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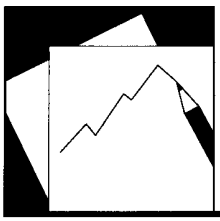

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Fiscal and Monetary Anchors for Price Stability: Evidence from Sub-Saharan Africa

Alfredo Baldini and
Marcos Poplawski Ribeiro

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Fiscal and Monetary Anchors for Price Stability: Evidence from Sub-Saharan Africa

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Abstract

The paper presents a model of fiscal dominance with borrowing constraints, and provides evidence for a large number of sub-Saharan African countries on the relative importance of fiscal and monetary determinants of inflation. Based on the dynamic response of inflation to different shocks, including nominal public debt, results show that a number of SSA countries were characterized throughout the period 1980–2005 either by chronic fiscally dominant regimes, with weak or no response of primary surpluses to public debt; or by a consistent adoption of a monetary dominant regime. However, a number of countries were also characterized by lack of a clear monetary and fiscal policy regime. The study also finds that changes in nominal public debt affect price variability via aggregate demand effects, suggesting that fiscal outcomes could be a direct source of inflation variability, as predicted by the fiscal theory of the price level.

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I. INTRODUCTION

Do fiscal considerations and commitment drive the choice of monetary policy and exchange rate regime? How does an unsustainable fiscal policy affect price stability? The classical view (Sargent and Wallace, 1981), which is rooted in the quantity theory of money (QTM), is that fiscal deficits cause inflation because governments that run persistent fiscal deficits tend, over time, to resort to money creation to finance the deficits. Thus, inflation is always and everywhere a monetary phenomenon.

However, according to more recent studies leading to a fiscal theory of price level (FTPL), money creation may not be the only channel through which fiscal policy becomes dominant and budget deficits cause inflation.[4] This theory argues that a fiscal dominant (non-Ricardian) regime may arise when fiscal policy is not sustainable and government bonds are considered net wealth (Woodford, 1998). These wealth effects could jeopardize the objective of price stability, irrespective of central bank commitment to low inflation. The implication is that in non-Ricardian regimes it is fiscal, not monetary, policy that determines the price level and becomes the nominal anchor. The FTPL therefore challenges the conventional wisdom dictated by the QTM, which implies that Ricardian regimes are the norm and that sooner or later fiscal policy will have to adjust to guarantee the solvency of the government intertemporal budget constraint.

These competing views of the interaction between monetary and fiscal policy and their effects on price stability are very relevant for policy makers. In the classical QTM view, in Ricardian regimes it is the demand for liquidity and its evolution over time that determines prices. In such a regime fiscal policy is passive, which implies that government bonds are not net wealth (Barro, 1974), and monetary policy works through the interest rate or another instrument to determine prices. In the FTPL view, a non-Ricardian regime will prevail whenever fiscal policy becomes active and does not accommodate or adjust primary surpluses to guarantee solvency of the public sector. As a result, the Ricardian equivalence breaks down, and the increase in nominal public debt to finance persistent budget deficits is perceived by private agents as an increase in nominal wealth. Within this regime, the only way to make the government's fiscal policy sustainable is through "debt deflation"—an increase in prices that erodes the real value of public debt and in turn the real value of financial wealth until demand equals supply and a new equilibrium is reached.[5] Here prices are determined by fiscal policy, and inflation becomes in essence a fiscal phenomenon.

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[4] The fiscal theory of price level (FTPL) was developed by Woodford (1994, and 1998), Leeper (1991), Sims (1994), and Cochrane (1998, and 2000). For the extension of the FTPL to an open economy, see Daniel (2001), Loyo (1998, 1999), Canzoneri, Cumby, and Diba (2001), and Dupor (2000).

[5] Burnside, Eichenbaum, and Rebelo (2003) provide empirical evidence that, at least in the first few years after a currency crisis, debt deflation and implicit fiscal effects are more important than seigniorage in causing inflation.

Against this theoretical background, the paper assesses the empirical plausibility of both Ricardian and non-Ricardian regimes on a large dataset.[6] In doing so:

- It provides evidence of the interaction between fiscal and monetary policy for a large sample of sub-Saharan African (SSA) countries, where the adoption of different monetary and exchange rates regimes has posed different challenges to the monetary and fiscal authorities;

- It proposes an econometric procedure to identify whether a given country is dominated by a fiscal or monetary regime, thus helping to gauge the main fiscal and monetary determinants of the inflationary process;

- It creates a comprehensive database of fiscal and monetary outcomes for 22 major SSA countries, including domestic debt; and

- It highlights the policy implications for achieving and maintaining price stability in the SSA region, where coordination between monetary and fiscal authorities is often hampered by poor public financial management and inadequate monetary institutions.

The rest of the paper is organized as follows: Section II reviews fiscal and monetary outcomes and inflation in a large group of SSA countries, controlling for different types of exchange rate arrangements and monetary integration. Section III discusses the various theories explaining the underlying causes of fiscal-dominant regimes and why lack of coordination between monetary and fiscal policy could threaten price stability. To bring this analysis to the reality of the SSA region, this section presents a simple model that emphasizes the role of fiscal policy in determining prices in a small open economy facing borrowing constraints.[7] Section IV describes the econometric methodologies used to test the empirical predictions of the model and to differentiate between monetary and fiscal dominance. Section V describes the dataset and discusses the results and policy implications for achieving and maintaining price stability in the SSA region. Section VI draws conclusions.

[6] To the best of our knowledge, this is the first attempt to test empirically the predictions of the FTPL for a large sample of Sub-Saharan African countries. Previous empirical studies of the FTPL included: Canzoneri et al. (2001), and Sala (2004) for the USA; Fialho and Portugal (2005), Loyo (1999), and Tanner and Ramos (2002) for Brazil; and Zoli (2005) for a number of emerging markets.

[7] In countries with thin capital markets, and inefficient tax systems, such it is found in the SSA region, the recourse to seigniorage to finance government deficits is typically higher. See Grilli, Masciandaro, and Tabellini (1991).

II. Inflation, Fiscal Outcomes, and Monetary Aggregates in sub-Saharan Africa: Stylized Facts

Over the last two to three decades, the SSA region has been characterized by long periods when fiscal discipline was lacking. As a result, persistent budget deficits and a large stock of nominal public debt increased the possibility of creating inflation out of fiscal imbalances. Figure 1 plots the overall budget balance and inflation for a sample of 34 SSA countries, during 1980–2004. To see if these two variables are correlated, the annual average of inflation (measured as the annual percentage change in the CPI) is regressed against the annual average of central government balance (including grants) as a percent of GDP. The estimation results of this simple OLS regression (reported inside the figure) suggest a significant positive correlation between overall balance and inflation; a 1 percentage point increase in the surplus-to-GDP ratio is associated with an almost 2 percent reduction in inflation. However, the relatively low value of the R-squared coefficient (0.14) suggests that other factors could have a significant impact on inflation.[8]

Table 1 summarizes for each country the average annual values of inflation and several other fiscal and monetary aggregates for 1980–2005. To see if inflation and its main determinants are sensitive to the choice of monetary and exchange rate arrangements, we have collected data for 42 SSA countries and divided them into three groups: (i) the first includes 14 CFA countries and the Union of Comoros[9]; (ii) the second ("non-CFA-fixed countries") consists of Botswana, Cape Verde, Lesotho, Namibia, Seychelles, and Swaziland, all of which had a de facto fixed exchange rate throughout the period[10]; and (iii) the third consists of 22 countries that were characterized by either independently fixed or floating exchange rate regimes ("non-CFA floating countries," since most of them shifted to various forms of de facto floating exchange rate arrangements in the mid-1990s).[11] At the bottom of Table 1 the averages for each group and for the whole sample are also reported.

