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Moving Toward a Monetary Union and Forecast-Based Monetary Policy in East Africa

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Abbreviations

BoT	Bank of Tanzania
BBR	Balanced Budget Rule
CBK	Central Bank of Kenya
CEMAC	Central African Economic and Monetary Community
CPI	Consumer Price Index
EAC	East African Community
EACB	East African Central Bank
EAMU	East African Monetary Union
ECB	European Central Bank
ECCU	Eastern Caribbean Currency Union
EMU	European Monetary Union
FTPL	Fiscal Theory of the Price Level
GBS	General Budget Support
GDP	Gross Domestic Product
IMF	International Monetary Fund
IT	Inflation Targeting
Ksh	Kenyan Shillings
MFEA	Ministry of Finance and Economic Affairs (Tanzania)
OECD	Organisation for Economic Co-operation and Development
SSA	Sub-Saharan Africa
WAEMU	West African Economic and Monetary Union

Executive Summary

The East African Community (EAC) has the historic opportunity to create a monetary union that will increase the size of the regional market and could potentially bring economic development, gains from regional integration and trade, and enhanced global competitiveness for the EAC. However, this paper shows that there are important fiscal considerations that must be resolved if a future East African Monetary Union (EAMU) is to maintain a strong and stable currency and effectively manage shocks that impact each member country differently.

Once a single currency is adopted, fiscal policy will be the main macroeconomic policy available to individual countries after giving up independent national monetary policy. Thus, fiscal management is especially important in the context of a monetary union. Furthermore, by establishing appropriate and transparent fiscal convergence criteria, the EAC countries can ensure a smoother transition to a monetary union and lay a strong foundation that establishes the rules needed to address departures from agreed-upon debt and deficit limits.

This paper addresses the need for explicit fiscal convergence criteria to be adopted by the EAMU as prerequisites and ongoing commitments for a monetary union. The EAC countries are moving in this direction, having proposed benchmarks for fiscal convergence criteria. Although fiscal convergence criteria are essential in proceeding towards a monetary union, it is also important that fiscal deficit limits be realistic and in line with recent and current deficit levels. Additionally, the legitimate need of East African countries to borrow in order to meet investment and development goals cannot be ignored. We recommend that the EAMU adopt a measure of fiscal deficits inclusive of grants to best account for realities of domestic revenue generation challenges and reliance on donor support in some countries. This paper also recommends a degree of flexibility and leeway in the deficit threshold. At the same time, we advocate a relatively conservative debt-burden threshold, measured as present discounted value of debt, as a convergence criterion for membership in the EAMU.

Research on aid flows indicates that budget assistance can have significant and volatile effects on domestic liquidity. Recognizing that the East African countries receive foreign aid flows, including budget support, limiting discretion in spending of budget aid for member countries can help ensure that problems managing aid flows do not have negative economic consequences at the regional level. This is especially important considering the risk of exchange rate appreciation and inflation spillovers in the context of a monetary union, in which countries effec-

tively have a fixed exchange rate regime with each other.

To avert problems associated with countries surpassing agreed-upon deficit levels, we propose that an automatic tax be applied to member states that run excessive deficits. To ensure that debt limits are enforced, we suggest that member states agree to special rules and processes to deal with countries that do not meet requirements. Independent surveillance and adjudication will be important in this regard.

In addition to fiscal issues that will impact the move to a monetary union, it is important to examine the nature of monetary policy challenges at the national level. The individual EAC countries will have to move to harmonize their monetary policy frameworks in preparation for forming a single central bank. In particular, many of the EAC countries are moving towards more forward-looking monetary policy frameworks and will have several issues to consider. Thus, this paper examines relevant selected topics in monetary policy.

Despite improvements in central bank independence, fiscal dominance is still present in the EAC. The absence of fiscal dominance is a prerequisite for inflation targeting (IT) and is likely to be necessary for countries to agree to a monetary union. While the EAMU presents the opportunity for the countries to create a fully independent regional central bank, achieving more independence at the national level is an important first step.

Financial development is also crucial for effective monetary policy, and an important aspect of that development is building a yield curve of long-term interest rates for government debt by issuing benchmark bonds on a regular schedule and promoting secondary-market trading. This allows private borrowers to access markets more easily, and Kenya has been implementing these policies with success over the past few years. Once a yield curve is in place, it can also provide valuable information for monetary policymakers seeking to implement a forecast-based monetary policy framework. Long-term interest rates reflect market participants' forward-looking expectations of inflation and other macroeconomic factors, so monitoring the yield curve can alert policymakers to changes in expectations. Our empirical analysis of recent bond market data from Kenya indicates that the yield curve is beginning to have useful information content, and we recommend that the Central Bank of Kenya develop indexes of long-term interest rates and continue to explore ways that this data can aid in policymaking. Other EAC countries may want to follow Kenya's lead in laying foundations for better yield curves.

As countries consider alternative monetary policy frameworks to reserves targeting, forecasting inflation will be important for the conduct of monetary policy. Furthermore, once forecasts are developed, IT could be an effective framework in East Africa. Our research shows, however, that international commodity prices and rainfall, factors over which central banks have no control, impact inflation in East Africa. As a result, if the region moves to IT, we recommend that a measure of core inflation be developed and that countries target core inflation.

As monetary policy is always conducted under some degree of uncertainty, it is as important to understand the uncertainties in a forecast as it is to have a forecast. This is particularly true for the forecast-targeting monetary policy frameworks the EAC countries are considering and for the EAC countries themselves, as the macroeconomic environment in developing countries can be particularly uncertain. Thus, we also present a methodology for formalizing and communicating a judgmental assessment of the risks and uncertainty around a macroeconomic forecast.

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- 2 Although the transition will not be simple, the EAC has the potential to become a leading example of a monetary union in sub-Saharan Africa. A monetary union has the potential to bring development, stability, and economic growth. The EAC countries' success will depend substantially on sound fiscal-monetary interactions and following appropriate fiscal convergence criteria in the move to a monetary union.

Section I. Introduction

The countries of the East African Community (EAC) are committed to implementing a monetary union within the next few years. This report evaluates how the EAC can best move toward this objective, with a focus on fiscal policy considerations. Monetary policy issues remain important, however, both while the individual countries work to harmonize their monetary policy systems in preparation for forming a single central bank and once the union is in place and monetary policy is conducted at the regional level. In particular, the EAC countries are considering a shift toward forecast-based monetary policy frameworks (e.g. inflation targeting), and this paper will discuss several issues they will need to consider in doing so.

The move to a monetary union will require fiscal and monetary convergence and further financial integration among these countries. Agreeing on the appropriate fiscal convergence criteria is seen by senior policymakers in the region as one of the most significant remaining challenges, with the treatment of aid flows being an important aspect of this. These convergence criteria are critical in conducting monetary policy under a union and will help avoid potential negative spillover effects of excessive deficits and debt on other members of the union.

The harmonization process required for moving towards a monetary union provides an opportunity for authorities to review all aspects of monetary policy, including those that are conduits for good policy as well as those that impede it. Accordingly, the report also considers some selected issues that can be addressed in the meantime regarding the conduct and effectiveness of monetary policy. Specifically, we examine:

- The fiscal dominance aspect of central bank independence;
- Debt market development; and
- The central banks' forecasting capabilities and their ability to influence aggregate prices in the face of supply-side shocks such as commodity prices.

This paper is the product of research carried out by ten students in the Economics and Public Policy field of the Master of Public Affairs program at the Woodrow Wilson School at Princeton University from September 2010 to January 2011. Students conducted field visits and interviews in Nairobi, Kenya and in Dar es Salaam and Arusha, Tanzania from October 30th to November 6th, 2010. Although this paper attempts to balance analysis to include all five EAC countries, it may at times reflect the fact that the authors have more in-depth knowledge of Kenya

and Tanzania than the other three countries.

The remainder of the report proceeds as follows. Section II provides background on the current macroeconomic issues surrounding the EAC countries. Section III turns to the fiscal policy considerations for moving to a monetary union and discusses fiscal convergence criteria in the presence of differential aid flows. In this context, we examine the merits of deficit and debt level criteria and end with an analysis of the issues surrounding surveillance and enforcement of these criteria. Section IV presents analysis on selected issues relevant to the effectiveness of monetary policy in general, and to the implementation of a forecast-based monetary policy framework in particular. In this context, we examine fiscal dominance, financial market development, and tools for forecasting inflation and for considering uncertainty. Section V concludes. This paper aims to serve as an additional resource for policymakers in East Africa who are working towards the goal of implementing a monetary union in the region.

Section II. Background

The EAC consists of Kenya, Tanzania, Uganda, Rwanda, and Burundi. These five countries cover 1.82 million square kilometers to the east and south of Lake Victoria in Eastern Africa, and they are home to 133.5 million people.¹ According to the World Bank, gross national income per capita in the region ranges from \$150 per year in Burundi to \$770 per year in Kenya.² Although the EAC countries have important natural resources and have been able to develop strong agricultural exports such as coffee, tea, and fresh flowers, poverty levels remain high. The World Bank estimates the poverty headcount ratio at the national poverty line to be 31.1% for Uganda, 35.7% for Tanzania, 46.6% for Kenya, 56.9% for Rwanda, and 68% for Burundi.³

As the EAC countries pursue economic integration and consider forming a monetary union, the relative size of the economies shapes the politics of integration. Kenya is the largest economy in the region, accounting for 43% of regional GDP. Tanzania and Uganda are the next largest economies in the community, accounting for 29% and 20% of regional GDP, respectively. Rwanda and Burundi are much smaller economies, representing only 6% and 2% of regional GDP, respectively. Although intra-regional trade in the EAC increased with implementation of the East African Community in 2000, current exports from Kenya, Tanzania, and Uganda to the other countries in the region remain relatively low and represent only about 5%- 20% of the region's total exports by country.⁴

With respect to monetary policy frameworks in the region, all the EAC countries currently use monetary targeting under a floating exchange rate regime. Under monetary targeting, an objective target for the inflation rate is set—currently five percent in Kenya, Uganda and Tanzania—and the central bank aims to achieve this by using money supply (usually M2 or M3) as the intermediate target. As central banks have direct control over reserve money, that is used as the operating instrument. The 1980s and early 1990s saw periods of high inflation in the EAC, but since the mid-90s, these countries have managed to control inflation quite well (see Figure 1).

However, in the face of financial innovation and structural change, some of the EAC central banks are questioning the effectiveness of their existing monetary policy frameworks. Changes to the structure of their economies, including the liberalization of capital markets and financial deepening, have generated a decline in the velocity of money and an increase in the money multiplier over the last decade (see Figure 2). These changes have made it harder to predict the relationship between base money and broad money and have destabilized the relationship between broad money and prices, both of which make monetary targeting less effective. For example, Kenyan monetary authorities missed the reserve money target in three out of seven years from 2003– 2009.⁵ As a result of these challenges, the EAC countries, either individually or as a monetary union, may consider adopting inflation targeting (IT) as an alternative to monetary targeting.

Regardless of the monetary policy framework, financial development, especially development of domestic debt markets, will be essential for effective monetary policy. Kenya has the most developed capital market in the region, followed in order by Uganda, Tanzania, Rwanda, and Burundi. Stock exchanges are operating in every country with the exception of Burundi. Importantly, governments in the EAC are developing domestic markets for treasuries, with some countries now offering benchmark bonds based on the yield curve. Benchmark bonds can facilitate corporate offerings and improve the monetary policy transmission mechanism. The EAC countries have made substantial gains in financial development, but improvements in both domestic financial markets and further financial integration in the region are needed to prepare for the eventual move to a monetary union. Indeed, as this paper will discuss, by strengthening their domestic markets, each country places itself in a better position to participate in a regional market.

The East African countries have set the ambitious goal of forming a monetary union by 2012. The future East African Monetary Union (EAMU) will replace the five individual country currencies with a common currency, to be managed by an East African Central Bank (EACB). The monetary union would be the next step in a series of efforts to increase economic integration in the region. The proposed EAMU, it is hoped, will offer significant economic benefits to the region, including reduced transaction costs, increased trade, and deeper financial integration. Monetary integration also offers potential political benefits, including, for example, potentially increasing the

1 East African Community Portal. “Quick Facts.” Available December 10, 2010: <http://www.eac.int/about-eac/quick-facts.html>

2 World Bank. 2009. *World Development Indicators*. Available December 10, 2010: <http://data.worldbank.org>

3 Ibid. More recent country-level data are available; however, the World Bank data are cited here for comparability purposes. For example, the poverty rate in Tanzania has declined to 33.6 percent according to the 2007 Household Budget Survey, available at <http://www.nbs.go.tz/nada3/index.php/ddibrowser/2/reports>.

4 International Monetary Fund. *International Financial Statistics*.

5 Rotich, H. (2010). “Can Inflation Targeting Work in Kenya? If So, What Should be a Credible Price Anchor?” Unpublished.

countries' collective political status in the international arena.

Regional integration efforts are not new to East Africa. Previous regional institutions include the Customs Union formed in 1917, the East African High Commission (1948-1961), the East African Common Services Organization (1961-1967), the East African Community (1967-1977) and the East African Cooperation (1993-2000). When the previous EAC was dissolved in 1977, the countries agreed to continue cooperation. Recently, countries became interested in reviving the East African Community, and a treaty re-establishing the East African Community was signed in Arusha in 1999. The treaty went into effect in January 2000. In addition, the five countries ratified the Common Market Protocol, agreeing to the free movement of goods, labor, services, and capital in the region, in November 2009.⁶

Despite excitement about regional integration in the EAC countries, the movement towards monetary union raises questions about future fiscal management and monetary policy. For example, if fiscal policies and limits on debt are not streamlined in the region, default problems in one country could have negative spillover effects at the regional level. In addition, monetary union also presents a moral hazard problem: countries may borrow unsustainably if a bailout is expected. The EAC has created a fiscal affairs committee to specifically address these issues, but agreeing on appropriate fiscal convergence criteria is still seen by policymakers in the region as one of the most significant remaining challenges for a future EAMU.

Figure 1

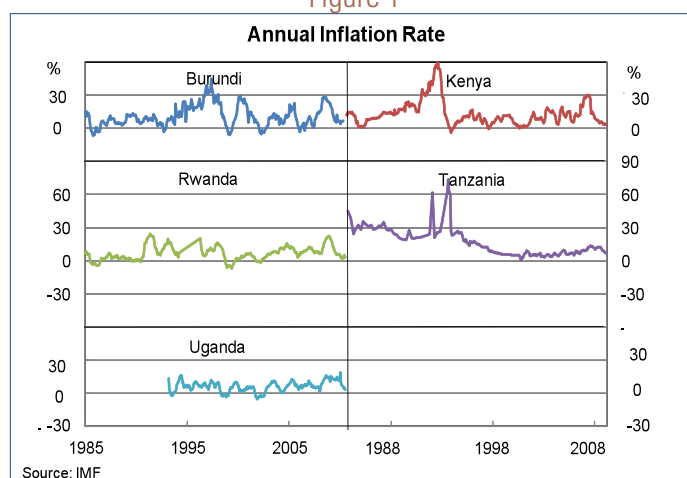
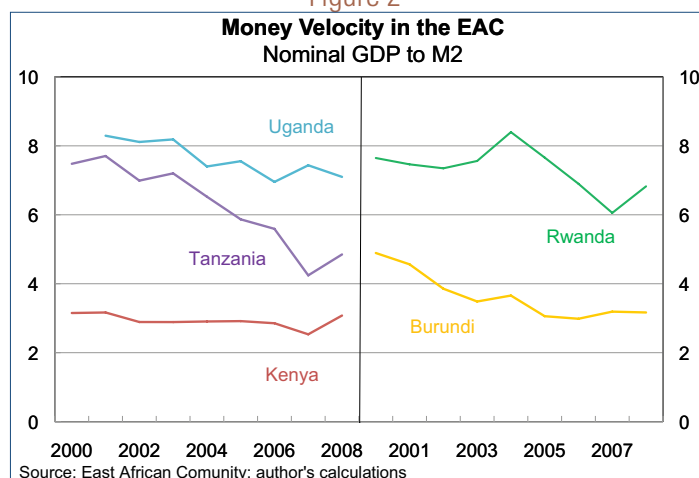


Figure 2



6 East African Community Portal. Available December 10 2010:
<http://www.eac.int/about-eac/quick-facts.html>

Section III.

