} c - \frac{b+\gamma}{\Lambda} c\theta_A^M - \frac{\eta a(b+\gamma)}{\Lambda} \varepsilon_A^M \quad (A.4)$$

$$\tau_i = \frac{a\gamma}{\Lambda} FN_i + \frac{\gamma^2\mu^2 b}{(b+\gamma)\Lambda} (FN_i - FN_A^M) - \frac{a+\gamma\mu(1+\mu)}{\Lambda} c + \frac{\gamma\mu}{\Lambda} c\theta_A^M + \frac{\eta\gamma\mu a}{\Lambda} \varepsilon_A^M \quad (A.5)$$

where  $\Lambda = a(b+\gamma) + \gamma\mu^2 b$ . The equilibrium depends on whether country  $i$  belongs to a monetary union  $M$  or not. If so,  $FN_A^M$  is the average financing need for the countries in the monetary union (weighted by GDP), and  $\theta_A^M$  is the amount of trade internalized in the union, as a ratio to GDP. If a country is not in a monetary union, then  $FN_A^M = FN_i$ , the country's own financing need, and  $\theta_A^M = 0$  (and necessarily the second and fourth terms on the RHS of equation 5 are zero). The parameters are  $a, b, \gamma, c, \mu, \eta$ . The first three are utility function parameters reflecting the weights on deviations from targets of inflation, taxes and government spending, respectively;  $c$  captures the effect of inflation surprises on output;  $\mu$  is the money income ratio; and  $\eta$  is a parameter reflecting society's desire to undertake countercyclical policy. The error terms in both equations are proportional to the shocks in country  $i$ 's output equation  $\varepsilon_i$ :  $\varepsilon_A^M$  is equal to the average output shock over the countries in a monetary union, or, if the country is not a member of a monetary union, that country's shock alone.

## 1. Estimating $\mu$

The common parameter  $\mu$  captures the base for the inflation tax, that is, the amount of revenue that can be raised through inflation. Since the model assumes that the parameter is the same for all countries, it was taken to equal 0.376572, the broad-money-to-GDP ratio across SSA, averaged over 1994 to 2005. Countries are weighted by their GDP shares (omitting Eritrea and Sierra Leone, for which data were missing).

## 2. Welfare function parameters ( $a, b, \gamma$ )

We use actual inflation defined as  $\pi = 100 * (p - p_{-1}) / p$  and total revenues/GDP ( $rev$ ) averaged over 1994–2005 as dependent variables to estimate cross-sectional regressions (A.4) and (A.5) in order to calibrate ( $a, b, \gamma$ ). The variable  $\theta_{A,i}^M$ , which captures the monetary spillovers internalized in a monetary union, is measured as the bilateral trade of members of the currency union; we use estimates from our earlier work for this variable (see Masson and Pattillo, 2005, appendix A). Writing the estimated coefficients of the system of equations as

$$\pi_i = a_0 + a_1 FNA_i + a_2 \theta_{A,i} + \varepsilon_{\pi,i} \quad (\text{A.4}')$$

and

$$rev_i = b_0 + b_1 FN_i + b_2 (FN_i - FNA_i) + b_3 \theta_{A,i} + \varepsilon_{\tau,i} \quad (\text{A.5}')$$

The  $a_i$  and  $b_i$  allow us to derive expressions for  $a, b, \gamma$  that are proportional to  $c$ , conditional on values for  $\mu$ . Thus,  $\Lambda$  is proportional to  $c^2$ .

Appendix Table 3 gives the coefficient estimates for (A.4') and (A.5'), using seemingly unrelated regression estimation (SURE) that accounts for the correlation of the error terms. It can be seen that a country's financing need has a strong effect on its revenue, and on its inflation rate (for a country with its own currency or the average financing need across a monetary union). These coefficients are significant at the 10 percent level or better, as is the  $\theta_{A,i}$  variable in the inflation equation: it leads to lower inflation as a result of the reduced temptation to over-stimulate monetary policy. It also raises tax revenues, as expected, but this coefficient is not significant.