Table 1 shows that countries that had a fixed exchange rate arrangement (including both CFA and non-CFA fixed) had on average lower inflation rates, less seigniorage, and higher

[8] Non-linear estimations of that regression provide similar qualitative results.

[9] The CFA franc arrangement, in place since the mid-1940s, is a fixed-exchange rate arrangement with France on one side and two monetary unions in Central and West Africa on the other: The West African Economic and Monetary Union (WAEMU) (Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal, and Togo);and the Central African Economic and Monetary Union (CEMAC) (Cameroon, Central African Republic, Chad, Republic of the Congo, Equatorial Guinea, and Gabon). La Banque Centrale des États de l'Afrique de l'Ouest (BCEAO) Issues Notes for WAEMU and La Banque des États de l'Afrique Centrale (BEAC) for CEMAC. The Comorian franc is also pegged to the euro. WAEMU, CEMAC, Comoros, and France form the franc zone.

[10] Of this group, Lesotho, Namibia, and Swaziland were independently pegging their currencies to the South African rand; Botswana, Cape Verde, and Seychelles pegged theirs to a basket of currencies (see October 1999 *World Economic Outlook*, Chapter VI).

[11] Throughout the paper, we have classified exchange rate regimes in SSA based on IMF de facto classification, which are available for 1990–2005. For 1980–90, we have used the Levy-Yeyati and Sturzenegger (2003) de facto classification.

primary surpluses than the last group. These facts are also evident in Figures 2, 3, and 4, which show the time series of annual inflation, primary balances, and seigniorage rates for CFA and non-CFA countries. Countries in the CFA franc zone or with other fixed exchange rate arrangements have been more successful in achieving price stability and single-digit inflation; the floating countries had on average double-digit inflation and very volatile prices. At 26 percent, average inflation in the floating group (excluding Angola and the Democratic Republic of Congo (DRC), which had hyperinflation) was four times higher than in the fixed-exchange rate group. Large differences are also observed for the average primary surplus-to-GDP ratio and seigniorage.

Within the group of 22 non-CFA floating countries, only 3 had on average single-digit inflation (Ethiopia, Mauritius, and Rwanda); 9 experienced either hyperinflation (Angola, DRC, and Zimbabwe) or high persistent inflation with average rates above 30 percent (Ghana, Guinea-Bissau before joining the CFA in 1997, Mozambique, Sierra Leone, Uganda, and Zambia).

On the fiscal side, however, the public liabilities-to-GDP ratios—which are the sum of public debt and reserve money—averaged about 125 percent of GDP for CFA countries and 106 percent for non-CFA floating countries. At less than 60 percent, for the non-CFA fixed countries the same ratio was much lower than in the other two groups. CFA and non-CFA countries, however, differed in the share of domestic versus foreign-currency-denominated public debt. Because until very recently the CFA zone did not have any domestic debt markets, public debt in CFA countries was mostly foreign-currency-denominated. As a result, the CFA countries were unable to inflate away the real value of their public liabilities, since these were mostly indexed to foreign currencies with low inflation rates. In non-CFA and floating countries, domestic government debt markets were instead more developed, and the average ratio of nominal domestic debt increased from 11 percent of GDP in the 1980s to 15 percent in the late 1990s, with the median increasing from 4 percent to 10 percent. Within this group, Angola, Botswana, the DRC, Mozambique, and São Tomé and Príncipe had no domestic government debt markets until 2004. Over time, an increasing number of countries built up domestic debt, and the number of countries with debt-to-GDP ratios exceeding 20 percent rose from three at the beginning of 1980 to nine by 2000.[12]

Another fiscal determinant of inflation is represented by the amount of seigniorage, which is measured as the annual change in reserve money as a percentage of GDP.[13] Persistent budget deficits may over time force the monetary authorities to monetize debt, creating inflation by increasing seigniorage. As a result, seigniorage has always been viewed as an implicit form of taxation to finance budget deficits. The experience of seigniorage in SSA is mixed (see

[12] These stylized facts are illustrated in Christensen (2004), while Kahn (2005) provides a useful analysis as to why domestic debt markets were underdeveloped in the SSA region.

[13] This way of measuring seigniorage is standard in the literature and follows, inter alia, Fischer (1981). For a review of the definition of seigniorage and inflation tax, see Drazen (1985). The theoretical and empirical literature on the use of seigniorage is extensive. See Blanchard and Fischer (1989) for a thorough analysis of seigniorage, deficits, and inflation. For a recent analysis of the effects of seigniorage on inflation targeting, see Buiter (2007).

Table 1): in non-CFA floating countries (excluding Angola and DRC) seigniorage was, at 1.7 percent of GDP, almost twice as large as in CFA countries, where the average was below 1 percent of GDP. For some countries, such as Angola, DRC, Ghana, Guinea-Bissau, Sao Tomé and Príncipe, Sierra Leone, Zambia, and most recently Zimbabwe, seigniorage revenues appear to have been an important component of financing policies. For fixed-rate countries, both CFA and non-CFA, seigniorage was much lower, except for Guinea-Bissau between 1997 and 2005 and Cape Verde.

Seigniorage, however, is not the only channel through which the state may appropriate fiscal resources by issuing base money. Another important source of government financing in SSA is the inflation tax (i.e., the reduction in the real value of the stock of base money due to inflation),[14] which provides a more striking picture than seigniorage.

Table 1 shows that the inflation tax was minimal in CFA fixed countries, where the average rate was less than 1 percent, and in non-CFA fixed countries, where it averaged about 3 percent—but was very large in non-CFA floating countries, where, even after excluding Angola and the DRC, the average annual rate was about 350 percent. Moreover, in countries with high inflation and persistent budget deficits, such as Ghana, Sierra Leone, Uganda, and Zambia, the inflation tax was very large; in Uganda and Zambia it averaged above 2,000. In other countries, such as Malawi, Nigeria, and Tanzania, where inflation was more moderate but budget deficits were still chronic, inflation tax rates ranged between 30 and 50 percent.

This preliminary evidence on inflation and its fiscal determinants in SSA seems to suggest the following conclusions:

- Countries with chronic budget deficits and high nominal public liabilities seem to have been more prone to fiscal-dominant regimes and high inflation.

- A number of countries that had no systematic recourse to other sources of implicit fiscal revenues, such as seigniorage and inflation tax, had lower inflation. Most of the low-inflation countries were anchoring their monetary and fiscal policies either to a currency union with a fixed exchange rate (the CFA zone) or to a basket of currencies.

- Countries that had multiple anchors or changes in their monetary and exchange rate arrangements experienced much more difficulty in credibly committing to low inflation and fiscal discipline.[15]

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[14] Other sources of implicit financing include (i) central bank revenues—the interest payments the authorities save on the stock of base money liabilities; and (ii) the operating profits of the central bank, or the taxes paid by the Central Bank to the government. However, due to lack of data on central bank revenues and operating profits, we were unable to compute these for the SSA.

[15] Based on a sample of 53 developing countries for the period 1964–98, Loungani and Swagel (2001) also provide evidence that inflation was higher in countries with floating exchange rate regimes.

In the next section, we turn to the theory to explain the underlying causes of fiscal-dominant regimes and why lack of coordination between monetary and fiscal policy could threaten price stability.