Fiscal Prerequisites for Monetary Union

A. Introduction to Monetary Union and Fiscal Convergence Issues

This section seeks to provide considerations for fiscal policy that will be useful to policymakers in the EAC as they move toward a monetary union. Given that leaders in the region have already made a political commitment to monetary union, a key policy question is how the EAC can best move toward that objective. Fiscal policy will be the main macroeconomic policy tool available to the countries after giving up independent national monetary policy, so the implications of monetary union on fiscal policy are critically significant. Additionally, fiscal convergence is an area where the EAC countries still have considerable work to do.

There are two main justifications for why fiscal convergence criteria may be needed. First, domestic fiscal policies can cause negative spillover effects on other members of the union. For example, excessive government deficits in one country may cause inflationary pressures on the common currency that would negatively impact other countries as well. Second, a moral hazard arises in a monetary union as countries become able to borrow unsustainably with the hope that other members of the union or a regional central bank would bail them out in case of a debt crisis.

As the EAC considers options for fiscal convergence criteria, there are several existing monetary unions that can provide policy lessons. The European Monetary Union (EMU) is the largest monetary union in the world, composed of a large number of developed countries and operating with a floating exchange rate. There are also examples of monetary unions in the developing world, such as the Eastern Caribbean Currency Union (ECCU), the West African Economic and Monetary Union (WAEMU), and the Central African Economic and Monetary Community (CEMAC). These monetary unions are composed of smaller and less-developed economies, and are characterized by fixed exchange rates and significant donor support. We will draw on lessons from these monetary unions in this paper, keeping in mind that the characteristics of the proposed EAMU will be different than any existing example.

Thresholds on government deficits and debts have been instated in all these monetary unions to address the negative externality and moral hazard issues. However, such thresholds are challenging to implement in practice. Whether fiscal commitments are implemented through

self-discipline, surveillance and persuasion, or centralized enforcement, the examples of monetary unions around the world are replete with unsuccessful efforts to prevent excessive deficits and debt crises. This section considers the theory and practical examples to provide policymakers with a framework to select fiscal thresholds and design enforcement mechanisms that are in the best interest of the EAC and its member countries.

B. Need for Explicit Fiscal Convergence Criteria

The first question facing EAC policymakers is whether fiscal convergence criteria should be adopted at all as part of an EAMU.⁷ One main consideration pertaining to this question is the influence of financial markets. Theoretically, international financial markets can enforce fiscal discipline. Markets should price the risks associated with increasing sovereign debt into the interest rates they accept. As debt levels become unsustainable, countries may find themselves cut off from private sector financing. That financial markets value fiscal discipline and are sensitive to a country's fiscal policy stance has been observed in OECD countries.⁸ However, a different perspective suggests that international financial markets have a tendency to be insufficiently forward-looking when lending to small developing economies.⁹ There are numerous historical examples of developing economies borrowing excessively, defaulting on their debt, and then borrowing from international markets to the point of default again.¹⁰

Furthermore, the dynamics of fiscal regulation by international financial markets are made more complex in a monetary union, where countries with prudent fiscal stances share the liabilities of other members with poor fiscal positions. A high-debt country can borrow through the international financial markets at a lower required

7 The EAC has established a tentative list of benchmark convergence criteria, although they have not been formally agreed to. Appendix I provides a list of these criteria.

8 Ardagna, Silvia. 2004. "Financial Markets' Behavior Around Episodes of Large Changes in the Fiscal Stance." ECB Working Paper Series No. 390 / September 2004. Frankfurt am Main, Germany: ECB.

9 Kufa, Phebbay, Anthony Pellechio, and Saqib Rizavi. 2003. "Fiscal Sustainability and Policy Issues in the Eastern Caribbean Currency Union." IMF Working Paper No. 03/162. Washington: International Monetary Fund.

10 Reinhart, Carmen, Kenneth Rogoff, and Miguel Savastano. 2003. "Debt Intolerance." *Brookings Papers on Economic Activity* 2003(1): 1-62.

risk premium if it were in a monetary union. This was observed in the Eurozone. Greece's ten-year government bond spread over Germany's closed and rose to less than 0.5% even after Greece admitted to misrepresenting its deficit figures. It was not until the runup to the 2008 global financial crisis that Greece's risk premium over Germany began to widen significantly.

The extent to which international financial markets can discipline fiscal policy is further reduced in countries with underdeveloped capital markets. Currently, capital markets in the EAC countries remain thin, and thus may not reliably or efficiently price government securities. Burundi does not have a secondary market. Where secondary bond markets exist, the level of trading activity ranges from very low to moderate. In Rwanda, the secondary market recorded only 55 trades worth \$870,000 within the 27 months it came into operation since January 2008.¹¹ Tanzania's daily turnover is estimated at \$1.3 million; Uganda recorded a turnover of \$1 billion in 2008; Kenya's market saw 1900 trades worth \$1.5 billion transacted in 2009 (as compared to South Africa's turnover in 2009 of \$1.6 trillion)^{12, 13} While most of the EAC countries are making efforts to deepen their secondary bond markets, their capital markets will likely remain rather thin in the coming years. Accordingly, the role of fiscal discipline enforcement will have to fall to a greater extent on other measures, such as fiscal convergence criteria.

An alternative argument against the need for fiscal convergence criteria is that the union could rely exclusively on individual countries to define and implement their own fiscal rules. However, with only three countries – Kenya, Tanzania and Uganda – making up the large majority of the regional economy, the composition of the EAC suggests that substantial negative spillover effects are possible. If any of those countries were to run excessive deficits, the resulting inflationary pressure could be substantial enough to significantly influence the common currency, spreading the costs of the inflation to the other EAMU members. Since each country has a stake in the others' behavior, there is justification for regionally agreed-upon constraints.

11 “17.75 Billion Raised Through Bonds On Capital Market” <http://allafrica.com/stories/201004140089.html>

12 Converted from local currency units using 2008 exchange rates to the U.S. dollar from World Development Indicators. In local currency, the figures are as follows: Rwanda: RWF 474.3 million, Tanzania: TZS 1.5 billion, Uganda: UGX 1.8 trillion, Kenya: Ksh 107 billion, South Africa: ZAR 13.4 trillion.

13 African Development Bank Group. 2010. *African Fixed Income and Derivatives Guidebook* (May 2010). <http://www.afdb.org/en/documents/publications/african-fixed-income-guidebook>

The need for institutional independence for a regional central bank within the monetary union is also a consideration. Central banks in the region operate with a certain degree of independence, but governments still exert some authority over the central banks' monetary policy (see Section IV-A). Institutional independence may be even weaker at the regional level, indicating that a “no-bailout” clause may not be fully credible. Explicit and enforceable fiscal constraints may help reinforce the nominal independence of an East African Central Bank.

This section makes the following policy recommendation:

The EAC countries should agree to explicit, binding fiscal convergence commitments as prerequisites and ongoing commitments in a monetary union. The examples of ineffective fiscal constraints in existing monetary unions indicate that fiscal constraints are no panacea for irresponsible fiscal policy. Nevertheless, established and agreed-upon fiscal constraints will serve as signals to markets, EAMU members, and donor countries of when fiscal situations are sustainable or may be unsustainably deteriorating.

C. Considerations Regarding Deficit Convergence Criteria

The first fiscal convergence criterion on which EAC members must agree is the level of government deficit any individual country should run. Currently, policymakers have set the following initial benchmarks: six percent of GDP excluding grants and three percent of GDP including grants, decreasing to five percent of GDP excluding grants and two percent of GDP including grants in the coming years.¹⁴

As policymakers begin discussions to revise and finalize these criteria, a first consideration is whether the initial levels are reasonable given actual budget deficits. The following two figures provide deficit levels both including and excluding grants in the five EAC countries for six recent years. The initial threshold of allowable deficits of three percent of GDP including grants is relatively close to the countries' actual deficit levels in 2008; the measures for deficits excluding grants (six percent) and future deficits including grants (two percent) are both more strict than the levels countries have been recently achieving.

14 European Central Bank (ECB). 2010. “Study on the Establishment of a Monetary Union Among the Partner States of the East African Community.” ECB Staff Report, June.

Table 1: Budget Deficit, Including Grants (Percent of GDP)

Country	2003	2004	2005	2006	2007	2008
Burundi	6.4	5.6	2.2	3.1	2.9	3.1
Tanzania	0.0	4.5	5.9	2.4	4.2	3.1
Uganda	1.6	0.5	2.2	1.9	2.3	3.4
Kenya	7.3	8.2	5.3	6.3	5.0	3.3
Rwanda	2.2	0.2	-0.3	0.2	1.0	-0.4

Source: ECB 2010

Table 2: Budget Deficit, Excluding Grants (Percent of GDP)

Country	2003	2004	2005	2006	2007	2008
Burundi	16.6	20.0	14.2	14.5	18.9	13.6
Tanzania	6.5	10.2	11.1	8.3	9.9	8.2
Uganda	9.8	7.8	7.1	7.1	7.5	7.7
Kenya	8.6	9.5	6.3	7.5	5.8	4.6
Rwanda	9.8	11.2	11.0	10.5	13.1	10.5

Source: ECB 2010

Table 3: Government Revenue from Taxes (Percent of GDP) for Kenya, Tanzania, and Uganda

Country	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Kenya	16.15	16.83	17.84	17.29	15.68	16.81	18.29	17.17	17.86	18.88
Tanzania	9.74	10.52	10.51	10.85	11.37	12.00	12.36	12.33	14.22	15.17
Uganda	10.69	10.36	10.57	11.17	10.98	10.75	10.56	11.06	12.24	11.15

Source: ECB 2010

A second consideration is the macroeconomic context of EAC countries. EAC countries are developing economies with serious poverty challenges. Given their significant need for investment and development spending, the EAC countries should be borrowing today under the expectation of future growth. From this perspective, annual deficits (which reflect current spending decisions) should be given more leeway than overall debt (which better reflects long-term sustainability).

Additionally, the countries face significant macroeconomic shocks, such as terms-of-trade shocks from international commodity prices and agricultural productivity shocks from weather. These shocks often affect countries in the EAC differently.¹⁵ Sufficient discretion in national fiscal policy would better enable individual countries to respond to national economic shocks.

A third important consideration is the differential levels of aid inflows received by the EAC countries. Budget support from donors is equivalent to 1.3 percent of GDP in Kenya, 4.3 percent of GDP in Uganda, 5.1 percent in Tanzania, 10.5 percent in Burundi, and 10.9 percent in

Rwanda.¹⁶ These differences in aid reflect not only variations in poverty, but also differential capacity to generate domestic revenues. Table 3 above shows government revenue from taxes for Kenya, Tanzania, and Uganda; that chart shows that for example Kenya, which receives the least budget support as a percentage of GDP, has the highest ratio of tax revenues to GDP.¹⁷

These differences must be borne in mind as the EAMU decides whether to measure its fiscal deficit criteria inclusive of grants or exclusive of grants. These options have vastly different implications for countries' ability to spend general budget support.

If fiscal balance were measured with grants, countries would have unlimited discretion to spend aid. As the figures above suggest, most countries in the union have an interest in a deficit target inclusive of grants; curtailing their ability to spend aid is costly for a region with pressing development needs and limited capacity to raise revenue domestically.

A fiscal deficit including grants is also the measure that most closely relates to potential harmful macroeconomic spillover effects. If countries are receiving grants as general

15 European Central Bank. 2010. "Study on the establishment of a monetary union among the Partner States of the East African Community". European Central Bank Staff Study. Kishor, N. Kundan and John Ssozi. 2009. "Is the East African Community an Optimum Currency Area?" Munich Personal RePEc Archive Paper No. 17645, <http://mpira.ub.uni-muenchen.de/17645/>

16 Ibid.

17 Source: IMF *Government Finance Statistics* for Kenya, Uganda, and GDP data; Tanzanian Ministry of Finance and Economic Affairs for fiscal data for Tanzania. For 2006 to 2008, Tanzanian GDP data is taken from the World Bank's *World Development Indicators*.

budget support (GBS), those grants are a line item in their revenues that they can use to finance expenditures without having to resort to borrowing. As such, the possible inflationary pressures from running a budget deficit would result from when expenditures are higher than total government revenue, which would include grants going to GBS.

If fiscal balance were measured without grants, countries would have little ability to spend general budget aid unless the rest of their budget was already near balance. However, unlimited discretion in spending aid may not be desirable from the EAMU's perspective. Aid is volatile and unpredictable, and it tends to exert a "ratchet" effect on spending—i.e. rising aid tends to increase spending while falling aid does not necessarily reduce spending.¹⁸ For these reasons, aid can have a destabilizing effect on fiscal policy. Many analysts expect GBS to decline in the future, and deficit financing of the shortfall would be tempting but problematic. An additional benefit to a measure of deficits excluding grants is that it reinforces a longer-term goal of reducing dependency on aid in the region.

Based on this analysis, this section makes the following recommendations:

1. At a minimum, the EAMU should adopt a measure of fiscal deficit that is inclusive of grants. This measure most closely relates to potential harmful macroeconomic spillover effects. It is also the most realistic given existing revenue generation capacity and existing reliance on donor support. However, given that aid inflows can have an independent inflationary impact, this deficit target should be paired with a program to manage the liquidity from aid inflows (see box on p.10).

2. The EAMU should consider measures to limit discretion in spending budget aid by member countries, given that levels of donor support are volatile and unpredictable. Some policy options include:

- Limitations on the ability of countries to domestically finance shortfalls in projected aid or to spend unexpected increases in aid. The IMF's Poverty Reduction and Growth Facility (PRGF) agreements could provide a template for these rules.
- Requiring some kind of discount factor to future aid commitments in country budgeting, in recognition of the fact that donor commitments

often are not realized in full or on their original schedule. Uganda has already adopted this practice, implementing a 20 percent reduction from forecast.

- At the extreme, having two deficit targets, one with and one without grants, which would allow the EAMU to define precisely how much discretion to grant member countries in aid spending through the size of the wedge between the targets. The level of discretion allowed could be adjusted over time.

3. The EAMU should ensure sufficient flexibility and leeway in the deficit threshold. Given development spending needs and historical deficit levels, the current proposed deficit targets of three percent of GDP, which would be reduced to two percent in coming years, seem a bit conservative. The EAC could consider revising them upward. Additionally, given the large shocks that affect the region, policymakers may consider a cyclically adjusted deficit threshold to allow more spending leeway during adverse shocks and less leeway otherwise. Whatever level the EAMU ultimately chooses must be subjected to debt sustainability analysis to ensure that it is sustainable and consistent with any debt targets adopted by the union.

D. Considerations Regarding Debt Level Convergence Criteria

The second fiscal convergence criterion on which EAC policymakers need to agree regards the debt burden that each individual country carries. The initial benchmarks for debt levels reference reducing the total debt-to-GDP ratio to "a sustainable level" in the short term and then engaging in "sustained pursuit of debt sustainability" moving forward.¹⁹ A relevant policy question is whether a specific quantitative threshold may be preferable to such qualitative benchmarks, and if so, what the debt burden threshold should be.

18 Buliř, Ales and Timothy Lane. 2002. "Aid and Fiscal Management." Paper presented at the IMF conference on Macroeconomics and Poverty, March 14-15.