We proceed to derive the values for the parameters as functions of the coefficients, and of  $\mu, c$ . In particular,

$$a = \mu \frac{b_1}{b_3} c \quad b = \frac{a_1}{b_3} c \quad \text{and} \quad \gamma = -\frac{a_1}{b_3 + \mu a_2} c$$



### 3. The stabilization role of monetary policy ( $\eta$ ) and the effect of monetary policy on output ( $c$ )

Parameters  $\eta$  and  $c$  are identified by the variances of the residuals in the output and inflation equations, given that output shocks  $\varepsilon_{Ai}$  are assumed to equal the change in the logs of terms of trade shocks, scaled by the openness of the economy. It can be seen from equations (A.4) and (A.4') that

$$\eta = \frac{sdev(\varepsilon_{\pi_i})}{sdev(\varepsilon_{Ai})} \frac{\Lambda}{a(b + \gamma)} \quad (\text{A.6})$$

Since this parameter is assumed to be the same for all SSA countries, we estimate it using a GDP weighted average of the values of  $\eta$  calculated in equation (A.6) (we include 17 countries plus WAEMU and CEMAC—averaging together all the countries in each of the CFA franc zones to make two composite currency regions). We were limited to the countries for which we had ICRG data (the set of countries used for the regressions in Appendix Table 1); in addition, we excluded countries which were subjected to major civil conflicts, in particular Central African Republic, Democratic Republic of the Congo, Liberia, Mozambique, Sierra Leone, Sudan, and Zimbabwe. See Appendix Table 4.

Parameter  $c$  is calibrated by comparing the variance of the TOT shocks with that implied by the model's output equation. From (A.4), inflation surprises can be written as

$$\pi_k - \pi_k^e = -\frac{\eta a(b + \gamma)}{\Lambda} \varepsilon_k \quad (\text{A.7})$$

Substituting this back into the equation for output<sup>34</sup>, using (A.5) to eliminate taxes, gives

$$y_i - y_{Ni} = \left[ 1 - c \left( \frac{\eta a(b + \gamma) + \eta \gamma \mu a}{\Lambda} \right) \right] \varepsilon_i + \sum_{k \neq i, k=1}^n \theta_{i,k} c \frac{\eta a(b + \gamma)}{\Lambda} \varepsilon_k - c \left( \frac{a\gamma}{\Lambda} FN_i - \frac{a + \gamma \mu(1 + \mu)}{\Lambda} c + \frac{\gamma \mu}{\Lambda} c \theta_A^M \right)$$

The LHS variable (the output gap  $y_i^G$ ) is measured as 100 times the difference between the log of real GDP and its trend value, while the shocks  $\varepsilon$  are equal to 100 times the change in log of the terms of trade—both calculated over the period 1990–08. Thus, the variance of the output gap can be written as

<sup>34</sup> Where all countries/regions have their own currencies. For WAEMU and CEMAC, all variables are averages over the member countries.

$$\begin{aligned}
\text{Var}(y_i^G) &= \left[ 1 - c \left( \frac{\eta a(b + \gamma) + \eta \gamma \mu a}{\Lambda} \right) \right]^2 \text{Var}(\varepsilon_i) \\
&+ 2 \sum_{k \neq i, k=1}^n \theta_{i,k} c \frac{\eta a(b + \gamma)}{\Lambda} \left[ 1 - c \left( \frac{\eta a(b + \gamma) + \eta \gamma \mu a}{\Lambda} \right) \right] \text{Cov}(\varepsilon_i, \varepsilon_k) \\
&+ \sum_{k \neq i, k=1}^n \theta_{i,k} c \frac{\eta a(b + \gamma)}{\Lambda} \sum_{j \neq i, j=1}^n \theta_{i,j} c \frac{\eta a(b + \gamma)}{\Lambda} \text{Cov}(\varepsilon_k, \varepsilon_j) + c^2 \left( \frac{\alpha \gamma}{\Lambda} \right)^2 \text{var}(FN_i) \\
&+ 2 \left( 1 - c \left( \frac{\eta a(b + \gamma) + \eta \gamma \mu a}{\Lambda} \right) \right) c \frac{\alpha \gamma}{\Lambda} \text{cov}(\varepsilon_i, FN_i) - 2c^2 \frac{\alpha \gamma}{\Lambda} \frac{\eta a(b + \gamma)}{\Lambda} \sum_{k \neq i} \theta_{i,k} \text{cov}(FN_i, \varepsilon_k)
\end{aligned} \tag{A.8}$$

While it is reasonable to expect the terms of trade shocks to be correlated across countries, and that each country's financing need may be correlated with the country's own terms of trade shocks, it is assumed that the correlation between financing need and *other countries'* terms of trade shocks is small enough to be ignored, so that the last term is zero. Financing needs are defined in terms of slow-moving variables that depend among others on ICRG institutional variables, suggesting low correlation with high-frequency TOT shocks. This covariance is in any case multiplied by the trade share between countries  $i$  and  $k$  divided by country  $i$ 's GDP, and hence is bound to be small.