III. Fiscal Dominance: Theoretical Background

In this section, we turn to the theory to explain the underlying causes of fiscal-dominant regimes and why lack of coordination between monetary and fiscal policy could threaten price stability. Economists generally agree that when policy is discretionary (i.e., there are no credible pre-commitments), the rate of inflation could be excessively high due to "dynamic inconsistency problems."[16]

Barro and Gordon (1983) describe inflation as a "dynamic inconsistency" problem, where inflation results from a game played between the government (more specifically, the central bank) and the private sector: a central bank may be rationally tempted to violate an announced inflation target to exploit a short-run Phillips curve between unemployment and inflation, thus reducing unemployment. However, the private sector then expects that inflation targets will not be met and raise their inflation expectations. This, in turn, increases inflation and makes the announced inflation target unachievable, while the government's attempt to increase employment above its natural or long-run equilibrium fails.

The literature on dynamic inconsistency also provides a rationale for why decisions about the supply of base money could be dominated by the fiscal authorities rather than by the central bank. In this case, the government is tempted to inflate mainly for two reasons: (i) to reduce the real value of a large and unsustainable nominal debt by creating unanticipated inflation; or (ii) to finance government expenditures by printing money (thus creating seigniorage) where the costs of levying taxes or borrowing constraints are significant. In this situation of fiscal dominance, the policy implication is that, to reduce a government's inflationary bias, monetary policy should be delegated to an independent and conservative central bank, which cares about building public confidence in announced inflation targets and avoids the temptation to violate them (see Rogoff, 1985).

All these models share the standard QTM assumption that sustained inflation is possible only if the money supply also increases in a sustained manner; thus, inflation is always and everywhere a monetary phenomenon. In contrast, according to the FTPL, money creation may not be the only channel through which fiscal policy becomes dominant and budget deficits cause inflation. The FTPL argues that fiscal policy may directly jeopardize the objective of price stability, even when there is a strongly committed central bank that does not accommodate the government's financing or employment objectives by printing money.

[16] This literature was pioneered by Kydland and Prescott (1977).

How is this alternative theory of fiscal dominance defined? The main difference between these two theories of price determination (QTM and FTPL) lies in their different interpretation of the government's intertemporal budget equation. The QTM states that the value of government debt is equal to the present discounted value of future government tax revenues net of expenditures, with both debt and surpluses denominated in units of goods.[17] The QTM interprets the government's intertemporal budget equation as a solvency constraint on the government's fiscal policy, and assumes the price level as given. According to this theory, whenever the solvency condition does not hold, the government must take revenue or expenditure measures, or both, to restore equality and satisfy the solvency condition.

However, the FTPL argues that the same intertemporal budget equation should be viewed as an equilibrium condition, including the determination of the price level. Whenever the solvency condition does not hold, the market-clearing mechanism will move the price level to restore equilibrium. This implies that, if there is a negative shock that increases the nominal stock of liabilities and the market anticipates a fall in future primary surpluses without corrective fiscal measures or an accommodative monetary policy, to reach a new equilibrium the real value of government debt would need to fall. In turn, with no adjustments in primary surpluses, a new equilibrium could only be achieved if prices increase.

As a result, the FTPL argues that if primary surpluses tend to be arbitrary and weakly correlated or uncorrelated with public liabilities, prices will have to adjust to ensure fiscal solvency, and a fiscally dominant (FD) regime would prevail, even if monetary policy is not accommodative of fiscal needs. Fiscal policy would then become the nominal anchor to determine the price level. Alternatively, if primary surpluses adjust promptly to limit or reduce the growth of public liabilities, fiscal solvency is ensured for any price level, a monetary dominant (MD) regime would prevail, and monetary policy is conducted independent of government financing requirements and becomes the nominal anchor for economic stability.

Nevertheless, the FTPL has been criticized: Buiter (2002) claims that the FTPL confuses the roles of budget constraint with equilibrium condition in modeling a market economy. Thus, under certain conditions, the FTPL can lead to inconsistencies such as overdetermined equilibria or negative price levels. Niepelt (2004) argues that the FTPL is inconsistent with rational expectations equilibrium where all assets holdings reflect optimal household choices. For him, the feasibility of non-Ricardian policy rests on the "not well founded" assumption of non-zero initial nominal government liabilities. In the FTPL, changes in the price level due to non-Ricardian fiscal policy occur via surprise asset revaluations, which rational households would anticipate and never accept at a first place. However, as advocated in

[17] For an analytical derivation of this relation, see the following section below.

Cochrane (2000) and Sims (1999), the FTPL determines the price level from the value of nominal government debt as a claim to government primary surpluses, just as private stock is valued as a claim to corporate profits. Since valuation equations are not constraints, these authors argue that the FTPL does not misinterpret the government's intertemporal budget constraint.

In sum, the FTPL explains that the occurrence of a Non Ricardian regime (NR) has consequences on aggregate demand and price stability, *within* an optimizing framework (that is with rational expectations, full information and access to capital markets, etc) and not as deviation from it. However, the occurrence of NR could also occur because of the existence of more familiar channels such as: (i) myopic expectations, (ii) intergenerational redistribution, (iii) thin capital markets, and (iv) government borrowing constraints, which are not optimizing features. However, on the empirical ground it is not possible to distinguish whether deviation from Ricardian equivalence occur because of either lack of optimizing behavior or due to the reasons advocated by the FTPL (that is, nominal rigidities and an evaluation effect of the nominal government debt).

Therefore, to bring the model closer to a SSA small open economy, we model the effects of fiscal policy on price determination by relaxing some idealized assumptions present in the FTPL. For instance, our model explicitly includes borrowing constraints on capital markets to help explain why a government in the SSA region would tend to resort to implicit sources of budgetary financing, such as seigniorage and inflation tax. In order to do so, the next section presents a simple model—based on Canzoneri, Cumby, and Diba (CCD) (1998 and 2001)—that emphasizes the role of fiscal policy in determining prices in a small open economy. The model also draws up testable predictions to identify the fiscal requirements compatible with a fiscal dominant regime.

A. The Model

This section presents a model of fiscal dominance, based on a model by Canzoneri, Cumby, and Dimba (1998), which illustrates how the FTPL price determination mechanism works. Our model, however, extends the analysis to an international set up consisting of two countries, each populated by a representative household, and a single consumption good in the same line of Corsetti and Mackowiack (2005). Further, we assume that one of the countries (country *1*) represents a SSA economy, which receives grants from the foreign donor-country and faces a borrowing constraint on its domestic debt.[18] The model assumes no borrowing constraints on foreign currency-denominated debt since this type of debt was largely made available on concessional terms by donors and International Financial Institutions (IFIs).

[18] For our sample of SSA countries, the average value of grants is significantly high, corresponding to 4.5 percent of the GDP during the sample period (1980–2005).

At date *t*, the household (both domestic and foreign) maximizes the following expected utility function from its consumption of goods produced in country *1* and *2*:

$$U_t \equiv E_t \sum_{s=t}^{\infty} \beta^{s-t} u\left(c_{1,s} + c_{2,s}\right), \qquad 0 < \beta < 1, \tag{1}$$

where E_t is the expected value operator, β is the household's intertemporal discount rate, and $c_{j,s}$ is consumption of country $j = 1, 2$ goods at date s.[19] The utility function is assumed to satisfy standard regularity conditions, guaranteeing the existence of a unique interior solution to the household's optimization problem. Moreover, we assume that goods are perishable and each individual is endowed with $y_{j,s}$ units of country j goods at date s, such that in equilibrium

$$y_{j,s} = c_{j,s} + g_{j,s}, \tag{2}$$

where $g_{j,s}$ are purchases by government j at date s that follows a regular exogenous stochastic process.