19 European Central Bank. 2010. "Study on the establishment of a monetary union among the Partner States of the East African Community". European Central Bank Staff Study.

Considerations on Macroeconomic Management of Aid Inflows

The EAMU countries could afford themselves more discretion in aid spending if the union is able to manage successfully the liquidity generated by budget aid. When a country receives aid for general budget support, the fiscal authority generally exchanges the foreign currency for a local currency deposit at the central bank. When the government spends this money, it is the equivalent of pure money creation unless the central bank either (1) absorbs the aid by selling the foreign exchange, or (2) sterilizes the excess liquidity through an open market purchase of assets. Absorbing the aid will tend to appreciate the domestic currency, which can negatively impact the competitiveness of the country's exports. Sterilizing the extra liquidity with open market operations will put upward pressure on interest rates, potentially crowding out private investment and increasing the fiscal burden of servicing the country's domestic debt. Thus, managing aid inflows requires countries to balance the risks of inflation, appreciation, and increases in interest rates.

In the context of a monetary union, liquidity management becomes even more important—and complex—because the potential costs of aid inflows are shared throughout the union. This is most obvious in the case of exchange rate appreciation, since the countries would effectively have a fixed exchange rate regime with each other, but inflation and interest rate spillovers would also be likely. If the macroeconomic environment were very unstable, the optimal policy response to aid inflows may actually be to not spend aid for a period of time until stability returned.²⁰ This possibility bolsters the case for the EAMU countries depriving themselves of some discretion to spend budget aid. However, if the EAMU developed good liquidity management policies, the need for such restrictions would be diminished.

Tanzania's aid management policies provide one possible template for an EAMU liquidity management strategy. Partly in response to concerns that the Bank of Tanzania (BoT)'s earlier practice of sterilizing aid inflows was leading to crowding out,²¹ the BoT developed a well-regarded system of auctioning the foreign exchange from aid. Rather than selling the foreign exchange when it arrives, which could generate large exchange rate fluctuations, the BoT announces aid sales three months in advance and sells a given amount in the foreign exchange market each day. The authorities also set a broad limit of how much exchange rate appreciation they would be willing to tolerate. The architects of the EAMU may want to consider a similar approach, ideally with the foreign exchange sales conducted by the EACB branches (or, in the case of a "federal" system, the national central banks) in each country.

20 International Monetary Fund (IMF). 2005. "The Macroeconomics of Managing Increased Aid Inflows: Experiences of Low-Income Countries and Policy Implications." <http://www.imf.org/external/np/pp/eng/2005/080805a.pdf>

21 Ibid.

There are some arguments being considered by policymakers in the EAC against a specific quantitative convergence criterion for debt levels. A quantitative threshold would be redundant if the EAMU member countries agree and adhere to an appropriate and sustainable constraint on fiscal deficits. However, this direct link between annual deficit thresholds and long-term sustainable debt levels is tenuous. The debt sustainability analyses that link government deficit levels to projected debt burdens are difficult to conduct with precision. The macroeconomic data on which these analyses are based can be questionable, and the analyses rely on projections of future growth and interest rates. Relying solely on projections of sustainability based on current deficit levels leaves significant room for error.

Another potential justification is that members of the monetary union with current levels of debt below the threshold would face an incentive to quickly increase their borrowing up to the maximum. However, this rationale is also lacking. Countries with relatively low debt burdens are not choosing at the moment to take on higher amounts of debt, even though markets have let them in the past. Although markets may be even more willing to lend once countries are in a monetary union, as long as the maximum threshold is sustainable, there does not seem to be a reason why having a specific debt threshold would encourage countries to act in a fiscally irresponsible way.

However, market expectations and debt intolerance support the adoption of a specific quantitative debt threshold. As mentioned above, international financial markets have a tendency to be insufficiently forward-looking when lending to developing countries. In the context of an EAMU, markets may expect a bailout from members of the monetary union or donor debt relief in the case of a debt crisis, and individual countries may then have incentives to borrow more and accumulate a greater debt than is sustainable. The likelihood of unsustainable debts leading to default is reflected in the concept of debt intolerance, which suggests that countries with a history of default (such as several EAC countries) are prone to recurrent cycles of unsustainable debt accumulation followed by default.²²

If EAC policymakers were to move towards a specific debt burden threshold, a key question is what

22 Reinhart, Carmen, Kenneth Rogoff, and Miguel Savastano. 2003. "Debt Intolerance." *Brookings Papers on Economic Activity* 2003(1): 1-62.

level should be chosen. The obvious fundamental consideration is that the chosen threshold must be sustainable. Current government gross debt is just over 20 percent of GDP for Rwanda and Uganda, 40 to 45 percent for Kenya and Tanzania, and over 150 percent for Burundi.²³ This paper will not recommend a specific threshold, as rigorous debt sustainability analysis will be necessary for any specific maximum considered. Historical analysis suggests that a relatively low threshold be chosen, as “debt intolerant” countries can experience debt crises at levels of debt that are sustainable in other countries; on the other hand, expectations of increased future growth due to monetary union may justify a higher level of sustainable debt. Whatever debt threshold is chosen must also be reasonably attainable by the members of the union; the variability in gross debt across the countries will complicate the selection of a particular threshold²⁴, and a reasonable debt threshold would need to be feasible given these current debt burdens.

This section makes the following recommendations:

1. Establish a specific and relatively conservative debt-burden threshold as a convergence criteria and fiscal commitment for membership in the EAMU. Long-term debt sustainability is fundamental to the success of a potential EAMU, and including a specific threshold is an important step to achieving sustainability. Given the fairly liberal threshold for government deficit recommended above, a more rigid overall debt threshold would complement short-term flexibility with a more conservative long-term focus. The threshold should include both foreign and domestic debt, especially as the composition of public debt in EAC countries becomes increasingly domestic.

2. Any specific threshold should be for a present discounted value of debt.²⁵ The debt stocks of EAC countries have varying levels of concessionality. Nominal values of debt thus reflect different actual repayment burdens, so a present discounted value of debt is a more accurate debt measure.

23 IMF World Economic Outlook Database, October 2010.

24 One likely approach will be to write some type of exception for Burundi given its current debt burden. Policymakers will have to prevent such an exception from being a loophole for other countries to increase their debt burdens.

25 Adam, Christopher and David Bevan. 2001. “Fiscal Policy Design in Low-Income Countries.” Paper prepared for UNU/WIDER research project on ‘New Fiscal Policies for Poverty Reduction and Growth’ Project Meeting, Helsinki, November 17 and 18, 2000.

E. Surveillance, Adjudication, and Enforcement

Once the EAC establishes fiscal convergence criteria that best suit the needs of its constituent members and the EAMU, an immediate challenge will be preserving those commitments. History demonstrates that several approaches have been tried and all have struggled through various periods. These include centralized enforcement (e.g., EMU and WAEMU since 1999), surveillance and persuasion (e.g., ECCU and CEMAC), and decentralized enforcement (e.g., USA).²⁶

These approaches attempt to address the imperfect incentives facing the governments who will decide the fiscal policies of each country. Among other imperfect incentives, elected officials tend to have short time horizons, and may discount the true cost of borrowing. At the same time, the political costs of prioritizing certain constituencies in the budget over others are real and immediate. A monetary union compounds this problem. Because the true cost of borrowing is now shared with other member states, the elected official can more easily postpone hard choices.

One method is to legally forswear bailouts. Unfortunately, this is difficult in practice. If State A is about to repudiate its debt, its creditors may be spread throughout the monetary union. Failing to bail out State A could cause a contagion affecting the rest of the monetary union. Despite the Maastricht Treaty’s “no-bailout” clause,²⁷ Greece and Ireland received bailouts. If the EAC becomes more integrated, costs of not bailing out a country may eventually exceed the costs of bailing out that country.

A second method is to create a firm, categorical rule banning deficits and debt beyond a certain level. To ban behavior, the sanctions must be prohibitive. This approach has advantages. Violations are easy to identify and are uniformly punished. If the sanction is sizable enough and

26 The USA is not colloquially thought of as a monetary union. It is a national monetary union (rather than an international monetary union) and took approximately 150 years to develop into its modern form. Hugh Rockhoff, “How Long Did It Take The United States to Become An Optimal Currency Area?” in *Monetary Unions: Theory, History, Public Choice*, ed. Forrest H. Capie and Geoffrey E. Wood (New York: Routledge, 2003), 70-103. Like international monetary unions, each constituent state in the USA operates its own fiscal policies, and fiscal constraints in force among the states have been studied as lessons for other monetary unions. See, for example, Jurgen von Hagen, “A Note On the Empirical Effectiveness of Formal Fiscal Restraints,” *Journal of Public Economics* 44(1991): 199-210.

27 Consolidated Versions of the Treaty on European Union and the Treaty on the Functioning of the European Union. March 30, 2010. O.J. C 83/1, art. 125.

credible enough then it should never have to be used. Unfortunately, these rules are also difficult to implement in the context of a monetary union.

Such strict standards tend to be both over-inclusive and under-inclusive. They are likely to forbid excessive deficits that are potentially prudent (e.g. a 3.5% deficit during a severe recession) and permit deficits that are imprudent (e.g. a 2.5% deficit during an expansion). Moreover, if countries carry different debt loads, have different levels of access to aid, and have different growth rates, as they do in the EAC, then economically, countries can afford different deficit levels. The same bright-line should not apply.

Given that excessive deficits are likely to come about during periods of economic hardship, and given the potential arbitrariness of the rule, severe sanctions seem potentially cruel and unwise. The rule would cruelly harm a population that is already struggling. The rule would unwisely prevent sound economic policies. In an integrated monetary union, the costs may spill over and affect other member states. As such, the rule is likely to face fierce political resistance.

That is exactly what happened in the EMU. At its founding in 1999, the EMU forbade deficits in excess of 3% of GDP. At the time, the reference value was seen as arbitrary. The Excessive Deficit Procedure gave countries 4 months to take satisfactory corrective action and one year and one month to eliminate the excessive deficit. If the government failed to act, it would face punitive, substantial, and escalating penalties of up to 0.5% of GDP.²⁸ Some commentators described this as the “nuclear option.”²⁹ When excessive deficit proceedings were initiated against France and Germany during a downturn in 2003, France and Germany successfully resisted.³⁰ As a result, the EMU revised its rules in 2005.

A third method might be enforcement with a more flexible, multifactor balancing test. This rule would allow the judge of excessive deficits to consider a country's circumstances to determine the economic merits and demerits of a particular deficit. The challenge is that such rules rely heavily on the judge's subjective opinions. A decision will

still be arbitrary if it is not sufficiently justified. Moreover, the judge may value tradeoffs (i.e. between price stability and growth) differently than the member state. Lastly, punitive sanctions can still be hard to impose against a country with excessive deficits. Subjective criteria means there is more room to disagree, and the outcome may still result in punishing a country that is struggling economically.

The original East African Currency Board, which was in place from 1960 to 1966, is a case in point. The Currency Board's fiduciary limits were decided jointly, and each country had an informal veto. As it took on the trappings of a true central bank, the fiduciary limits periodically increased. However, by 1964 both Tanzania and Uganda had reached their borrowing limits, while Kenya rarely borrowed more than 50 percent of its limit. Tanzania and Uganda wanted to raise the limits to borrow more, but they needed Kenya's approval. Kenya could decide on whatever criteria it felt was appropriate and frequently opposed more borrowing.³¹ Within six years of independence, the monetary union dissolved.

The EMU's Amended Excessive Deficit Regulations after 2005 provide another example. The rules Germany and France helped advance required that the European Commission and the Ecofin Council consider broad country-specific factors like “developments in the medium term economic position (in particular, potential growth, prevailing cyclical conditions, the implementation of policies . . . for promoting research and innovation),” “developments in the medium term budgetary position (in particular, fiscal consolidation efforts in ‘good times,’ debt sustainability, public investment and the overall quality of finances),” and “any other factor . . . [including] European policy goals.”³² The time horizon for corrective action was extended. As demonstrated in the Appendix Table A2a, noncompliance continued unabated both before and especially after the Financial Crisis.

A fourth method relies on political procedures to constrain excessive deficits within the country. These procedures have the advantage that they are self-enforcing by providing the time and political space for opponents of excessive deficits to mobilize. However, these rules might overcompensate or undercompensate for other perverse political incentives, and they do not address the moral hazard facing an entire country.

In response to debt crises among USA states in the 19th Century, nearly every state has imposed on itself balanced

28 Roger J. Goebel. 2008. “Economic Governance in the European Union: Should Fiscal Stability Outweigh Economic Growth in the Stability and Growth Pact?” *Fordham International Law Journal* 31: 1312-16. Malcolm Levitt and Christopher Lord. 2002. *The Political Economy of Monetary Union*. New York: St. Martin's Press. pp. 152-53.

29 Goebel, “Economic Governance in the European Union,” 1309-17.

30 Goebel, “Economic Governance in the European Union,” 1329-40.

31 David Stasavage. 2003. *The Political Economy of a Common Currency*. Burlington: Ashgate Publishing. pp. 164-65.

32 European Community Council Regulation No. 1056/2005, June 27, 2005, O.J. L 174/5, § 1(1)(3).

budget rules (BBR) and debt limits of varying degrees of strictness. BBRs require that budgets be balanced, either when they are proposed, passed, or in practice across a particular period of time. Debt limits require special procedures, such as a supermajority or a referendum, before states can exceed particular debt limits. As demonstrated in the Appendix Table A2b, states had numerous crises in the 19th Century, but only one state defaulted in the 20th Century.³³ Statistical analyses find that stricter rules do reduce the number of states with excessive debt levels. But the evidence also suggests that states may divert debt to funds not subject to limits and that these constraints do not always prevent extreme outcomes.³⁴ While the USA is an advanced economy with far less volatility than EAC member states, the almost total absence of state defaults warrants close attention.

In light of the challenges facing every method, this section makes three policy recommendations:

1. The EAC should adopt a moderate, automatic tax that is applied to member states with excessive deficits on a pro rata basis. This proposal is a fifth method that stands in contrast to bans on excessive deficits. Since there can be legitimate reasons for excessive deficits, this policy shifts the decision making burden from the regulator to the regulated. It retains the automaticity of a bright-line rule and also the flexibility of a balancing test. A tax would simply price in the costs and risks the country is creating for the rest of the EAMU at the time the costs and risks are being created.³⁵ If a country feels the deficits warrant the extra cost, then they can proceed with running a larger deficit. Because the tax is automatic, moderate, and proportionate, there will be less resistance and less hesitation before imposing such a penalty. With its regular use, credibility for the rules would increase, and arbitrariness would be reduced. The law and economics literature frequently favors the use of “price” control over “command” control, at least in the context of a domestic legal system.³⁶

An important question to address is the exact size and use of any taxed deficits. If the funds are used to partially

insure a country in need of a bailout, good arguments could be made that such a program would significantly reduce, or alternatively exacerbate, moral hazard in a monetary union. Distributing the funds to other EAC member states, as the EMU rules do with sanctions, might also have ambiguous effects on moral hazard. Answering these questions goes beyond the scope of this paper, but might depend on (a) how the cost of taxes to foreign entities are internalized by political decision makers in EAC countries and (b) what different rules suggest about the size, likelihood, and source of a bailout.

2. The EAC should have an independent authority to oversee issues of surveillance, adjudication, and enforcement. It is critical for an EAC to have the legitimacy, credibility, and independent capacity to enforce fiscal commitments. Independence involves the personnel selection process, the EAC enforcement agency’s budget, and the enforcement mechanism. For example, if an EAC Commission were created and tasked with enforcing fiscal commitments, but it lacked the power to enforce audits or the power to impose a tax without the acquiescence of a member state, then it arguably lacks meaningful independence. The details, however, are beyond the scope of this paper.