So given values of the other parameters and the covariance matrix of terms of trade shocks, we can solve the quadratic equation (A.8) for  $c$ . One additional complication is that the parameters  $a$ ,  $b$ ,  $\gamma$ ,  $\eta$ , and  $\Lambda$  depend on  $c$ , seeming to require an iterative process to solve (A.8) for  $c$ . In fact, as mentioned in the appendix,  $a$ ,  $b$ ,  $\gamma$  are all proportional to  $c$ , and  $\Lambda$  is proportional to  $c^2$ . In addition, from (A.6),  $\eta$  is invariant to  $c$ . Hence the coefficients in (A.8) are all invariant to  $c$ . Letting

$$A \equiv \eta a(b + \gamma) / \Lambda, \quad G \equiv \alpha \gamma / \Lambda, \quad \text{and} \quad B \equiv \eta \gamma \mu a / \Lambda.$$

equation (A.8) can be written:

$$\begin{aligned}
&c^2 \left[ (A + B)^2 \text{var}(\varepsilon_i) - 2A(A + B) \sum_k \theta_{i,k} \text{cov}(\varepsilon_i, \varepsilon_k) + A^2 \sum_k \sum_j \theta_{i,k} \theta_{i,j} \text{cov}(\varepsilon_k, \varepsilon_j) + G^2 \text{var}(FN_i) \right] \\
&+ 2(A + B)G \text{cov}(\varepsilon_i, FN_i) \\
&- c \left[ 2(A + B) \text{var}(\varepsilon_i) - 2A \sum_k \theta_{i,k} \text{cov}(\varepsilon_i, \varepsilon_k) + 2G \text{cov}(\varepsilon_i, FN_i) \right] + \text{var}(\varepsilon_i) - \text{var}(y_i) = 0
\end{aligned} \tag{A.9}$$

This quadratic is solved for each country  $i$ , and the results averaged, to obtain the estimate for  $c$ . The resulting individual estimates for  $c$ , and the average across countries, are given in Appendix Table 4. The estimates are quite tightly grouped, and indicate that monetary policy is relatively ineffective: a one percent inflation surprise is associated with a 0.6 percent in output. Interestingly, South Africa, with its flexible exchange rate has the largest value for  $c$ . However WAEMU and CEMAC, despite their pegs to the euro, seem to retain some monetary autonomy to cushion shocks (but presumably not to run persistently higher or lower inflation than the euro zone. The same goes for Lesotho,

Namibia, and Swaziland, whose currencies are pegged to the rand, but the variation of whose money supplies may help cushion output shocks.

The following table summarizes the calibrated values of the parameters:

Parameter	Estimate	Standard error
$c$	0.63735	0.16294
$\mu$	0.37657	..
$a$	1.20359	1.7006
$b$	2.33295	3.2573
$\gamma$	2.35337	4.8626
$\eta$	4.3213	1.6642

Appendix 1. Table 1. Effects of Governance Indicators on Central Government Revenues, Grants, and Expenditures for SSA Countries

	Estimator: Three-stage least Squares		
	Government Revenue (Excluding Grants)	Government Expenditure	Grants
Income per capita	0.01 *** (2.75)	...	-0.01 *** (-3.67)
Income per capita squared (divided by 1,000,000)	-1.52 ** (-1.91)	...	1.52 *** (3.11)
Oil share in GDP	0.24 *** (4.22)	...	...
Law and order	1.25 (1.53)	...	...
Bureaucratic quality	1.87 ** (1.32)	...	...
Revenue (excl. grants)	...	...	...
Grants	...	1.42 ** (2.55)	...
Democratic accountability	...	-0.93 (-1.54)	...
Corruption	...	...	1.43 ** (1.96)
R squared	0.74	0.89	0.41
Number of observations	29	29	29

Note: The t-statistics are reported in parentheses (with superscripts \*, \*\*, and \*\*\* denoting statistical significance at the 10, 5, and 1 percent levels respectively). They are robust to heteroskedasticity. Constants are not reported.