The government in country j for each period imposes lump sum taxes τ_j on the representative agent, issues its own currency M_j, and borrows by issuing sovereign bonds denominated in both domestic and foreign currency (B_j and B_j^* respectively). It also either receives (or donates) grants A from the other country, which for simplicity are assumed to be entirely used in the same period of their donation. The flow budget constraint of government *1* (similar to government *2*) reads then as follows:

$$M_{1,s+1} + \frac{B_{1,s+1}}{1+i_{1,s}} + \frac{e_s B^*_{1,s+1}}{1+r_{1,s}} + p_{1,s}\tau_{1,s} + e_s A_s = M_{1,s} + B_{1,s} + e_s B^*_{1,s} + p_{1,s} g_{1,s}, \tag{3}$$

where, in addition, $i_{j,s}$ is the nominal interest rate in country j, e_s is the nominal exchange rate defined as units of currency *1* per unit of currency *2*, and $p_{j,s}$ is the price of the consumption good in terms of currency M_j.

To better represent an African economy, we also include a borrowing constraint on the domestic debt of country *1*. So, in each period s, country *1* is able to borrow in the domestic market up to a level $\overline{B}$, such that $B_{1,s}$ can be written as

$$B_{1,s} = I_s\left[B_{1,s}; \overline{B}\right] * B_{1,s} + \left(1 - I_s\left[B_{1,s}; \overline{B}\right]\right) * \overline{B}, \tag{4}$$

[19] Throughout the paper, and except for the nominal interest rate and exchange rate, capital letters denote nominal values and small letters denote real values.

where $I_s\left[B_{1,s};\overline{B}\right]$ is an indicator function, such that $I_s\left[B_{1,s};\overline{B}\right]=1$ if $B_{1,s}\le\overline{B}$, and $I_s\left[B_{1,s};\overline{B}\right]=0$ otherwise.

Regarding the financial transactions of the household, we use a standard cash-in-advance (CIA) constraint. At the beginning of each period households observe the state of the economy (endowments and the government policy variables) and execute all of their financial transactions except the actual buying and selling of goods. They purchase goods using the currency of the seller. Government purchases are not subject to CIA constraints, though. Hence, assuming that nominal interest rates are positive in equilibrium, the household's CIA constraint in country *j* is binding, and in equilibrium equal to

$$M_{j,s+1}=p_{j,s}c_{j,s}=p_{j,s}\left(y_{j,s}-g_{j,s}\right). \tag{5}$$

After incorporating the CIA constraint, the household's budget constraint for period *s* becomes:

$$\begin{aligned}&p_{1,s}c_{1,s}+e_s p_{2,s}c_{2,s}+\frac{B_{1,s+1}}{1+i_{1,s}}+\frac{e_s B_{2,s+1}}{1+i_{2,s}}+\frac{e_s B^*_{1,s+1}}{1+r_{1,s}}+\frac{B^*_{2,s+1}}{1+r_{2,s}}+p_{1,s}\tau_{1,s}+e_s p_{2,s}\tau_{2,s}\\&=M_{1,s}+e_s M_{2,s}+I_s B_{1,s}+\left(1-I_s\right)\overline{B}+e_s B_{2,s}+e_s B^*_{1,s}+B^*_{2,s}+p_{1,s}y_{1,s}+e_s p_{2,s}y_{2,s}.\end{aligned} \tag{6}$$

The household maximizes (1) subject to (6) over non-negative values of $c_{1,s}$, $c_{2,s}$, $B_{1,s+1}$, $B_{2,s+1}$, $B^*_{1,s+1}$, and $B^*_{2,s+1}$. To simplify this maximization problem, which exhibits a discontinuity due to the borrowing constraint (4), we approximate the indicator function $I_s\left[B_{1,s};\overline{B}\right]$ with a transition function. In particular, we apply the logistic function[20]

$$l_s\equiv l\left(B_{1,s};\gamma,\overline{B}\right)=\frac{1}{1+\exp\left(-\gamma\left(\overline{B}-B_s\right)\right)},\quad \gamma>0. \tag{7}$$

When $\gamma\to\infty, l\left(B_{1,s};\gamma,\overline{B}\right)\to I\left[B_{1,s};\gamma,\overline{B}\right]$. Hence, for high values of γ, the logistic function will be a good approximation to the indicator function. It will make the borrowing constraint (4) practically binding when $B_{1,s} > \overline{B}$. Then, solving the household's optimization problem for $s = t$, the first-order condition with respect to consumption results in

$$p_{1,t}=e_t p_{2,t}. \tag{8}$$

[20] The logistic function has been applied to various nonlinear models, see, for example, Bayoumi et al. (1995), Wheaton (2000), and Ribeiro et al. (2007).

Equation (8) represents the purchasing power parity condition (PPP).[21] By using (8), the first-order conditions with respect to $B_{1,s+1}$, $B_{2,s+1}$ for $s = t$ can be written as:

$$\frac{1}{1+i_{1,t}} = E_t\left\{\alpha_t \frac{p_t}{p_{1,t+1}} l_{t+1}\left[1-\left(B_{1,t+1}-\overline{B}\right)\gamma\left(1-l_{t+1}\right)\right]\right\}, \quad \text{and} \tag{9}$$

$$\frac{1}{1+i_{2,t}} = E_t\left\{\alpha_t \frac{p_{2,t}}{p_{2,t+1}}\right\}, \tag{10}$$

where $\alpha_t \equiv \beta \dfrac{u'\left(c_{t+1}\right)}{u'\left(c_t\right)}$ is the intertemporal rate of substitution, or discount factor of the total consumption $c_t = c_{1,t} + c_{2,t}$. The discount factor α_t is an exogenous stochastic process, since c_t is given by (2).

Equations (9) and (10) are Euler equations required for the optimal intertemporal smoothing of consumption. From them, we find the following interest rate parity condition (IRP):

$$\left(1+i_{1,t}\right) = \left(1+i_{2,t}\right) * E_t\left\{\frac{e_{t+1}}{e_t} * \frac{1}{\left[l_{t+1}+\left(B_{1,t+1}-\overline{B}\right)l'_{t+1}\right]}\right\}, \tag{11}$$

where $l'_{t+1} \equiv \dfrac{\partial l_{t+1}}{\partial B_{1,t+1}} = -\gamma l_{t+1}\left(1-l_{t+1}\right)$.

Due to the borrowing constraint (4), this condition shows an additional risk premium given by $\left(1/\left[l_{t+1}+\left(B_{1,t+1}-\overline{B}\right)l'_{t+1}\right]\right)$. For values of debt in the SSA country (country *1*) expected to be lower or equal to the debt constraint $\overline{B}$, that term is approximately equal to *1* and, therefore, (11) is similar to a standard uncovered interest rate parity.[22] However, if $E_t\left\{B_{1,t+1}\right\} > \overline{B}$, then the term $\left(1/\left[l_{t+1}+\left(B_{1,t+1}-\overline{B}\right)l'_{t+1}\right]\right)$ tends to infinity, which makes the interest rate i_t in country *1* to explode so that the government will no longer be able to borrow domestically.

In turn, combining it with (10), the first-order condition of the household's maximization problem with respect to $B^*_{1,s+1}$ for $s = t$ results in

[21] This condition is in no way essential for the results that follow. The countries' goods could be imperfect substitutes and we would still be able to find the equilibrium in the terms of trade (see Canzoneri, Cumby, and Diba, 1998).