3. The EAC should require states to impose special rules for exceeding debt limits. Given the strong record of US states in meeting their past debt obligations, BBRs and Excessive Debt Limits warrant attention as a complement to other methods of reducing excessive deficits. Such rules can create a speed bump by which those internal constituencies who might oppose excessive borrowing can mobilize and make their case. If such political roadblocks are required, the tax on excessive borrowing paid to the EAC or other member states and the reports from independent monitors should augment the arguments of those who oppose unjustified deficits. Thus, such rules can magnify the political costs associated with imprudent fiscal policies.

Combined, these three rules present a potentially more credible and durable constraint on excessive fiscal policies. If they were implemented and proved effective, the EAC might serve as a model for other monetary unions.

33 The ultimate outcome of the recent Financial Crisis on state finances remains to be seen. Michael Cooper and Mary Williams Walsh. 2004. “Mounting Debts by States Stoke Fears of Crisis,” *The New York Times* December 4, A1.

34 Jurgen von Hagen. 1991. “A Note on the Empirical Effectiveness of Formal Fiscal Restraints.” *Journal of Public Economics* 44: 199-210

35 For example, suppose that an EAC country ran a deficit of 7% with a debt limit inclusive of grants of 6%. If there was a 5% tax on excessive deficits, that EAC country would pay a tax equivalent to 0.05% of GDP. An 8% deficit would result in a tax of 0.1% of GDP.

36 E.g., Steven Shavell. 1987. “Liability for Harm versus Regulation of Safety.” *Journal of Legal Studies* 13: 357-66, 372-74.

Section IV: Transition to a Forecast-Based Monetary Policy Framework

The transition to a monetary union is an important medium-to-long term goal for the EAC. In preparation, these countries have the opportunity to consider aspects of their economies that function as an effective conduit for monetary policy. As discussed in Section II, the increasingly unstable money demand function is one feature that is hampering the effectiveness of monetary policy. Accordingly, these countries are considering moving away from monetary targeting and towards a forecast-based monetary policy framework along the lines of inflation targeting (IT).³⁷ Specifically, the framework would change to one that uses inflation expectations as the nominal anchor, rather than monetary aggregates.³⁸

The move to IT raises a number of issues; in particular, whether the EAC countries satisfy certain preconditions for successful use of an IT framework. These include an independent central bank (such as instrument independence and a lack of fiscal dominance), a healthy financial system (including deep debt markets and a robust transmission mechanism), a sound technical infrastructure (including having forecasting capabilities and access to relatively high-quality economic data) and an economic structure that does not weaken the potency of monetary policy (such as low sensitivity to exchange rate or commodity price movements). Batini *et al.* (2005) show that most IT countries did not meet these conditions prior to adopting the framework but did rapidly improve in these areas after the framework was implemented.³⁹ Nonetheless, it is still worthwhile examining these factors, as they are likely to enhance monetary policy regardless of the framework being used.

The remainder of this section examines three important issues related to the effectiveness of monetary policy that

will be particularly important for the EAC countries to consider as they implement forecast-based monetary policy frameworks. Following from the examination of the fiscal dimensions of monetary unions, we first discuss the influence of fiscal policy on monetary policy, with an emphasis on the Fiscal Theory of the Price Level (FTPL) and fiscal dominance. We then look at efforts to deepen and develop financial and debt markets. Following that, we discuss the importance of developing an inflation forecast and a framework that allows for explicit consideration of the uncertainties in that forecast. In that vein, we consider forecasting issues specific to the EAC countries - in particular, the degree to which they can influence aggregate prices in the face of commodity shocks and their implications for which price variable to target. Finally, we introduce a methodology of formally presenting judgment about the economy as a forecast distribution that can be used in a central bank's internal communications or in its communication to the public.

A. Fiscal Dominance

There are a variety of fiscal considerations relevant to monetary policy in the EAC countries. In general, the borrowing behavior of a government may constrain the ability of its central bank to conduct effective monetary policy by making inflation more difficult to predict, creating macroeconomic pressures that are impossible to counteract, or directly interfering with central bank operations. Situations in which fiscal policies exert more power than monetary policy over the macro economy are referred to as fiscal dominance.

In this section, we briefly introduce theories of fiscal dominance and then discuss the extent of fiscal dominance in EAC countries. This issue is important as it helps determine the optimal strategies for implementing monetary policy.

Theories of Fiscal Dominance

A macroeconomic policy regime is said to exhibit fiscal dominance if fiscal policy plays a more important role than monetary policy in determining inflation. For example, one mechanism through which fiscal policy affects prices is if the government chooses to finance its expenditures by borrowing excessively from the central bank. In this case, the central bank can lose control over the size of its balance sheet and hence its ability to control the

37 Kenya and Uganda are currently furthest along in these plans. For a discussion of Kenya's move to inflation targeting, see Adam, Christopher, Benjamin Maturu, Njuguna Ndung'u and Stephen O'Connell. 2011. "Building a Monetary Regime for the 21st Century." Chapter 7 in Adam Christopher, Paul Collier and Njuguna Ndung'u (eds.), "Kenya: Policies for Prosperity", Oxford University Press. For Uganda, see the 2009/10 Annual Report of the Bank of Uganda.

38 The use here of the term IT should be taken as a broad term to describe a monetary policy framework that aims to manage inflation expectations. It can encompass inflation-forecast targeting (Svensson, Lars E.O. 1997. "Inflation Forecast Targeting: Implementing And Monitoring Inflation Targets." *European Economic Review* 41(6): 1111–1146); IT-Lite (Stone, Mark. 2003. "Inflation Targeting Lite."), or IT in the strict sense as described in Mishkin, Fredric S. and Miguel A. Savastano. 2001. "Monetary Policy Strategies for Latin America." *Journal of Development Economics* 66(2): 415–444.

39 Batini, Nicoletta., Kenneth Kuttner and Douglas Laxton. 2005. "Does Inflation Targeting Work in Emerging Markets?" Chapter 4 in IMF, *World Economic Outlook*, September, pp. 161–186.

money supply. This type of problem can be mitigated by ensuring that the central bank is politically independent and by prohibiting, or at least limiting, direct financing of government deficits by the central bank.

However, the Fiscal Theory of the Price Level suggests an additional mechanism through which fiscal policy can affect prices. According to the FTPL, fiscal policy determines prices when the government does not adjust its budget in response to fiscal disturbances that affect its long-run budget constraint. This is referred to as non-Ricardian behavior. In this case, prices have to adjust to balance the constraint. Thus, the FTPL has implications for the conduct of monetary policy. For instance, a policy rule that specifies how much the central bank should move interest rates in response to particular deviations of inflation and GDP, without taking into account fiscal policy, would lead to a low and stable inflation level when combined with Ricardian fiscal policy, but could lead to high inflation when fiscal policy is non-Ricardian.⁴⁰ This has been put forward as an explanation for the inflation episode in Brazil in the early 1980s.⁴¹

Certain aspects of the FTPL model are relevant in the EAC context: these governments might be forced into non-Ricardian spending behavior because of borrowing constraints, for example. The analysis conducted by Baldini and Ribeiro (2008) using a sample of Sub-Saharan African (SSA) countries suggests that Ricardian equivalence generally does not hold in Kenya, Tanzania, Uganda or Burundi (results are indeterminate for Rwanda).⁴² However, the FTPL has been critiqued on theoretical grounds, and more recent literature points to the view that the behavior of inflation and output is determined by the central bank's policy rule as long as both fiscal and monetary policymakers are behaving sensibly.⁴³

Whether or not the FTPL holds, there is risk of fiscal policies interfering with monetary policy mechanisms, and central bankers must be cognizant of this.

Fiscal Dominance in the EAC

Since the absence of fiscal dominance is one of the prerequisites for moving to an IT framework, it is important to assess the extent to which fiscal dominance is an issue

in the EAC. Baldini and Ribeiro (2008) assessed the presence of fiscal dominance in SSA by testing the relative importance of fiscal and monetary determinants of inflation. Their results indicate that Kenya and Rwanda have a monetary-dominant regime, Tanzania and Burundi have a fiscal-dominant regime, and the results are indeterminate for Uganda (by which they mean that the regime might have switched during the time period of analysis, 1980 – 2005).

We now turn our attention to measures of central bank independence in the EAC countries. *De jure* measures of fiscal dominance, such as Crowe and Meade's (2007) central bank independence measure, support the view that Kenya has less fiscal dominance than Uganda or Tanzania. Of the EAC countries, Crowe and Meade cover Kenya, Uganda and Tanzania for the years 1995 through 2004. They construct an index that measures the limitations on central bank lending and its financial independence from the government by examining the type of lending, its magnitude, and the maturity and interest rate on government debt.⁴⁴ For instance, in Kenya, government borrowing from the central bank is restricted to five percent of last year's audited revenue, whereas in Tanzania the limit is 12.5%. The more restrictions on lending that are written into law, the higher the index. The index is calibrated from zero to one, with higher numbers indicating less fiscal dominance. Fiscal dominance is just slightly more present in emerging market and developing economies on average than in advanced economies, with advanced economies being more varied.

The EAC countries appear to be subject to greater fiscal dominance, on average, than other developing countries. Kenya has the highest score, 0.65, and is above the average for the developing countries (Figure 3). Uganda's score is below the developing country average, 0.63, and Tanzania has the lowest score, 0.57. However, there are limitations to using legal measures, since what occurs in practice can differ from the law. This is clear when we see that some advanced IT countries have lower independence scores than some developing countries, which is a surprising result.

40 Michael Woodford. 1998. *Public Debt and the Price Level*. Princeton University.

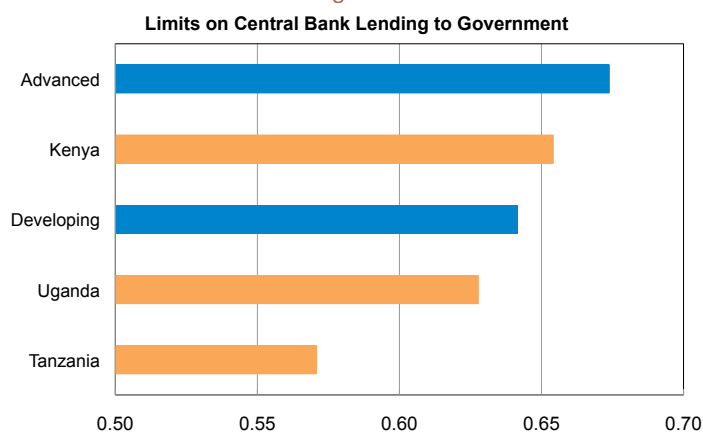
41 *Ibid.*

42 Baldini and Ribeiro use the methodology proposed by Canzoneri, Cumby and Diba (2001).

43 Bennett T. McCallum. 2005. *How Should the Fed Respond to Large Fiscal Deficits?* Carnegie Mellon University and NBER.

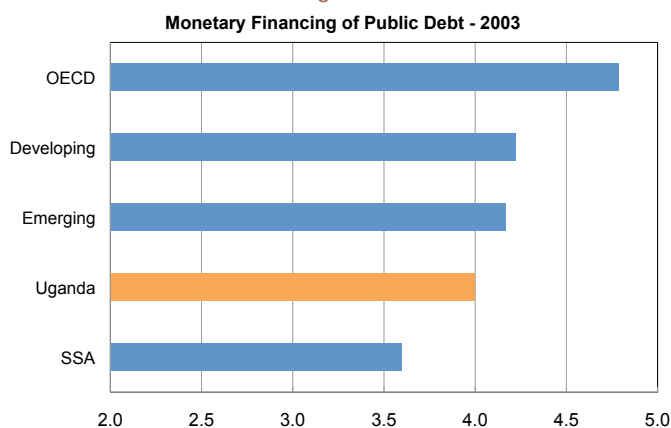
44 See Cukierman *et al.* (1992) for details regarding the eight characteristics that comprise the index.

Figure 3



Note: The blue bars denote the average score of 26 advanced economies and 70 emerging market and developing economies. Source: Crowe and Meade (2007), author's calculations

Figure 4



Index is measured from 1-5. Source: Arnone et al. (2006)

An alternate *de jure* measure of central bank independence comes from Arnone *et al.* (2006). Using their data, we constructed a sub-index of their overall autonomy score that examines the monetary financing of public deficits in 2003. This measures whether credit is automatically extended and, if so, at what rates, whether there are any conditions on lending, and whether the central bank participates in the primary market for treasury securities. The index is scaled from 1–5, with 5 being the most independent. Of the EAC countries, data are only available for Uganda (Figure 4). Uganda received a score of 4, losing a mark because the central bank can participate in the primary market for public debt securities. Uganda's score is above the average for SSA countries and slightly below the average score for developing and emerging markets.⁴⁵ Again, this measure is only a partial indicator of how the government and central bank interact, as it measures what

⁴⁵ The authors include 18 OECD countries, 12 emerging market and 10 developing economies. The SSA countries included are Uganda, Nigeria, South Africa, WAEMU and Zambia.

is written into law, rather than what occurs in practice.

The analyses consistently point to the burden of fiscal dominance being lower in Kenya than in Tanzania or Uganda. There are several reasons why this is the case. On the monetary side, the Central Bank of Kenya enjoys greater *de jure* as well as *de facto* independence than the Central Bank of Tanzania. On the fiscal side, there are at least two reasons for the difference. First, both revenues and expenditures are far less volatile in Kenya than in Tanzania, and second, Tanzania has a higher level of dependence on aid, which poses a challenge for fiscal management (Figure 5).

B. Forward-Looking Information from Debt Markets

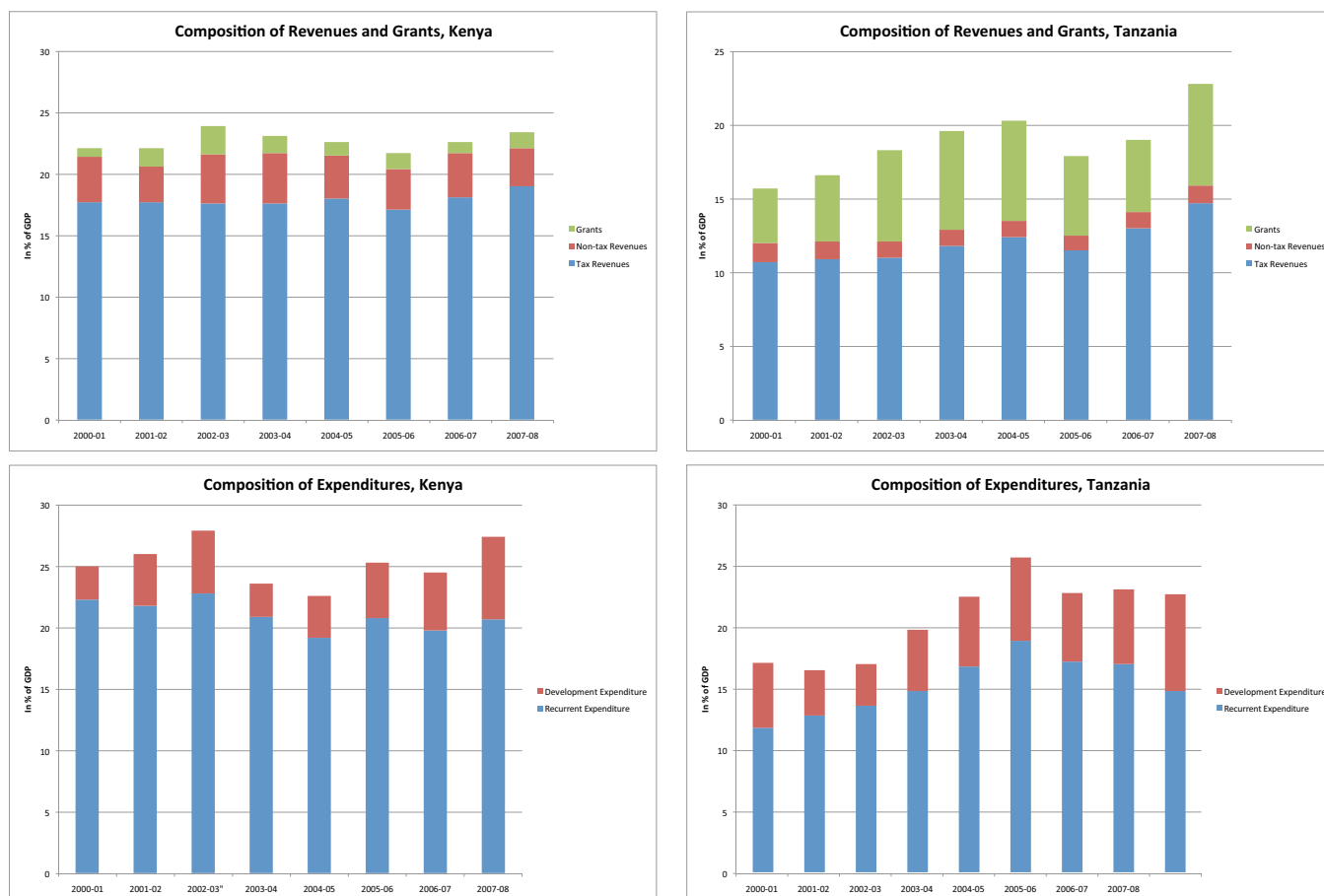
As the EAC countries move closer toward forecast-targeting monetary policy frameworks, it will become increasingly important to develop forward-looking assessments of inflation and growth. Newly-developing financial markets can provide an additional source for this type of information. Because yields on long-term government bonds reflect investors' expectations of inflation, growth, and other risk factors, shifts in the yield curve of interest rates can alert policymakers to changes in market expectations.