Appendix 1. Table 2. Calculated Financing Need, Central Government  
(Averages, 1994-2005)

	Government Expenditure / GDP	Government Revenues Including Grants / GDP	Per Capita Income (US \$)	Financing Need at Mean Income (FN)
Angola	52.7	41.9	782	57.8
Benin	18.9	17.9	431	35.7
Botswana	37.5	39.8	3939	42.2
Burkina Faso	22.0	18.5	281	39.5
Burundi	28.1	23.2	123	48.3
Cameroon	15.4	14.2	733	32.4
Cape Verde	41.4	31.5	1431	54.0
Central African Rep.	15.8	13.7	285	36.2
Chad	17.8	13.4	288	34.5
Comoros	24.1	20.4	461	43.5
Congo, DR	13.1	7.7	115	37.6
Congo, Republic of	32.9	28.2	1025	39.0
Côte d'Ivoire	20.7	18.6	742	37.9
Djibouti	35.8	32.4	863	..
Equatorial Guinea	19.7	24.0	1896	22.9
Eritrea	63.1	40.7	221	79.7
Ethiopia	23.0	17.8	135	39.7
Gabon	27.6	30.5	4578	22.9
Gambia, The	26.9	20.9	315	40.5
Ghana	29.2	20.3	385	45.8
Guinea	17.4	14.0	442	33.4
Guinea-Bissau	34.9	25.3	200	55.9
Kenya	23.0	21.5	450	39.6
Lesotho	51.1	51.3	431	66.5
Liberia	14.3	14.0	153	36.8
Madagascar	19.2	14.3	254	35.6
Malawi	30.7	24.6	183	46.7
Mali	22.2	19.0	302	42.4
Mauritania	30.5	25.4	539	46.1
Mauritius	24.6	19.6	3896	27.6
Mozambique	24.4	20.9	234	42.6
Namibia	33.0	29.6	2257	41.5
Niger	18.2	14.7	196	39.6
Nigeria	19.1	19.2	425	31.5
Rwanda	21.3	18.5	236	40.0
São Tomé & Príncipe	45.5	34.8	713	62.3
Senegal	20.0	19.0	542	37.2
Seychelles	44.7	38.3	9461	..
Sierra Leone	22.6	15.8	183	43.0
South Africa	26.1	23.4	3470	33.3
Sudan	13.1	11.9	423	34.2
Swaziland	29.2	27.4	1718	44.4
Tanzania	15.1	13.6	288	31.1
Togo	17.8	15.1	294	38.4
Uganda	19.5	16.7	260	35.5
Zambia	29.8	25.8	387	46.6
Zimbabwe	34.6	27.5	458	52.1

Source: Authors' estimates.

Appendix 1. Table 3. Estimation of Equations (A.4') and (A.5')

	Estimator. Seemingly Unrelated Regression	
	Inflation	Revenue
FNA	0.40 * (-1.83)	...
$\theta_{A, i}$	-0.58 * (-1.81)	0.11 (-0.67)
FN	...	0.55 *** (-4.92)
FN-FNA	...	0.14 (-0.74)
R-Squared	0.21	0.47
Number of Observations	45	45

Source: Authors' estimates.

Note: The t-statistics (robust to heteroskedasticity) are reported in parentheses (with superscripts \*, \*\*, and \*\*\* denoting statistical significance at the 10, 5 and 1 percent levels respectively).

Constants are not reported.

Appendix 1. Table 4. Calculation of  $\eta$  and  $c$ 

	Standard Deviations over 1990-2008 of:			Estimates	
	Inflation Residual 1/	TOT	Output Gap 3/	$\eta$	$c$
Angola	22.09	7.79	8.4	3.23	0.47
Botswana	2.46	1.69	1.9	1.65	0.45
Ethiopia	6.92	1.52	3.63	5.19	0.72
Gambia	4.57	5.26	1.42	0.99	0.29
Ghana	8.89	2.34	0.83	4.32	0.32
Guinea	3.27	1.13	1.13	3.28	0.44
Kenya	3.01	0.98	1.72	3.49	0.65
Lesotho	1.96	1.08	1.07	2.07	0.35
Madagascar	9.02	1.99	2.32	5.15	0.39
Malawi	11.24	1.92	2.58	6.65	0.45
Namibia	2.11	1.96	1.48	1.23	0.37
Nigeria	12.2	3.69	4.83	3.76	0.53
South Africa	2.11	0.46	1.64	5.18	0.75
Swaziland	2.39	1.42	0.57	1.91	0.24
Tanzania	6.57	1.15	2.7	6.52	0.83
Uganda	3.25	1.49	1.17	2.49	0.40
Zambia	4.57	1.82	4.29	2.86	0.62
WAEMU	3.38	1.13	1.18	3.41	0.49
CEMAC	5.3	2.23	2.43	2.71	0.58
Mean Estimate 4/				4.32	0.64
Standard Deviation 5/				1.66	0.16

Source: Authors' estimates.

1/ 1995-2005.

2/ The log change of the terms of trade, scaled by the average of imports plus exports over GDP.

3/ Root mean square residuals of regression of  $100 \cdot \log(Y)$  on time.

4/ Weighted by GDP.

5/ Unweighted.