[22] For $\gamma \to \infty$, if $E_t\left\{B_{1,t+1}\right\} \le \overline{B}$ then $l_{t+1} \to 1$ and, therefore, $\left[l_{t+1}+\left(B_{1,t+1}-\overline{B}\right)l'_{t+1}\right] \to 1$.

$$r_{1,t} = i_{2,t}. \tag{12}$$

Hence, expressing the flow budget constraint of government *1*, equation (3), in terms of total liabilities and using (8) to (12), we derive the following equation for country *1*:

$$\frac{M_{1,t} + B_{1,t} + e_t B^*_{1,t}}{p_{1,t} y_{1,t}} = \left\{ \begin{array}{c} \dfrac{d_{1,t}}{y_{1,t}} + \dfrac{\theta_{1,t}}{y_{1,t}} + \\ E_t\left\{ \alpha_t \gamma_t \left(\dfrac{\left(M_{1,t+1} + B_{1,t+1}\right)\left[l_{t+1} + \left(B_{1,t+1} - \overline{B}\right)l'_{t+1}\right] + e_{t+1} B^*_{1,t+1}}{p_{1,t+1} y_{1,t+1}} \right) \right\} \end{array} \right\}, \tag{13}$$

where $d_{1,t} \equiv \left(\tau_{1,t} + \dfrac{A_t}{p_{2,t}} - g_{1,t} \right)$ is the real primary balance (including grants),

$\theta_{1,t} \equiv \dfrac{M_{1,t+1}}{p_{1,t}} \dfrac{i_{1,t}}{1 + i_{1,t+1}}$ represents the real transfers from the central bank to the fiscal authority (seigniorage), $\gamma_t = y_{t+1} / y_t$ is the ratio of real GDP between period *t* and *t+1*.

Solving (13) forward and using the following transversality condition for country *1*:

$$\lim_{T \to \infty} \left(\prod_{k=t}^{T+t-1} \alpha_k \gamma_k \right) \left(\frac{\left(M_{1,t+T} + B_{1,t+T}\right)\left[l_{t+T} + \left(B_{1,t+T} - \overline{B}\right)l'_{t+T}\right] + e_{t+T} B^*_{1,t+T}}{p_{1,t+T} y_{1,t+T}} \right) = 0, \tag{14}$$

we obtain the present value of the government budget constraint for the SSA country as

$$\frac{M_{1,t} + B_{1,t} + e_t B^*_{1,t}}{p_{1,t} y_{1,t}} = \left\{ \begin{array}{c} \dfrac{d_{1,t}}{y_{1,t}} + \dfrac{\theta_{1,t}}{y_{1,t}} + E_t\left\{ \displaystyle\sum_{n=t+1}^{\infty} \left(\prod_{k=t}^{n-1} \alpha_k \gamma_k \right) \left(\frac{d_{1,n}}{y_{1,n}} + \frac{\theta_{1,n}}{y_{1,n}} \right) \right\} - \\ E_t\left\{ \displaystyle\sum_{n=t+1}^{\infty} \left(\prod_{k=t}^{n-1} \alpha_k \gamma_k \right) \left(\frac{\left(M_{1,n} + B_{1,n}\right)\left\{1 - \left[l_n + \left(B_{1,n} - \overline{B}\right)l'_n\right]\right\}}{p_{1,n} y_{1,n}} \right) \right\} \end{array} \right\}, \tag{15}$$

In equilibrium, the real value of public liabilities over GDP equals the present discounted value of future real primary surplus and seigniorage over GDP minus the discounted sum of real future money and domestic debt over GDP for all periods when the constraint is binding.

Notice that when the domestic debt over GDP is below the borrowing constraint value ($B_{1,n} < \overline{B}$), the term $\left[l_n + \left(B_{1,n} - \overline{B}\right)l'_n\right]$ in equation (15) is approximately equal to *1 and (15) is equal to the government budget constraint without borrowing constraints (country 2).*

However, when the domestic debt is equal to the borrowing constraint value, ($B_{1,n} = \overline{B}$), country *1* is only able to borrow funds by issuing bonds denominated in foreign currency. Thus, l_n is close to zero, and the term $\left[l_n + \left(B_{1,n} - \overline{B}\right)l_n'\right]$ is negative. Therefore, under this case, for the present value of the country *1* budget constraint to be in equilibrium (Ricardian equivalence), real primary surplus and seigniorage over GDP have to be higher than for country *2's* budget constraint. In other words, when the debt hits its own borrowing constraint, the country's government is required to implement a larger fiscal effort by increasing its primary surplus (including seigniorage).[23]

Summarizing, our model shows how fiscal and monetary-dominant regimes are determined in an open economy facing borrowing constraints, and via the intertemporal government budget constraint. Under fiscal-dominant regimes, the primary surpluses, including seigniorage are determined by an arbitrary process unrelated to the level of liabilities. Within this context, the government's fiscal policy would be sustainable only through "domestic debt deflation"– that is, an increase in the price level that erodes the real value of domestic public debt and, in turn, the real value of financial wealth until demand equals supply, and a new equilibrium is reached. Under monetary dominant regimes, instead, the primary surpluses, including seigniorage are closely related to the level of liabilities by being adjusted to any given level of liabilities to satisfy the government budget constraint (15). This gives monetary authorities the possibility to anchor expectations and determine the price level.

IV. Econometric Methodology

A. Stochastic Approaches to Identify Fiscal or Monetary Dominance:

To provide robust evidence on the relative importance of monetary and fiscal determinants of inflation, this section develops the following econometric approaches using nonstructural VAR and cointegration analysis:[24]

- based on the dynamic relationship between public liabilities and primary surpluses, we test how fiscal authorities respond to ensure the solvency of the public sector;

[23] Dupor (2000) and Loyo (1998) pointed out that in this setting, there is still the theoretical possibility that the indebted country could borrow in an unlimited way from the other country, so that the country's transversality conditions are not satisfied and prices are undetermined. This case of price indeterminacy, was however resolved by Daniel (2002) by assuming that each government is willing to accept an intertemporal deficit but not an intertemporal surplus. The rationale behind Daniel's model is that in a country with an intertemporal surplus, the household sector would not be maximizing its welfare by lending resources for foreign households, and would therefore be willing to borrow to reach a higher welfare. Under this assumption, the model allows to reach the equilibrium when the government faces the transversality condition (14).

[24] For a discussion of different approaches to test the FTPL empirically, see, among others, Sala (2004), Tanner and Ramos (2002), Canzoneri, Cumby, and Diba (2001), and Christiano and Fitzgerald (2000).

- based on the interaction between fiscal and monetary variables, we estimate the relative importance of wealth effects of domestic public debt and money growth on inflation;

- based on the relationship between inflation, aggregate demand, and monetary policy instruments, we test how monetary authorities respond in order to mitigate shocks in inflation; and

- using Johansen cointegration analysis, we also run a simple econometric test to detect deviations from Ricardian equivalence, which helps identifying fiscal dominant regimes.