Within the past decade, Kenya, Tanzania, and Uganda have developed deep domestic bond markets, and all now issue large volumes of government debt with broad maturity profiles. (Rwanda and Burundi are in the earlier stages of bond market development.) In this section, we discuss the information content of yield curves and assemble a time series of benchmark bond yields for Kenya to assess whether the market is liquid enough to provide useful information about the macroeconomic outlook.

We focus on Kenya here because we were given access by the Nairobi Stock Exchange to secondary-market data on government bond trades since 2008. This type of pricing data is not available for EAC bond markets from international sources such as the Bloomberg Professional service or Thomson Reuters Datastream, nor do the central banks or exchanges in the region publish indexes of bond yields.⁴⁶

⁴⁶ Some of these central banks and exchanges do publish individual yield curves, but there seems to be little discussion of the term structure of interest rates in public communication.

Figure 5



Why Develop Debt Markets?

Government debt markets provide three primary types of benefits for low-income countries.⁴⁷ First, deeper and more liquid markets provide a more reliable and lower-cost source of financing for government deficits. Second, the government debt market serves as a benchmark for pricing other types of financial assets, which in particular makes it easier for private companies to access new sources of credit by issuing bonds. Finally, liquid and competitive markets can enhance the effectiveness of monetary policy by helping to ensure that changes in short-term interest rates will be reflected in a broad range of other credit instruments.

In addition to these primary benefits, a yield curve can also provide valuable information about market expectations of inflation and growth once it is in place.

Information Content of Bond Yields

The yield of a bond is the overall rate of return implied by comparing its market price to the cash flows it promises. In a relatively efficient market, the difference in yield between two bonds should reflect the differences in risk assessed by investors. Because investors can choose between purchasing a long-term government bond or a series of shorter-term bonds, the yield of the long-term bond should equal the expected average short-term rate over the period until it matures, plus a premium reflecting the additional risk of the long-term investment.⁴⁸ Short-term rates represent a combination of real rates and inflation, so:

Long-term rate = expected real rates + expected inflation + risk premium

47 See IMF Selected Issues reports on Togo (2009, No. 09/165) and Algeria (2008, No. 08/104), available at www.imf.org.

48 The risk premium comprises a number of factors, including aversion to bad inflation outcomes, the possibility of default (credit risk), and the anticipated difficulty of selling the bond (liquidity risk).

Thus, changes in the long-term yield reflect changes in some combination of these underlying components. A rising yield could indicate higher expectations for future real rates, higher expected inflation, or an increase in ancillary risks and risk aversion. Real rates in turn are closely tied to the business cycle, largely because of monetary policy. Central banks raise short-term interest rates during periods of rapid growth, and cut rates sharply during contractions to stimulate investment.

The academic literature on the yield curve focuses on formalizing these bond pricing patterns, and on fitting functional forms to bond yields in order to estimate smooth yield curves that can be decomposed into different factors.⁴⁹ Stock and Watson (2003) survey the literature on using asset prices to forecast growth and inflation. To the extent that market expectations are accurate, we would expect changes in bond yields to be followed by changes in the macro-economy.⁵⁰ Indeed, the slope of the yield curve (i.e., the spread between long-term and short-term rates) provides robust but imprecise forecasts of inflation and growth.

Most of these empirical studies focus on the United States and other industrialized countries that have yield curve data going back for decades. However, many lower-income countries also began issuing government debt in recent years, and there is evidence that the same forecasting relationships exist in these emerging economies as well. Mehl (2009) provides the first comprehensive assessment of this, finding that the predictive power of changes in the slope of the yield curve holds in a sample of 14 different emerging economies between 1995 and 2005.⁵¹

The Government Bond Market in Kenya

The Finance Ministry and Central Bank of Kenya have been implementing measures to promote the country's debt markets since at least 2003, with goals including being able to raise money more easily for the Treasury and encouraging the issuance of corporate bonds.⁵² We exam-

ine secondary-market trading data to assess whether the bond market in Kenya is robust enough now to provide information about inflation and growth expectations to monetary policymakers. Patterns in the data are discussed in more detail in Appendix II.

The Kenyan bond market has become increasingly liquid in recent years. Trading volume increased substantially after an automated trading system was introduced at the end of November 2009, and in 2010 average daily turnover surpassed Ksh 1.5 billion. Although annual government bond issuance has remained relatively steady since 2002, the size of the market has increased steadily as the average maturity of new issues has risen from about 4 years in 2002–05 to about 10 years in 2009–10.

Certain bond tenors are traded more frequently than others. Bonds with about 5, 10, and 15 years to maturity are traded disproportionately often, and this preference is stronger in 2010 than in prior years. Investors also prefer to trade bonds that were issued relatively recently: bonds issued within the past one to three years make up the vast majority of trades since 2008. These patterns make it easier to construct time-series of yields for particular maturities.

We can draw raw yield curves for particular days, weeks, or months by plotting points corresponding to the maturity and yield of each bond traded.⁵³ Yield curves were relatively sparse and unvarying in 2008 and 2009, but in 2010 the higher trading volume resulted in many more data points. The entire yield curve shifted down by several percentage points during the early part of 2010.

49 The 1985 Cox-Ingersoll-Ross model represents an early landmark in the field, and Monika Piazzesi surveys more recent developments in "Affine Term Structure Models," *Handbook of Financial Econometrics*, 2003.

50 Stock, James H., and Mark W. Watson. 2003. "Forecasting Output and Inflation: The Role of Asset Prices," *Journal of Economic Literature* 91, Sept.

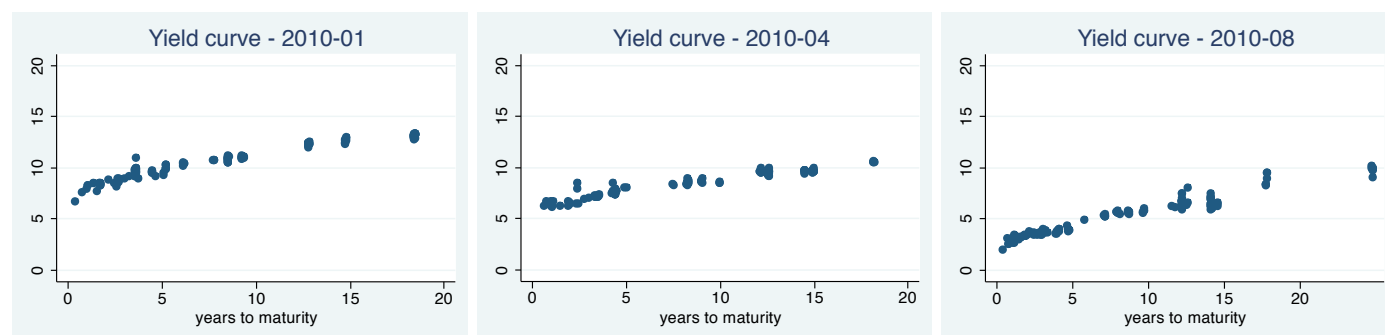
51 Mehl, Arnaud. 2009. "The Yield Curve as a Predictor and Emerging Economies." *Open Economies Review* 20(5).

52 Indeed, one of the stated missions of the Ministry of Finance's Department of Debt Management is to "foster growth of the domestic debt market and create a sustainable local interest rate yield curve" (see www.finance.go.ke). Also see remarks by CBK Governor

Njuguna Ndung'u at the Market Leaders Forum Cocktail, December 3, 2010, available at www.centralbank.go.ke.

53 Before constructing yield curves or indexes, we drop all trades less than KSH 10 million in value to reduce the number of outlying data points.

Figure 6: Representative Monthly Yield Curves in 2010⁵⁴

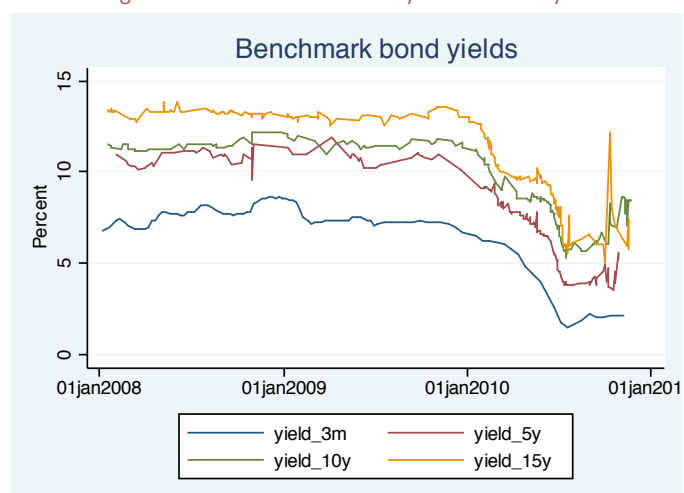


Time Series of Benchmark Bond Yields

Yield curves illustrate the relationships among interest rates at a single point in time, but to track changes in yields it is easier to look at data for individual benchmark maturities over time. We construct these indicators for the Kenyan market: the 5-year time-series reports the traded yield of the most recently issued 5-year bond, the 10-year time-series tracks the most recently issued 10-year bond, and the same for 15-year bonds.⁵⁵

In Figure 7 we plot these time-series of 5-, 10-, and 15-year bond yields since the beginning of 2008. We also include the yield of 3-month Treasury bills, which are auctioned weekly by the Central Bank of Kenya. All these yields are relatively steady during 2008 and 2009, and then drop sharply during the first half of 2010.

Figure 7: Benchmark bond yields in Kenya⁵⁶



⁵⁴ Includes all large trades in each month. Sources: Nairobi Stock Exchange, authors' calculations.

⁵⁵ This is referred to as an on-the-run time-series. When benchmark bonds are only issued once or twice a year, as happens sometimes in Kenya, breaks can appear when a newer bond replaces an older one. An alternative methodology is to estimate smoothed yields based on the prices of several bonds within a maturity range.

⁵⁶ Sources: Nairobi Stock Exchange, Central Bank of Kenya, authors' calculations.

What do these changes in yields imply about investors' macroeconomic outlook? The decline in Treasury bill yields primarily reflects the central bank's expansionary monetary policy in the first half of 2010, an attempt to reduce the cost of credit and encourage investment. Longer-term yields moved closely in tandem, which we would not expect unless investors expect short-term interest rates to remain low for a sustained period. Because there doesn't seem to have been any new information that would reduce the long-run growth outlook, a strong possibility is that the market views the substantial decline in inflation over 2009 and 2010 as being relatively permanent, and this has reduced the inflation expectations component of long-term interest rates.

Declining term premium components probably play a role as well. The Kenyan financial system has been awash with excess liquidity because of growing deposits and loose monetary policy, and instead of lending more, banks have been increasing their holdings of low-risk instruments such as Treasury securities. Higher demand bids down the risk compensation component of yields across the maturity spectrum. Another influence in 2010 has been the greatly increased liquidity of the bond market itself, aided by the implementation of an automated trading system. This has probably played a role in reducing bond risk premiums as well.

Conclusions

Any change in interest rates can have a wide variety of explanations, and it is impossible to estimate models of the structural relationships between the yield curve, inflation, and growth in Kenya until there is a much longer history of data exists. However, it looks like benchmark interest rates in Kenya are beginning to reflect the market's macroeconomic outlook. At a minimum, monitoring these yields would alert policymakers to instances when market expectations are shifting.

As they continue to develop their debt markets, central banks in the EAC should look out for ways that they can use yield curve data to their advantage in developing well-rounded, forward-looking intelligence about the macro economy. Time-series of benchmark bond yields may be more valuable than individual yield curves because they more clearly portray changes over time. This will be an important aspect of developing forward looking assessments of inflation and growth.

C. Inflation Forecasting and Considerations of Uncertainty

Monetary policy decisions are forward-looking—monetary policy stance is decided, which necessarily affects the economy with a lag, in order to shape the economy going forward. Thus, macroeconomic forecasts are a vital tool for central bankers. Monetary policy decisions are also always made under uncertainty, as it cannot be known exactly how the economy will perform in the future, and it is even uncertain exactly how the country is performing at the moment or performed over the recent past. This means central banks, in addition to needing a forecast of the future, need a sense of the uncertainty in their forecast. This is true for all countries and all central banks, but it is particularly true in developing countries, where the macroeconomic environment is typically much more uncertain than in developed countries. It is therefore of particular importance for central banks in developing countries to consider uncertainty and the risks to their forecast when forming monetary policy.

This section considers two issues regarding forecasting and dealing with uncertainty. First, in recognition of the importance of commodity prices for the EAC countries' economies, we empirically investigate whether commodity prices and rainfall can be used to forecast inflation and what that means for the countries' ability to effectively target inflation. Second, we present a methodology for formalizing and communicating a judgmental assessment of the risks and uncertainty around a macroeconomic forecast.

Commodity Prices and Inflation

Forecasting future inflation is an important aspect of conducting monetary policy, but Burundi, Kenya, Rwanda, Tanzania, and Uganda are still in the process of producing complete inflation forecasts. In East Africa, where food

and fuel constitute a large portion of consumption for the majority of the population, it is reasonable to expect that changes in international commodity prices will impact the local price level. Because food grown in these countries also makes up an important part of consumption and the Consumer Price Indices (CPIs) of the EAC countries, factors that determine crop success, such as rainfall, could also impact prices. If international commodity prices or local weather patterns are good predictors of inflation in East Africa, then these variables, for which data are readily available, could be used to roughly anticipate movements in inflation. These variables could then be built into inflation forecast models.

Using time series data for eight commodity indices and inflation in Kenya, Uganda, and Tanzania, we find that international indices influence inflation in Kenya, Tanzania, and Uganda. We find evidence of Granger causality between the petroleum price index, raw agricultural materials index, the non-fuel commodities index, and the food commodities index and inflation in these countries. In Kenya, rainfall levels have a strong leading relationship to inflation. High levels of rainfall are associated with decreases in inflation, which are most strongly apparent with a three-month lag. A dummy variable for drought is found to be highly significant; increases in annualized inflation as large as 10% following a drought.

Methodology

Drawing on Engle and Granger (1987) and Granger (1988) and following the methodology used to examine predictive value of commodity prices for consumer prices in the UK used by Garcia-Herrero and Thornton (1997), we test for Granger causality between commodity indices and inflation in Kenya, Uganda, and Tanzania and rainfall in Kenya. The analysis uses monthly data from 1992 for commodity indices and data from 1980 for rainfall.⁵⁷

The Engle-Granger method leads us to reject the null hypothesis that lags of the covariate of interest have no predictive value for the dependent variable, rather than showing causality per se.⁵⁸ First, we examine the relationship of eight commodity price indices to CPI in East Africa, all from the International Monetary Fund's *International Financial Statistics*:

57 Rwanda and Burundi were not included in this analysis, but it could be easily extended to them.

58 Despite its name, Granger causality should not be interpreted as showing causality. The F-tests on lags of covariates reject the null hypothesis that the X variable contributes nothing to predicting future movements in the Y variable. Furthermore, it is possible that Granger causality might be observed when a third, exogenous variable drives both X and Y.

- Non Fuel Commodities Index – 2005 =100, available from February 1980
- All Commodities Index- 2005=100, available from January 1992
- International Energy Index- 2005 = 100, available from January 1992
- Metals Index, 2005=100, available from 1957
- Raw Agriculture Materials Index, 2005=100, available from 1957
- Beverage Index, 2005=100, available from 1957
- Food Index, 2005=100, available from 1957
- Petroleum- 3 Spot Price Index 2005=100, available monthly from 1960

Second, we test whether rainfall is a useful leading indicator for inflation in Kenya using average national monthly rainfall data for Kenya, constructed from rainfall data from the Kenya Meteorological Department in Nairobi.⁵⁹

In testing for Granger causality, we used three steps:

1. Test the order of integration between the series using the Augmented Dickey-Fuller (ADF) test statistics.
2. Test for cointegration by examining the residuals from regressions on pairs of series.
3. Test for Granger causality in the regression including the error-correction term derived from the long run cointegrating relationship (the residuals from the cointegrated equation).

The test for cointegration uses the following regression: $CPI_{it} = \hat{\alpha} + \hat{\beta}(CP_{wt}) + \varepsilon_{it}$, where CP represents commodity prices and CPI is country CPI . We then regress international commodity prices on inflation, including as a regressor the residuals from the original regression:

$$Inf_{it} = \alpha_0 + \varepsilon_{t-1} + \gamma \Delta(CP_{wt}) + (CP_{wt-1}) + \dots + \gamma_n \Delta(CP_{wt-n})$$

The test for Granger causality is an F-test that $\gamma_n = 0$. If $\gamma_n \neq 0$ then there is evidence that CP_{wt-n} is useful in predicting Inf_{it} .⁶⁰

For rainfall, we regress mean Kenyan CPI on the mean of rainfall including residuals in the error-corrected regression:

$$\text{Step 1: } CPI_{it} = \hat{\alpha} + \hat{\beta}(Rain_{it}) + \varepsilon$$

$$\text{Step 2: } Inf_{it} = \alpha + \varepsilon_{t-1} + \gamma_1(\Delta \log Rain_t) + \gamma_2(\Delta \log Rain_{t-1}) + \dots + \gamma_n(\Delta \log Rain_n)$$

$$\text{Test } \gamma_1 \dots \gamma_n = 0$$

Results: Commodity Prices

We find the level commodity price indices and CPI in the three countries to be cointegrated. However, from the Augmented Dickey Fuller tests we reject the hypothesis of a unit root for all the inflation or annual percent change in the commodity price indexes. The annualized log of all commodity prices and inflation are found to be integrated of order one for both the monthly and quarterly inflation and commodity price data (where the index itself, and not inflation, is taken to be the level). All have a unit root, but first differences are non-stationary.

⁵⁹ This analysis was only conducted for Kenya, as that was the only country for which we obtained rainfall data.

⁶⁰ Causality can be assumed to run in both directions. Here the East African levels of commodity exports are small enough that we would not expect the price level in Kenya, Uganda, or Tanzania to influence international commodity price movements.

Table 4: Granger Causality Tests

Commodity Index	Monthly data		
	Kenyan CPI (1992-2008)	Tanzania CPI (1995-2010)	Uganda CPI
	Granger causality F-test	Granger causality F-test	Granger causality F-test
Non-fuel commodities	$F(11, 165) = 1.92^*$ p-value = 0.04	$F(11, 174) = 2.60^*$ p-value = 0.00	$F(11, 198) = 2.23^*$ p-value = 0.02
Agriculture raw materials index	$F(13, 163) = 2.07^*$ p-value = 0.02	$F(13, 172) = 1.20$ p-value = 0.28	$F(13, 196) = 3.97^*$ p-value = 0.00
Food commodities index	$F(10, 166) = 2.38^*$ p-value = 0.01	$F(10, 175) = 2.58^*$ p-value = 0.01	$F(13, 196) = 1.71$ p-value = 0.06
All commodities (1995)	$F(12, 164) = 0.79$ p-value = 0.66	$F(12, 173) = 1.56$ p-value = 0.11	$F(12, 197) = 1.51$ p-value = 0.12
Energy Price Index(1995)	$F(13, 163) = 0.94$ p-value = 0.51	$F(13, 172) = 1.62$ p-value = 0.08	$F(4, 208) = 2.09$ p-value = 0.08
Oil Prices (1995-2008)	$F(5, 182) = 5.57^{**}$ p-value = 0.00	$F(4, 182) = 3.60^{**}$ p-value = 0.01	$F(4, 208) = 2.34$ p-value = 0.05
* = significant at a= 0.05 level, ** = significant at a= 0.01 level			

As the test statistics in Table 4 show, we find statistically significant effects for non-fuel commodities in all three countries. The agricultural raw materials index is a significant predictor of inflation in Kenya and Uganda. We find Granger causality from food commodities index to inflation in Kenya and Tanzania and from the petroleum price index to inflation in all three countries. For most of these commodity indices, the effect seems to be strongest with a three- to seven-month lag, although oil prices have faster pass-through (coefficients on one –two month lags are most significant). These results suggest that certain international commodity price movements, especially petroleum prices, a composite non-fuel commodity index, agricultural raw materials and food commodities, are useful indicators for forecasting inflation in East Africa.

Results: Rainfall

Kenya has a strong agricultural base, and staples such as rice, corn, wheat, vegetables and tea are grown and consumed in the country. Food currently makes up 36% of the Kenyan CPI as of 2010, and previously accounted for 50.5%.⁶¹ For the majority of the Kenyan population, locally produced food consumption makes up a large portion of their consumption bundles.

The effect of rainfall on prices is complex, as in theory both lack of rainfall and heavy rains could cause supply shortages and high prices. Heavy rains, for example, could increase transport times and costs. Furthermore, to the extent that ample rains cause bumper crops, a large segment of the population may see increased incomes and consequently increase demand for non-agricultural goods, creating upward pressure on prices. Kenyan producers also may be able to pass along increased costs of inputs when it rains less than expected, since Kenyans perceive lack of rains to be associated with reduced supply of food goods. A squared term of the change in rainfall is included to investigate nonlinearity. We also investigate the impact of drought on inflation. We create a dummy variable for drought of four consecutive months with rain less than 60 mm per month, or for a month with less than 20 mm rainfall.

Figure 8: Kenyan Inflation and Average Rainfall

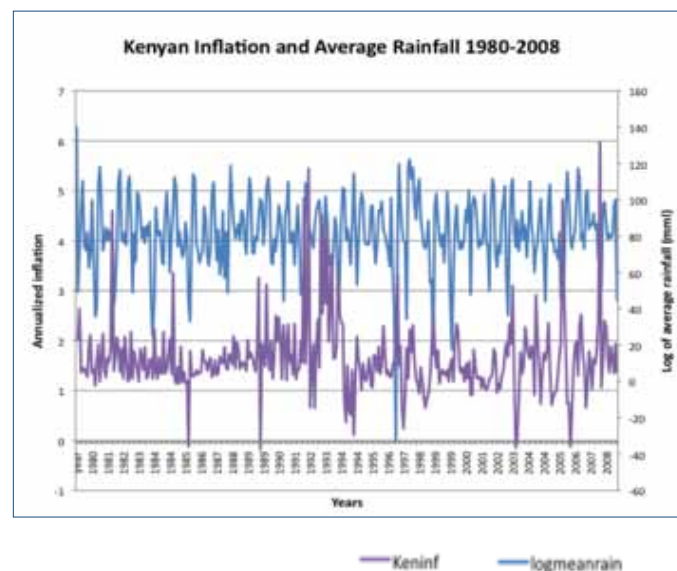


Figure 8 shows change in rainfall and inflation in Kenya. We see some evidence of periods of decreasing rainfall followed by spikes in inflation, and the graph indicates that these $L(1)$ variables follow a stochastic process, which we test with the Augmented Dickey-Fuller procedure. The model with six-month lag of the change in monthly average rainfall shows that Granger causality for the change in rainfall is not statistically significant at the 95% confidence level.

61 Kenya National Bureau of Statistics. 2010. *Economic Survey 2010*. Nairobi: KNBS.

Table 5: Rainfall and Inflation: OLS and VAR Results

Rainfall, Drought and Inflation					
Variable	OLS			VAR	
	(1)	(2)	(3)	(4)	(5)
Kenyan Inflation					
Current month				.1802**	.2034**
				(.0535)	(.0537)
One month lag				.1669**	.3041**
				(.0537)	(.0830)
Change in Rainfall (%)					
Current month	-2.602	-2.003	-2.319		
	(1.730)	(1.988)	(1.856)		
One month lag	-4.478*	-.9886	-1.330	.2192	.22711
	(1.874)	(2.103)	(2.211)	(1.847)	(1.994)
Two month lag	-3.584	-.6142	-2.445	.8926	-4.817
	(2.074)	(2.232)	(2.295)	(1.944)	(2.816)
Three month lag	-8.435**	-5.7698*	-7.375**	-4.77**	-6.654**
	(2.308)	(2.402)	(2.438)	(1.954)	(2.075)
Four month lag	-5.353*	-3.346	-4.211	-2.322	-3.050
	(2.074)	(2.129)	(2.120)	(1.880)	(1.933)
Five month lag	-3.452	-1.915	-2.889	-.5937	-1.574
	(1.868)	(1.887)	(1.912)	(1.714)	(1.735)
Six month lag	-4.013*	-3.219*	-3.650*	-2.621	-3.293*
	(1.697)	(1.684)	(1.688)	(1.56)	(1.575)
Drought dummy					
Current month		3.058			
		(3.491)			
One month lag		10.754 **	11.942**	12.346**	13.140**
		(3.481)	(3.328)	(3.34)	(3.347)
Two month lag				-3.635	-6.811
				(3.504)	(3.527)
* = significant at a= 0.05 level, ** = significant at a= 0.01 level					

Table 5 presents more detailed results for ordinary least squares regressions (OLS) and vector autoregressions (VAR) of the percent change in rainfall, the drought dummy, and the change in rainfall squared. When only the change in rainfall is included, lags of one month, three months, four months, and six months are significant and show that a one percent increase in the change in average monthly rainfall is associated with reduction in inflation, with the resulting change in inflation dependent on the lag time considered. When drought and the change in rainfall squared terms are added, change in rainfall has the strongest effect three months after a change in rainfall.

The dummy variable for drought is highly significant with a one-month lag: as defined, a drought is associated with on average a 10-13% increase in inflation. When squaring the change in rainfall, coefficients become too small to be very informative. This is not enough information to make conclusions about the functional form, but further research could test the robustness of this model and fit a better model to the data. Results for VAR equations are similar: the three- and six-month lag variables are significant, and the one-month lag on the drought dummy remains highly significant.

These results suggest that rainfall is a good leading indicator for inflation in Kenya. Certainly, the presence of drought seems to be a clear warning sign that price increases can be expected in Kenya.

Implications for Monetary Policy

These findings have implications for inflation forecasting and, consequently, for the EAC central banks' abilities to effectively employ forecast-based monetary policy. They suggest that factors outside the control of the central banks – namely international commodity prices and rainfall – play an important role in determining inflation. Thus, one should be cautious in expecting the EAC central banks to be able to completely control inflationary pressures using monetary policy.

If the EAC countries move towards IT, either individually or together as the EAMU, this research suggests that supply-side factors that cannot be influenced by the central bank may make it hard to achieve targets in the face of shocks. If IT were implemented, these results suggest that using central banks should consider using a core inflation measure, as that could likely be managed using monetary policy more easily.

However, core inflation would not be as representative of the actual prices consumers face. The EAC central banks should therefore consider calculating core inflation in addition to, and not as a substitute for, headline inflation.

Developing and Communicating a Subjective Forecast Distribution

There are many methods available for developing a forecast and an accompanying distribution, from judgmental techniques to statistical models (such as vector autoregressions) to DSGE models. Of those, here we focus on judgmental techniques; in particular, this section presents a methodology to formalize and communicate a judgmental assessment of the risks and uncertainty around a forecast. The methodology presented here is therefore particularly relevant for use by central banks in developing countries, as it is well suited for use in environments in which economists have a deep knowledge of the economies in which they operate but have not yet built robust statistical models to forecast inflation. It can be used in lieu of a more objective forecasting model while one is being constructed and can continue to be used as a complement to objective forecasting techniques once those are developed.

This section first briefly describes the methodology and then discusses ways in which it can be used by the EAC central banks. The methodology presented is one that is currently used by economists at the Federal Reserve Bank of New York (FRBNY) to use judgments about the economy to construct and communicate a subjective forecast distribution.⁶²

In the methodology, the forecaster already has period-by-period point forecasts for inflation and GDP, which he or she can have developed either judgmentally or using a model. A point forecast for GDP or inflation can be thought of as the mode of an implicit joint probability distribution over all possible GDP and inflation outcomes; thus, the methodology assumes the point forecasts are the modes of jointly normal distributions, with standard deviations based on the historical root mean squared errors of the forecasts.⁶³ Call this distribution the “central scenario” – that is, the scenario that is most likely to occur.

Following this methodology, the forecaster also forecasts possible alternatives to the central scenario that he or she

believes have a not insignificant probability of occurring but that are not as likely as the central scenario (these can be thought of as shocks) – for example, unexpectedly high global demand, which would cause realizations of output and inflation that are higher than would generally be predicted under the “central scenario.” In a simple version of the methodology, the forecaster could have up to six of these “alternative scenarios,” with each representing a unique combination of inflation and/or output above or below the point forecast in the central scenario. Each of these alternative scenarios would then be characterized by truncated normal distributions for inflation and output that are truncated above or below the mean in the central scenario.

Finally, the forecaster then defines a transition matrix for the scenarios – in other words, the probability that the economy will move between these scenarios in a given period. Once these have been defined, the central and alternative scenarios and the transition matrix can be fed through a simulation exercise. In particular, the path of the economy from the current period through the forecast horizon is simulated 10,000 times. The methodology assumes the economy starts in the current period in the central scenario; in each simulation, in each subsequent period, the simulation draws a random number to determine if the economy leaves the central scenario for one of the alternative scenarios, with the probability of that occurring given by the transition matrix. This produces 10,000 “scenario paths” that define which scenario the economy was in for each period of each of the 10,000 simulations. For each period in each simulation, inflation and output realizations are then drawn from a distribution defined by the scenario the simulation was in for that period. This produces 10,000 accompanying paths for inflation and 10,000 accompanying paths for output. See Appendix III for a more detailed description of the methodology just described.