In the first three approaches, we identify the VAR model as follows. To test for the stationarity of each variable, we apply the augmented Dickey-Fuller (ADF) unit root test. This test includes a constant and a trend (when necessary) with five lags assumed as a starting point, thus applying a general to a specific methodology. To verify the joint stationarity of variables in the VAR model, we use, as in the last approach, the Johansen cointegration analysis procedure.[25] Several statistics, such as the likelihood ratio test and the Akaike and Schwarz information criteria, are selected to choose the correct lag length of the VAR. We then proceed to the estimation both in levels and first differences of the VARs for each country in the sample. At this stage, we check their stability by looking at the roots of the characteristic polynomial. If all roots are inside the unit circle, the estimated VAR is considered stable.
We also inspect the normality of the residuals by applying the Urzua (1997) multivariate extension of the Jarque-Bera test. In addition, homoskedasticity is examined by applying an extension of the White's heteroskedasticity test to our systems of equations. Based on these identification, stability, and normality checks, we decided to estimate a standard VAR model including a constant and two lags for each country of the sample.[26] The impulse response and variance decomposition are computed using the Cholesky decomposition, and standard deviation bands are derived via a Monte Carlo bootstrap procedure with 1,000 iterations.

We also estimated Panel VARs (PVAR) for the entire SSA panel of countries and the three subgroups displayed in Table 1 by using an estimation strategy based on Kireyev (2000). The first step is to pool the data for a particular sample, we then identify the PVAR by testing for stationarity (panel unit root tests) and lag selection, and finally we estimate it.[27] The next

[25] The issue of whether the variables in a VAR need to be stationary has not been fully resolved. Nevertheless, the standard approach when variables are nonstationary individually but present cointegrating relationships (i.e., are jointly stationary) is to work in levels. That is because imposing stationarity by differencing may remove from the time series important information about comovements (Kireyev, 2000).

[26] Results were qualitatively similar by using other lag lengths.

[27] We also estimated the PVAR by using the group mean estimator. This technique relaxes the common coefficient hypothesis in the panel estimation and averages out (using the same weights) the country's impulse

(continued)

section explains each one of the econometric approaches in relation to our analysis of identifying fiscal and monetary regimes.

Public liabilities and primary surpluses approach

This approach, which follows the methodology used by Canzoneri, Cumby, and Diba (2001) (hereafter CCD), uses simple nonstructural VAR analysis and allows us to identify monetary- or fiscal-dominant regimes by estimating how primary surpluses respond to a temporary shock in public liabilities, and vice versa. This test is based on impulse-responses analysis of future total public liabilities to a shock in current surpluses $(d_t + \theta_t)$. These tests are conditional on the persistence of the primary surplus, estimated by its autocorrelation. A surplus with a positive autocorrelation up to at least 5 lags is considered positive and persistent; otherwise the surplus is considered negatively auto correlated, and therefore indicating low persistence.[28] Table 2 summarizes the criteria for identifying FD and MD regimes using this approach:

1. First, let's consider how public liabilities respond to a shock in the primary surplus, conditional on surpluses being positively and persistently auto correlated (criteria 1, 2, and 3 of Table 2). Under a MD regime, an increase (or positive shock) in the current surplus leads to a fall in future liabilities to guarantee fiscal solvency. As a result, a MD regime is identified by a negative relationship between current surpluses and future liabilities (criterium 1, Table 2).[29] This implies that equation (15) is solved at any price level, and therefore no inflationary pressures would arise from the government budget constraint. Under a FD regime, however, the fiscal surpluses are assumed to be exogenous, and therefore future liabilities should be either unresponsive to a current increase in surpluses or lead to an increase. If this is the case—as predicted by the FTPL— equation (15) is solved only if the price level adjusts to guarantee the fiscal solvency (criterium 3 of Table 2). The remaining possibilities do not allow identifying either regime, so we labeled them Non-identified (criteria 2 and 4, Table 2).

2. Then, let's consider how surpluses respond to a shock in total public liabilities, conditional on the surpluses being positively and persistently auto correlated (criteria 1 and

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responses and variance decomposition coefficients. The estimation results using this technique were very similar to those using the pooled sample.

[28] There is no consensus in the literature of the FTPL of the minimum number of lags to measure a high persistence of surplus. Canzoneri et al. (2001) find a positive auto correlated surplus at lags up to 9 years for the US from 1951 to 1995. Here, we choose 5 years given that fiscal policy is more volatile in SSA than in the US, and that the average length of a complete business cycle for developing countries (including SSA countries) is approximately 3 years (Rand and Tarp, 2002).

[29] However, as pointed out by Tanner and Ramos (2002), a positive relationship between current innovations to the primary surplus and future liabilities would also be consistent with an MD regime. This interpretation assumes that the government is generating a larger primary surplus in anticipation of higher future obligations.

3 of Table 2). Under a MD regime, an increase (or positive shock) in government liabilities leads to an increase in future surpluses to guarantee fiscal solvency, and therefore a positive relationship between current shocks to liabilities and future surpluses. However, this case raises an identification problem between regimes, since a positive relationship would also be consistent with an FD regime, where the price level *has* to fall to make the value of current debt equal to the expected present value of the surpluses (criteria 1, and 3, Table 2). A negative or no relationship between shocks to total public liabilities and response of future surpluses is consistent with a FD regime (criterium 3, Table 2).

3. Finally, a case of no dominant regime may also arise. This may happen when: (i) surpluses are negatively auto correlated (fourth case); or (ii) when future liabilities respond negatively to a shock in current surpluses, and future surpluses do not respond positively to a shock in current liabilities (Criterium 2—fourth row of Table 2).

Domestic public debt and money growth: the pass-through analysis

This section analyses how inflation variability is directly affected by fiscal and monetary aggregates, and helps identifying MD and FD regimes. The FTPL predicts that, under a FD regime, the main source of changes in the price level could be explained primarily by the associated wealth effects upon private consumption (see Woodford, 1998), with increases in nominal domestic debt growth.[30] This is because, with a non-Ricardian (FD) regime, a positive shock in domestic debt makes households perceive they can afford more lifetime consumption, leading to higher demand for goods, which drives up domestic prices. This analysis is similar to the exchange rate pass–through on inflation analysis. In our case, the empirical motivation is to identify which of the two policy variables—money growth or nominal debt growth—best explains inflation variability in a SSA country, after controlling for the aggregate demand channel (here proxied by a measure of real output gap).

To test for the existence of these wealth effects, a VAR is run with the following causal ordering (nominal domestic debt growth→growth rate of reserve money→real output gap→inflation rate). This VAR identification ensures that the inflation rate is the only variable responding contemporaneously to fiscal and monetary policy shocks. The real output gap is included to control for the effect of aggregate demand onto inflation. Subsequently, variance error decompositions for inflation in each VAR are computed. These decompositions separate the variation in inflation into component shocks to the VAR, thus providing information about the relative importance of each random innovation in affecting inflation.

[30] FTPL models generally assume that the real value of private sector claims on the government equals private financial wealth at the beginning of period *t* (Woodford, 1998).

Of particular interest here is the percentage of the forecast error of inflation that is explained by shocks to the growth of either nominal debt or money reserves. If the forecast error is explained by shocks to nominal debt growth, one could then argue that changes in the price level could be explained by the wealth effects of nominal debt growth, which would support the FTPL prediction of fiscal dominance. If instead the forecast error is explained by shocks to money growth, one could argue that monetary policy has been passive and has accommodated shocks in debt through debt monetization, ultimately causing inflation. The QTM predicts that this inflation channel would be associated with a FD regime.