The output from this program can then be used to produce various graphs depicting the forecaster’s judgmental assessment of the economy. For example, all 10,000 paths for inflation can be lined up in order for each quarter and used to calculate and depict confidence intervals of interest, as in Figure 9.⁶⁴ Alternatively, the paths can be grouped according to which, if any, alternative scenario they entered, and then inflation could be averaged across

62 A forthcoming working paper by Simon Potter and Kristin Mayer will discuss this methodology at length.

63 As each EAC central bank may not have a lengthy forecast history from which to determine this standard deviation, they could each use each other’s forecast history, or other Sub-Saharan African countries’ forecast histories.

64 In this and other figures, for simplicity, the inflation forecast is constant across the forecast horizon. The methodology presented here does not force this to be the case, and in fact, in most cases it will vary period by period. The figures included in this section depict forecasts that are constant over the forecast horizon. This will almost never actually be the case, but is depicted as such for simplicity.

each path in a group to depict the expected path of inflation under a given scenario, as in Figure 10.⁶⁵

Figure 9

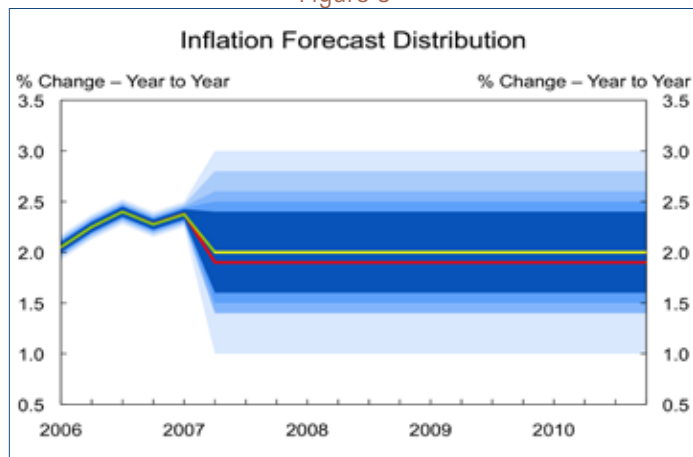
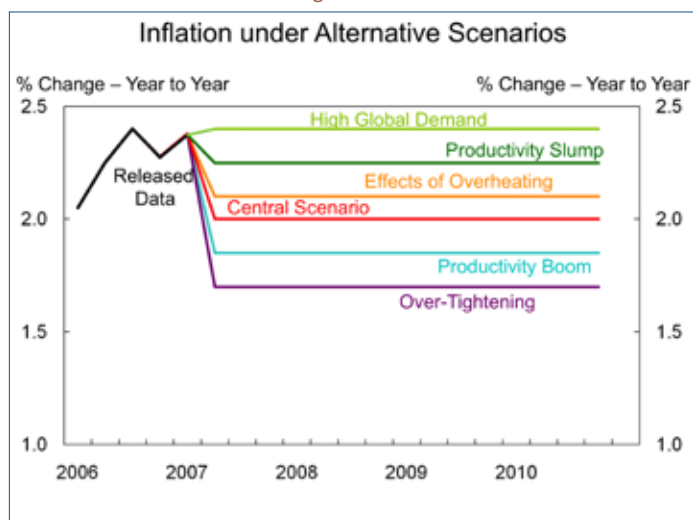


Figure 10



As noted earlier in this report, the EAC banks are considering moving toward forecast-targeting monetary policy frameworks. As they begin to shift to such regimes, they will need more devices for thinking systematically about the forecast and about the associated balance of risks and uncertainty. In Kenya, in preparation for that move, the central bank is working on developing a macro model to forecast macro variables, but it does not yet have one. In the meantime, the advantage of the methodology presented here is that it does not require a formal forecasting

65 In this example, there are five alternative scenarios considered, and the distributions associated with them are defined in a slightly more complicated than described here. They are still truncated normals, but the truncation point and the standard deviation vary by scenario to produce greater variety of possible paths for inflation.

model, only a deep understanding of the macroeconomic environment in the country. IMF working papers have in fact noted that, in the beginnings of an IT regime, forecasting can be based entirely on judgment and not refer to any formal forecasting model.⁶⁶

Using this methodology, both until a more formal forecasting model is developed and as a complement to formal models once one is developed, has many applications to monetary policymaking in the EAC countries. First and foremost, if central banks do not have a good mechanism for discussing uncertainty, it may mean they are not setting monetary policy at the optimal level to guard against potential downside or upside shocks. This methodology gives them such a mechanism.

Second, this methodology allows for the forecast distribution and other aspects of forecasters' uncertainty assessments to be communicated easily to others, including non-economists. To make informed decisions, the monetary policy committee, which is likely not comprised entirely of academic economists, as in many of the EAC countries, needs a clear picture of the range of knowledge the forecasters have that is pertinent to the monetary policy decision. An understanding of uncertainty and the balance of risks are essential for making monetary policy decisions, and research shows that monetary policy committees understand and want this.⁶⁷ This model allows for those to be communicated alongside the standard point forecast in graphs that are straightforward and easy to understand.

In addition, if the EAC countries move to a forecast-targeting framework, they will also need to communicate their forecasts to the public. The methodology presented here gives them a clear and simple way to do so, and it has the additional advantage of de-emphasizing the point forecast, and instead emphasizing the full range of possible outcomes (e.g. by showing Figure 9). This prevents the public from putting more weight on the central bank's point forecast than it actually merits given that it is just one possible outcome from a larger forecast distribution.

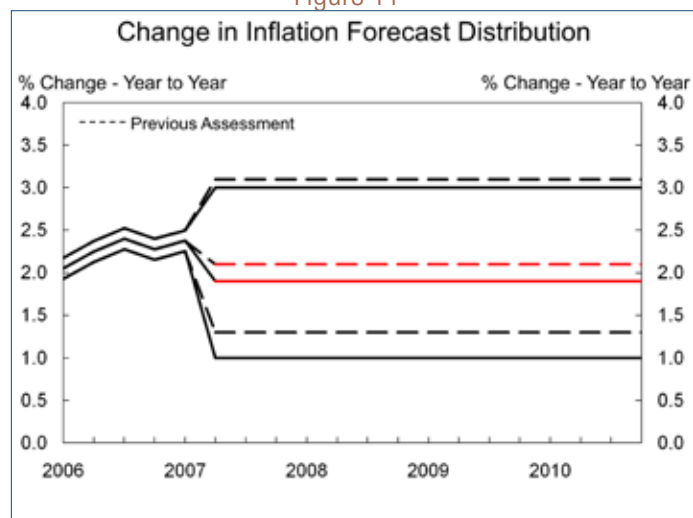
66 Of course, they also note the importance of eventually developing a core macro model to support the inflation-targeting regime, but this can be developed over time. Laxton, D. 2009. "Developing a Structured Forecasting and Policy Analysis System to Support Inflation-Targeting (IFT)." IMF Working Paper 09/65.

67 Robertson, J. (2000). "Central Bank Forecasting: An international comparison." Federal Reserve Bank of Atlanta *Economic Review* Second Quarter 2000.

It also means the central bank is held accountable for producing inflation, output and other forecasted variables within a range of possible values rather than at a single specific value.

There are several ways in which the EAC central banks can incorporate the outputs from the methodology presented in this section into their policy processes. Most fundamentally, they can use it to augment existing communication devices between their research departments and their Monetary Policy Committees. In meetings to discuss the forecast, Research could use some of the figures that appear in this paper. They can also use the output from the methodology to produce other charts of use – for example, a chart showing how the balance of risks has shifted since the MPC last saw the forecast (Figure 11)⁶⁸ or a chart showing optimal central bank behavior under different scenarios (Figure 12).⁶⁹

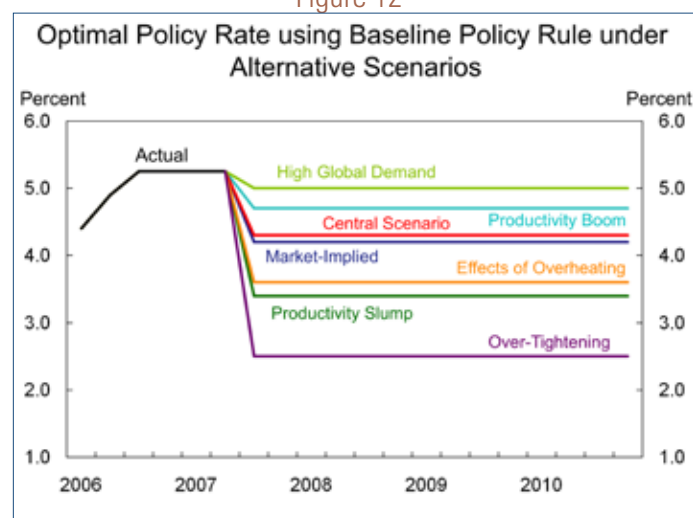
Figure 11



68 This pictures the point inflation forecast and the 5th and 95th percentiles from the inflation forecast distributions for the current and previous assessments.

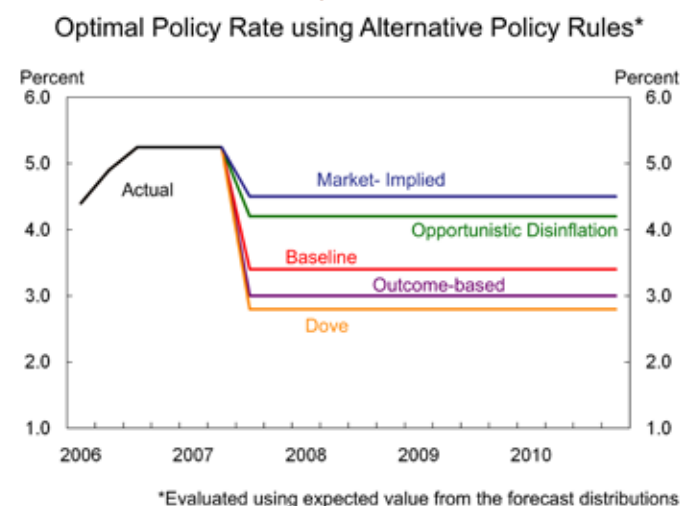
69 In this figure, average paths for the economy under each of the scenarios (i.e. the paths pictured in Figure 2) are fed through a “baseline” policy rule that calculates the optimal policy rate based on a possible set of policymaker preferences (in this example, it assumes some smoothing of the policy rate and places a somewhat higher weight on deviations of inflation from the assumed goal than on deviations of output from potential).

Figure 12



As the EAC countries move toward their goal of forming a monetary union (discussed in detail in Section III), it will be necessary for the central banks in each country to begin to harmonize their policymaking processes in anticipation of ultimately forming a single central bank. One aspect of this will be increasing communication between the different central banks, for which they will need a common framework for discussing monetary policy. This methodology gives them one tool for this discussion, as its outputs allow for comparisons of optimal central bank behavior across the different scenarios that the different central banks may judge most likely (Figure 12) or across the same forecast but using the central banks’ different loss functions (Figure 13).⁷⁰

Figure 13



70 In this figure, the expected value from the forecast distribution from inflation is fed through different loss functions that reflect different assumptions about policymaker preferences (here, those rules differ primarily in terms of the relative weights they place on inflation and output gaps).

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Appendix I

Convergence Criteria and Fiscal Compliance in Existing Monetary Unions and EAC

Table A1: EAC Macroeconomic Convergence Criteria⁷¹

Stage 1 (Year 2007-2010):

Primary Criteria

- a) Overall Budget Deficit to GDP Ratio (excluding grants) of not more than 6.0 percent, and Overall Budget Deficit to GDP Ratio (including grants) of not more than 3.0 percent;
- b) Annual Average Inflation Rate not exceeding 5 percent; and
- c) External Reserves of more than 4 months of imports of goods and non-factor services.

Secondary Criteria

- a) Achievement and maintenance of Stable Real Exchange Rates;
- b) Achievement and maintenance of Market Based Interest Rates;
- c) Achievement of sustainable Real GDP Growth Rate of not less than 7.0 percent;
- d) Sustained pursuit of debt reduction initiative on domestic and foreign debt i.e. reduction of total debt as a ratio of GDP to a sustainable level;
- e) National Savings to GDP Ratio of not less than 20 percent;
- f) Reduction of Current Account Deficit (Excluding grants) as a percentage of GDP to sustainable level consistent with debt sustainability;
- g) Implementation of the 25 Core Principles of Bank Supervision and Regulation based on agreed Action Plan for Harmonization of Bank Supervision; and

- h) Adherence to the Core Principles for Systematically Important Payment Systems by modernizing payment and settlement systems.

Stage II (2011-2014)

Primary Criteria

- a) Overall budget deficit to GDP Ratio (excluding grants) not exceeding 5 percent; and Overall Budget deficit to GDP Ratio (including grants) not exceeding 2 percent;
- b) Annual average inflation rate of not more than 5 percent;
- c) External reserves of more than 6 months of imports of goods and non-factor services.

Secondary Criteria

- a) Maintenance of market-based interest rates;
- b) Maintenance of high and sustainable rate of real GDP growth of not less than 7.0 percent;
- c) Sustained pursuit of debt sustainability;
- d) Domestic savings to GDP ratio of at least 20 percent;
- e) Maintenance of sustainable level of current account deficit (excluding grants) as percentage of GDP; and
- f) Achievement of sustainable growth rate of real GDP of not less than 7.0 percent.

Stage III (2015)

Introduction and circulation of a single East African Currency

71 Source: ECB 2010; information cited by ECB from the Monetary Affairs Committee report "Achievements, Challenges and Way Forward (1998-2008)", January 2009. For a table of quantitative fiscal guidelines of the Eastern Caribbean Central Bank, the European Union, and the West African Economic and Monetary Union, please see Table 2 in Kufa et al. (2003).

Table A2a: Excessive Deficit Procedures by Period in the European Monetary Union⁷²

	Period 1 ⁷² : Original Excessive Deficit Regulation 1/1999-11/2003	Period 2 ⁷³ : Transition 12/2003-6/2005	Period 3 ⁷⁴ : Amended Excessive Deficit Regulation 7/2005-Present
Excessive Deficit Procedures:	Portugal (9/2002-5/2004)		
	Germany (11/2002-6/2007)		
	France (4/2003-1/2007)		
		The Netherlands (4/2004-6/2005)	
		Greece (5/2004-6/2007)	
			Italy (6/2005-6/2008), Portugal (6/2005-6/2008), France (2/2009-present), Greece (2/2009-present), Ireland (2/2009-present), Spain (2/2009-present), Malta (5/2009-present), Italy (7/2009-present), The Netherlands (7/2009-present), Austria (7/2009-present), Belgium (7/2009-present), Portugal (7/2009-present), Slovenia (7/2009-present), Germany (10/2009-present), Slovakia (10/2009-present), Cyprus (5/2010-present), Finland (5/2010-present)

72 Source: European Commission, Economic and Financial Affairs, Stability and Growth Pact: Country-Specific Procedures: http://ec.europa.eu/economy_finance/sgp/deficit/countries/index_en.htm. Note: The EMU had 11 members in 1999, 12 by 2001, 13 by 2007, 15 by 2008, and 16 by 2009.

73 Period 1 begins with the start of the Eurozone on January 1, 1999 and concludes with the Ecofin Council's November 25, 2003 rejection of the EU Commission's recommendation to begin Excessive Deficit Procedures against Germany and France.

74 Period 2 begins after the November 25, 2003 Ecofin Council decision. Period 2 includes litigation over that Ecofin decision at the European Court of Justice (decided July 13, 2004). Period 2 also covers the negotiations up until the adoption of the Amended Excessive Deficit Regulation on June 27, 2005.