However, the increase in domestic debt could also be caused by an abrupt fall in output originated by a shock exogenous to the country or, endogenously, by social unrest or civil wars, (as it has been frequently observed in the SSA region). These types of shocks would cause imbalances in the supply and demand for goods, and in turn lead to lower taxation, thereby increasing the need to finance the government deficits by increasing domestic debt. Therefore, it is necessary to be careful in interpreting wealth effects pass-through on prices, and in-depth single-country analysis is warranted to fully understand the sources of inflation.[31]

Active monetary authority: the MD test

As a robustness check of the previous two approaches, the third approach aims at verifying in which countries the monetary authority has tried more actively to mitigate shocks in inflation during the sample period. To determine whether a country has been following an active monetary policy a two-step procedure is implemented:[32]

1. Run a VAR with the following causal ordering: real output gap (proxy for aggregate demand)→inflation→ reserve money growth (or the discount rate when available). This ordering ensures that the monetary instrument (either reserve money or the discount rate) is the only variable responding directly to inflationary shocks.[33]

2. Compute the impulse responses to estimate how the monetary instrument responds to an innovation in inflation. To test whether the country has had an active monetary policy, money growth rates should respond negatively (or, equivalently, discount rates respond positively) to a positive innovation in current inflation. If we observe instead an increase in

[31] In addition, we also estimate our VARs including time fixed effects to control for those other reasons.

[32] However, active monetary policy alone does not rule out high inflation. In some cases, fiscal and monetary policies can be simultaneously 'active' and an increase in interest rate can deteriorate even further debt sustainability, triggering an escalation of the inflation and leading to the "tight monetary paradox" or the "fiscalist hyperinflation" phenomena (Cochrane, 1998; Loyo, 1999, and 2000).

[33] It has been difficult to determine which of these instruments (money growth or discount rate) have been used by the monetary authorities in SSA during the sample period covered in this study (see also Saxegaard, 2006).

money growth (or a decrease in the discount rate) after a positive shock in inflation, it would suggest that the monetary authority has been passive, accommodating the fiscal shocks, and the country cannot therefore be characterized as following a MD regime. This result would also help in the identification of a FD regime, given the results provided by the first approach. Table 3 summarizes the identifying criteria of monetary policy responsiveness.

Active fiscal authority: the Ricardian Equivalence, or FD test

Finally, we also run a simple empirical test of Ricardian equivalence following Haug (1991), Kremers (1987), and Trehan and Walsh (1991) methodology. This test consists in checking whether the public liabilities and primary surplus, including seigniorage, co-move. If they co-move, one could argue that Ricardian equivalence is satisfied because the government intertemporal budget constraint is satisfied. However, this test does not distinguish whether the fiscal adjustment was made through seigniorage or primary surplus, thus it cannot rule out the possibility of a FD regime realized via debt monetization and seigniorage. Corresponding to equations (14) and (15) of our model, we first estimate whether the lag of outstanding public liabilities and surplus (including grants and seigniorage) in percent of GDP are cointegrated of order zero or CI (1, 1). If so, cointegration would imply that there exist a linear combination of these two fiscal variables which is stationary in levels, even if the single variables are non stationary in levels. This would imply that Ricardian equivalence holds since fiscal authorities adjust their fiscal surpluses (including seigniorage) in relation to their liabilities' level. (similar to criterium 1 of Table 2).

V. RESULTS AND INTERPRETATION

A. Data

Both domestic and total public debt are used to compute total liabilities. Thus, for the first and fourth approaches (the CCD analysis and the FD test) the dataset is limited to a sample of 22 SSA countries, which forms an unbalanced panel of at least 17 and at most 25 years of observations for each country from 1980 through 2005.[34] As in Table 1, this SSA sample is divided into three subgroups: (i) CFA (4 countries—Cameroon, Mali, Senegal, and Togo); (ii) non-CFA fixed (4 countries—Botswana, Lesotho, Seychelles, and Swaziland); and (iii) others (the other 14 countries). For the third approach, the domestic public debt pass-through analysis, given the paucity of data on domestic debt (particularly for CFA countries), the VAR decomposition is computed for 18 SSA countries with at least 16 years of observation (excluding Botswana, Mali, Senegal, and Togo). The third approach, the MD test, is run again for 22 countries used in the first and fourth approach because the money growth variable and real output are available for all those countries for 1980 through 2005.

[34] The 22 countries are Botswana, Burundi, Cameroon, Ethiopia, Ghana, Kenya, Lesotho, Malawi, Mali, Mauritius, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, South Africa, Swaziland, Tanzania, Togo, Uganda, Zambia, and Zimbabwe.

Most of the data are extracted from three main sources: (i) grants and primary and total public surplus come from the IMF African Department database; (ii) output, price indexes, and monetary aggregates from the IMF *World Economic Outlook* (WEO); and (iii) discount rate and foreign, domestic and total public debt mainly from the IMF International Financial Statistics (IFS). Given the lack of a unified data source for the SSA region during the period 1980-2005, the public debt variables (both domestic and foreign) were computed by using the following sources: Christensen (2004), the IMF country desks data, the World Bank African Indicators (WBAI), and the World Bank Development Indicators (WDI).

Finally, the de facto exchange rate regimes classification, which is relevant for allocating the sample to the SSA subgroups, is compiled since 1997 from the "IMF Annual Report on Exchange Arrangements and Exchange Restrictions," and retroactively to 1980 using Bubula and Ötker-Robe (2002), Levy-Yeyati and Sturzenegger (2002), and Reinhart and Rogoff (2003).

B. Single-Country Analysis

This section presents the results of the four econometric approaches to identify FD and MD regimes in SSA region. Tables 4, 5, and 6 summarize, respectively, the various approaches described above for the respective samples of countries available.[35] Third column of Table 4, shows the signs of the responses of future real liabilities to a shock in current real surplus, while the fourth column shows the signs of future real surpluses to a shock in current real liabilities. The fifth column shows the autocorrelation sign of the surpluses, and the sixth column identifies the type of regime (FD, MD, or not identified) based on the criteria summarized in Table 2.[36] The last column of Table 4, corresponding to the Ricardian Equivalence or FD test, shows the number of cointegrating relationships for each country.

The main findings presented in Table 4 are as follows:[37]

- Of a sample of 22 SSA countries, 9 have an identified regime throughout the sample period, of which 4 are estimated to have followed a FD regime (Botswana, Burundi,

[35] All the details about the dataset and the empirical results are available upon request.

[36] One of the limitations of the CCD approach is that it does not allow to identify a predominant regime if both FD and MD regimes are alternating during the sample period covered. This may result in having positively correlated surpluses but inconclusive impulse-response analysis. Under these cases it would be appropriate to apply VAR techniques that allow to identify when regimes are switching, which is beyond the scope of this paper: see Leeper and Troy (2006) for a general model, and for an application to Brazil, Fialho, and Portugal (2005).

[37] The limited sample size of public debt for the SSA region undoubtedly reduces the statistical power of these econometric tests. However, the use of different econometric tests and approaches to underpin the relative importance of monetary and fiscal determinants of inflation should improve the reliability of the results.

Tanzania, and Zimbabwe) and 5 a MD regime (Cameroon, Kenya, Nigeria, Rwanda and South Africa). These results are robust to the Ricardian equivalence test developed by Haug (1991) with the exception of Kenya, and South Africa, where, despite a MD regime, no cointegrating relationship were found between public liabilities and primary surpluses. In case of Zimbabwe, which is estimated to have a FD regime, one cointegrating relationship was found, thus implying that the fiscal authorities have resorted to match their growing public liabilities by increasing money reserve and seigniorage rather than their primary surplus.

- For the remaining 13 countries, no regime was identified, either because the surpluses were negatively correlated (12 cases) or, when the surpluses were positively correlated (Zambia), the impulse-response analyses were inconclusive.