75 Period 3 encompasses all Excessive Deficit Procedures under the Amended Excessive Deficit Regulation.

Table A2b: Adverse Credit Events by American States⁷⁶

State	Year	Adverse Credit Event
Arkansas	1841	Partially Repudiated ⁷⁶
Florida ⁷⁷	1841	Totally Repudiated
Michigan	1841	Partially Repudiated
Mississippi	1841	Totally Repudiated
Indiana	1841	Temporary ⁷⁸ Default
Pennsylvania	1842	Temporary Default
Maryland	1842	Temporary Default
Illinois	1842	Temporary Default
Louisiana	1843	Partially Repudiated
Minnesota	1859	Partially Repudiated
North Carolina	1870	Partially Repudiated
Florida	1872	Totally Repudiated
South Carolina	1873	Partially Repudiated
D.C.	1874	Federal Bailout
Louisiana	1874	Partially Repudiated
Georgia	1875	Totally Repudiated
Alabama	1876	Partially Repudiated
Arkansas	1877	Totally Repudiated
Tennessee	1879	Partially Repudiated
Virginia	1879	Partially Repudiated
Virginia	1882	Partially Repudiated
Arkansas	1884	Totally Repudiated
Arkansas	1932	Temporary Default

76 Sources: William B. English, "Understanding the Costs of Sovereign Default: American State Debts in the 1840s," *American Economic Review* 86(1996): 259, 265 t.3; B.U. Ratchford, *American State Debts* (Durham: Duke University Press, 1941), 184-191, 203-10, 230-32, 245-47, 383-406.

77 "Repudiation" does not refer to all state debts, but only to those debts affected by the Adverse Credit Event.

78 In 1841, Florida was still a territory.

79 "Temporary" in this table refers to a delay of 3 to 6 years.

Appendix II

Kenyan Bond Market

This appendix provides more information about the Kenyan bond market data discussed in Section IV B. We obtained data from the Nairobi Stock Exchange, which operates the secondary market for government bonds in Kenya, covering all trades between January 2008 and November 2010. The data include price, volume, and yield-to-maturity for each trade, as well as issuance information for all outstanding bonds. The following tables and figures summarize issuance and trading.

Table A3: Annual government bond issuance in Kenya⁸⁰

Tenor	2002		2003		2004		2005		2006		2007		2008		2009		2010	
	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value	#	Value
1	4	13.1	4	10.4	3	10.0	8	27.0			2	8.1	1	3.0	2	10.0		
1.5	1	4.0																
2	5	22.9	6	14.6	4	14.9	3	12.3	4	19.0	3	11.7	3	16.0	1	6.0	3	26.1
3	6	22.9	4	16.3	5	17.1	3	10.8	2	12.8	2	6.9						
4	2	10.0	3	12.0	2	6.5	1	3.6	3	9.6	1	3.4						
5	1	7.0	4	14.3	1	3.6	1	6.1	2	7.9	2	5.4	4	24.1	2	15.0	1	12.0
6	1	3.0	3	15.0	3	11.0	1	4.7	2	14.0	2	11.7						
7			1	3.0	2	4.9	1	3.9	1	3.2	1	2.3	1	8.0				
8			1	4.0	1	1.5			1	3.2	1	2.3						
9			1	4.0	1	7.2			1	3.0								
10			1	2.7	1	5.9			1	5.1			2	14.3	4	36.0	3	10.6
11											1	3.9						
12											2	8.8			1	18.5		
15											2	11.1	2	14.4			1	10.4
20													1	7.5	1	13.0		
25																	1	15.0
Value	82.9		96.3		82.6		68.4		77.8		75.6		87.3		98.5		74.1	
Tenor	2.733		4.299		4.494		2.696		4.683		6.779		8.253		9.533		10.111	

80 Note: Values in Ksh. billions. Last rows report total value issued and weighted average tenor. Data for 2010 go through November only. Sources: Capital Markets Authority (Kenya), Central Bank of Kenya, Nairobi Stock Exchange, authors' calculations.

Table A4: Size and turnover of government bond market in Kenya⁸¹

Daily averages	2008	2009	2010
Number of bond issues outstanding	65.4	64.4	59.3
Value of bonds outstanding (Ksh billions)	306.7	323.1	364.2
Number of bond issues traded	3.5	5.1	9.6
Number of trades	4.0	6.3	15.0
Value of bonds traded (Ksh millions)	281.5	392.1	1,636.1
Average trade size (Ksh millions)	72.4	74.0	113.9

Figure A1: Monthly trade volume of government bonds in Kenya⁸²

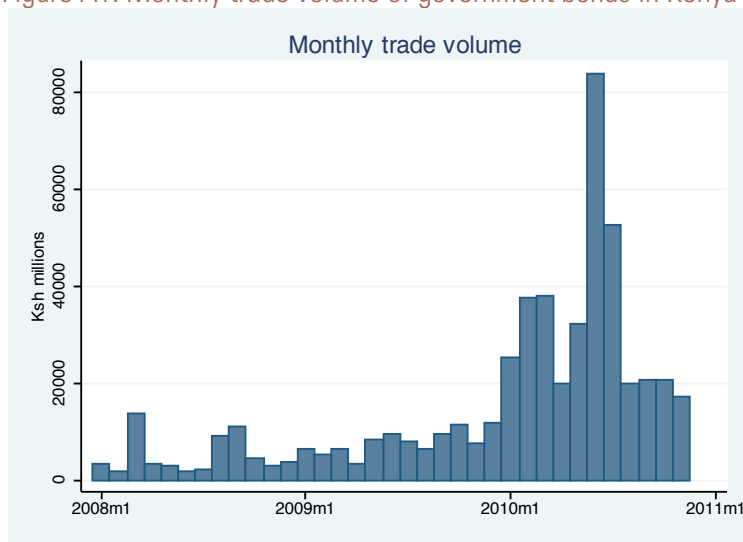
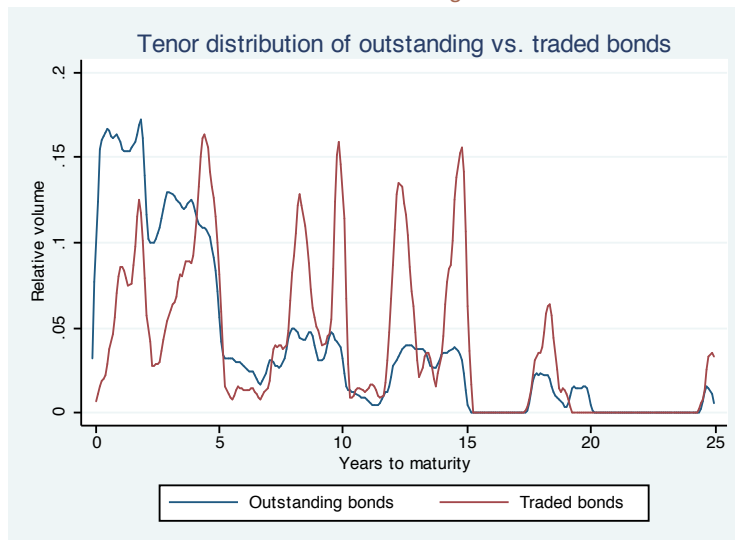


Figure A2: Tenor distribution of outstanding and traded bonds in Kenya⁸³



81 Note: Averages for 2010 are calculated through November only. Sources: Nairobi Stock Exchange, author's calculations.

82 Source: Nairobi Stock Exchange, authors' calculations.

83 Note: Kernel density plots of data from January 2008 to November 2010. Sources: Nairobi Stock Exchange, authors' calculations.

Appendix III

Constructing a Subjective Forecast Distribution

The Research Group at the Federal Reserve Bank of New York uses a methodology that is a generalization of techniques used by the Bank of England (BoE) to construct its subjective forecast distribution. The methodology uses a characterization of the most likely paths of inflation and output and judgments about what shocks may hit the economy and affect those paths and the likelihood of those shocks to construct an aggregate forecast distributions for inflation and output. As this is just a methodology that formalizes and allows easy communication of a forecaster's judgment about the economy, rather than carefully modeling the workings of the economy, the FRBNY uses the subjective forecast that this produces as a complement to, rather than a substitute for, more objective or formal forecasting techniques.

Three components underlie the methodology: (1) a “central scenario” characterized by distributions around the forecasters' modal forecasts for inflation and output; (2) “alternative scenarios”, which are essentially the forecaster's assessment of different shocks that could hit the economy, with their own distributions for output and inflation; and (3) a transition matrix that describes the economy's movement between those scenarios. Through these components, two types of uncertainty about the future of the economy are captured. The first is uncertainty over what scenario the economy will be in – whether it will proceed along a path the forecaster can foresee or whether shocks (e.g. productivity or demand shocks) will hit the economy and put it on a different path. This is captured by the fact that there is not only a central scenario but also several alternative scenarios. The second type of uncertainty is uncertainty over exactly what path the economy will follow when it is in a given scenario. This is captured by the fact that each scenario is characterized not by specific paths for inflation and output, but rather by distributions for inflation and output.

Together, the three components listed above define the forecasters' judgment about the current macroeconomic situation in the country. These are then used in an exercise that simulates paths for output and inflation over the forecast horizon. In each period of each simulation, the economy “enters” one of the scenarios, where “being in a scenario” in a given period means the output and inflation outcomes for that period are chosen according to the definition of the scenario. The transition matrix determines how the economy enters and moves between the scenarios in a given simulation. Below we describe each of the three components and the simulation exercise in more detail.

The *central scenario* is what the forecasters believe is the most likely outcome for the economy. Use of the word “scenario” is meant to underscore that it is only one of several possible outcomes for the economy. The central scenario is characterized by a jointly normal distribution for inflation and output centered on the central banks' point forecast.⁸⁴ At long enough forecast horizons, the point forecast will generally have output and inflation at what the forecaster assumes to be the economy's potential output growth and at the inflation goal the central bank uses in its loss function, respectively. The standard deviations of the two distributions are based primarily on the historical root mean squared errors of the central bank's forecast, and they increase over the forecast horizon to represent the fact that periods farther in the future are more uncertain.

The *alternative scenarios* represent the other possible outcomes for the economy (essentially, shocks that could occur in the future). Possible alternative scenarios could be, for example, that the economy experiences the effects of higher-than-expected global demand or that the economy suffers unexpectedly from the central bank's accidental over-tightening of monetary policy in past periods. In this methodology, the alternative scenarios are defined in terms of how they differ from the central scenario – specifically, they are characterized by truncated normal distributions for inflation and output, with the truncation occurring at the mean of the central scenario distributions and capturing either the upper half or lower half of the central scenario distribution, depending on how the alternative scenario is defined. In a high global demand scenario, for example, conditions in other countries could cause them to demand more home-country exports than forecasters predicted. This would cause home-country output to be higher than forecast and would likely put upward pressure on prices, causing home-country inflation to also be higher than forecast. This scenario, then, would be characterized by distributions for output and inflation that are scaled-up versions of the upper halves of the central scenario distributions.

The *transition matrix* is a matrix of probabilities representing the forecasters' judgment about how the economy will likely move between scenarios, which is essentially the forecaster's assessment of the likelihood of different shocks occurring. If, for example, the forecaster thought that in any given period over the forecast horizon there was a 25% chance that there

84 As noted previously, the point forecast can be produced either judgmentally or using a forecasting model.

would be a positive shock to consumption that would increase global demand, this would be represented in this model as the forecaster placing a 25% probability on the event of the economy moving from the central scenario to some sort of “high global demand” scenario in any given quarter. An example of a transition matrix is pictured in Table A5.

Table A5: Transition Matrix

	Central Scenario	Alternative 1	Alternative 2
Central Scenario	0.5	0.25	0.25
Alternative 1	0.4	0.6	0
Alternative 2	0.3	0	0.7

As shown in Table A5, each row and column of the matrix represents the central or one of the alternative scenarios, and each cell of the matrix represents the probability that the economy will leave the “row” scenario and enter the “column” scenario. On the diagonal are the probabilities that the economy will remain in the current scenario, and the probabilities in each row sum to 1. The probabilities along the diagonal can be thought of as signifying the “persistence” of a given scenario, while the probabilities of moving from the central scenario to an alternative scenario can be thought of as the “initial probability” of a given shock. In the example pictured in Table A5, if the economy is in the central scenario in a given period, there is a 50% chance it will remain in the central scenario in the next period, a 25% chance it will leave the central scenario and enter Alternative Scenario 1, and a 25% chance it will leave the central scenario and enter Alternative Scenario 2.

As noted above, the transition matrix is primarily completed according to the forecaster’s judgment about the future of the economy. There are, however, a few assumptions made about the transition matrix in this methodology. First, it is assumed that the economy always begins the simulation in the central scenario.⁸⁵ In each period following it can either remain in the central scenario or

enter one of the alternative scenarios, with the probability of either of those events given by the transition matrix. Once the economy enters an alternative scenario, in each period following it can either remain in that alternative scenario or return to the central scenario. Once the economy returns to the central scenario, it remains there with certainty for the remainder of the forecast horizon (i.e. in the example in Table A5, the value of cell (1,1) would be set to 1 and all other values would be set to 0). Other than the change that occurs in the transition matrix when the economy returns to the central scenario from an alternative scenario, the transition matrix is assumed to remain unchanged over the forecast horizon.⁸⁶

The fact that the economy returns to the central scenario after experiencing a shock reflects some assumptions about the long-term mechanisms at work in the economy. First, it reflects the assumption that shocks to the economy do not fundamentally alter the long-term trend of the economy. Second, while there is no explicit transmission mechanism for monetary policy built into this methodology, that feature is meant to mimic the behavior of an economy in which the central bank has sufficient credibility to achieve its long-run inflation goal while pursuing a short-run stabilization policy. These are features that the EAC countries may want to re-examine if they adopt this methodology. In developing countries shocks have sometimes been observed to be much more persistent and sometimes to even affect the long-term trend of the economy.⁸⁷ This likely means the assumption that the effects of a shock would decay over a reasonable forecast horizon (e.g. three to four years) would not be appropriate in a developing country environment. Instead, the EAC central banks may want to increase the persistence of alternative scenarios in their model set-up (i.e. increase the probabilities on the diagonal of the transition matrix). Alternatively, they could modify the model such that when the economy enters an alternative scenario, there is some probability that it never returns to the central scenario, thus allowing for the possibility that some shocks will affect the long-term trend of the economy.

The previous three components are then used to define an exercise that simulates the future path of the economy. In this simulation exercise, the path of the economy from the current quarter through the forecast horizon is simulated 10,000 times. As noted above, in each simulation the economy begins in the central scenario. From there, for each quarter, random numbers are drawn that indicate, according to the transition matrix, if the economy

85 The simulations begin in the current quarter, and we believe we are certain enough about the current state of the economy to assume output and inflation in the current quarter will be as reported by the national statistics agency, plus or minus a margin of error determined by the history of data revisions.

86 This assumption is made mainly for the sake of simplicity.

87 Aguiar, M. and G. Gopinath. 2007. “Emerging Market Business Cycles: The cycle is the trend.” *Journal of Political Economy* 115(1).

remains in the central scenario or enters an alternative scenario and if, from there, it remains in that alternative scenario or returns to the central scenario. For each period in each simulation, inflation and output are then jointly drawn from distributions according to which scenario the economy is in.

To give a concrete example, imagine a given simulation of ten quarters of the economy had the economy in the central scenario for the first three periods, in a “high global demand” scenario for the next four periods, and then back in the central scenario for the remaining three periods. For the first and last three periods of that simulation, the values for inflation and output would be drawn from jointly normal distributions centered on the central banks’ point forecast. For the middle four periods, the values for inflation would be drawn from a distribution with values above the central banks’ point forecast for inflation and the values for output would be drawn from a distribution with values above the point forecast for output.

The result of the simulation exercise, then, is 10,000 paths indicating what scenarios the economy was in for each period of each simulation, 10,000 associated paths for inflation, and 10,000 associated paths for output. These essentially represent the forecasters’ forecast distribution, and the different paths can be used to produce many different depictions of that distribution.