Table 5, summarizes the pass-through analysis results, suggesting that inflation variability could be mostly explained by:

- domestic debt growth in 5 countries (Burundi, Lesotho, Mauritius, South Africa, and Zambia);

- money growth in 6 countries (Cameroon, Kenya, Malawi, Sierra Leone, Tanzania, and Zimbabwe); and

- by both determinants in 5 countries (Ethiopia, Nigeria, Seychelles, Swaziland, and Uganda).[38]

In Table 5, third column, reports the regime identified by the CCD approach, while the fourth and fifth columns show the average percentage of inflation variability for ten periods due to, respectively, nominal domestic public debt, and nominal reserve money. Burundi, for example, is a case previously identified as a FD regime. Under this test, the inflation variability is more likely to be associated with changes in nominal public debt (18 percent), than changes in reserve money, suggesting that the type of FD regime in Burundi could be explained by the FTPL mechanism. For Zimbabwe, however, which is also a FD regime, the largest variability in inflation is associated with changes in reserve money (49 percent) than changes in public debt (28 percent), indicating that the type of FD regime could be best explained by the QTM mechanism of debt monetization. For countries whose regimes were not identified by the CCD approach, the pass-through analysis seems to point out that the inflation variability is more closely associated with either nominal debt (Ethiopia, Lesotho, Mauritius, Uganda, and Zambia), or reserve money (Malawi, Seychelles, Sierra Leone, and Swaziland).

[38] For Ghana and Rwanda, however, both variables have very low explanatory power for inflation variability (i.e., standard errors are quite large).

Finally, Table 6 reports the results of the active monetary authority tests—a robustness check on the regimes identified as FD by the CCD approach (Botswana, Burundi, Tanzania, and Zimbabwe). With the exception of Botswana, the tests clearly reject that the monetary authorities acted consistently with a MD regime by either tightening reserve money or increasing the discount rate in response to an inflationary shock. Overall, these results seem to indicate that inflation variability could also be associated with changes in nominal public debt in countries under a MD or Ricardian regime, implying that nominal debt variability could *per se* be detrimental to price volatility.

VI. CONCLUSION

This paper makes the following contributions. First, to illustrate the underlying causes of fiscal dominance in the SSA region, it presents a theoretical model that emphasizes the role of fiscal policy in determining prices in a small open economy facing borrowing constraints. Second, it provides quantitative evidence for the relative importance of fiscal and monetary sources of inflation and trace out the dynamic response of inflation to different shocks, including the dynamics of nominal public debt. In particular, the study finds that, as predicted by the fiscal theory of price determination, the occurrence of wealth effects of changes in nominal public debt may pass through to prices by increasing inflation variability. Therefore, nominal public liabilities, as reflected either in money growth or in nominal public debt, matter for price stability.

Third, it also presents evidence that the differences in the relative importance of monetary and fiscal sources of inflation between countries in SSA correspond to differences in the exchange rate regime. The contribution of money growth to inflation in the CFA monetary union is far less relevant than in floating exchange rate regimes. However, the restrictions imposed to issue nominal public (domestic) debt in the CFA countries during the period analyzed might also have been a key factor in keeping inflation low. On the other hand, non-CFA countries with fixed exchange rates but with domestic-currency nominal sovereign debt (e.g., Botswana, Lesotho, and Swaziland) have had higher average inflation than countries in the CFA area. Looking ahead, the current shift in the conduct of monetary policy to market-based instruments will provide an important test for the interdependence between monetary and fiscal policy in the CFA area, including the effects of nominal public debt on price stability.

The paper also provides evidence that fiscal-dominant regimes may arise even where monetary policy is independent (like in the case of the CFA) and not accommodative. This highlights the importance of coordination between monetary and fiscal policy. Finally, it provides stylized facts on inflation, fiscal outcomes, and monetary aggregates in the SSA region, which has been broadly characterized by lack of fiscal discipline, which increases the possibility of creating inflation out of fiscal imbalances.

Summarizing, Cameroon, Kenya, Nigeria, Rwanda, and South Africa seem to have been characterized by a MD regime in SSA throughout the period 1980–2005, while Botswana, Burundi, Tanzania, and Zimbabwe seem to have been characterized by a FD regime. For the remaining countries, the evidence is less clear cut to infer that they had been following a certain type of regime throughout the sample period.

Several refinements of this analysis could be usefully addressed in future work. First, to identify monetary—and fiscal-dominant regimes, the present study relies heavily on nonstructural VARs of the response of key variables and inflation to various shocks. The downside of non-structural statistical approaches is that it cannot help to distinguish between the capacity and the willingness of a given country to honor its fiscal obligations in full. An alternative strategy would be based on identifying additional assumptions derived from a dynamic general equilibrium model that would describe price determination as arising from a fiscal-dominant regime. Second, our specification does not allow for regime switching between monetary- and fiscal-dominant regimes. Hence, it would be interesting to apply VAR techniques that allow for identifying when regime switches are occurring. Moreover, this study does not distinguish between countries with very high average inflation, including hyperinflation, and countries with low to moderate average inflation. Other factors complicating the need to ensure an anchor which were not analyzed here might be also related to output and price volatility, capacity constraints in fiscal and monetary institutions, and shallow financial depth.

Table 1. Sub-Saharan Africa: Selected Economic Indicators, Annual Averages, 1980-2005
(in percent of GDP, unless otherwise specified)

	Inflation [1] (CPI)	Primary Balance [2]	Seigniorage [3]	Total Primary Surplus [2]	Reserve Money	Total Public Debt [2]	Total Public Liabilities [2]	Budget Balance [2]	Inflation Tax [4]
		(A)	(B)	(A + B)	(C)	(D)	(C + D)		
CFA Countries									
Benin	4.5	-0.4	1.2	0.8	10.7	...	…	-2.8	0.7
Burkina Faso	4.2	-2.9	0.8	-2.1	9.7	...	…	-3.8	0.5
Cameroon	5.5	1.0	0.4	1.4	5.3	53.2	58.5	-2.0	0.5
Central African Rep.	4.4	-1.7	0.9	-0.8	13.3	116.5	129.8	-3.2	1.0
Chad	4.7	-3.5	0.6	-2.9	10.3	57.0	67.2	-4.1	0.6
Comoros	4.2	-4.5	1.1	-3.5	12.3	122.5	134.7	-5.5	0.6
Congo, Republic of	3.8	2.6	0.8	3.5	8.6	222.2	230.8	-3.1	0.4
Côte d'Ivoire	5.3	-0.8	0.5	-0.3	10.6	121.9	132.6	-6.2	0.9
Equatorial Guinea	13.2	0.3	0.7	1.0	8.6	...	…	-3.8	0.8
Gabon	4.8	3.4	0.4	3.8	5.1	78.3	83.4	-0.3	0.4
Guinea-Bissau (1997-2005)	7.9	-8.2	2.6	-5.5	39.2	226.1	265.3	-12.9	0.9
Mali	4.3	-4.2	1.2	-3.0	13.0	88.3	101.3	-4.4	0.7
Niger	4.1	-1.7	0.4	-1.3	7.8	...	…	-3.6	0.3
Senegal	4.7	0.1	0.8	0.9	9.2	62.4	71.6	-2.2	0.7
Togo	5.0	-2.2	0.8	-1.4	17.3	93.8	111.0	-3.8	1.2
Non-CFA Countries with Fixed Exchange Rate during the entire period (NCFA Fixed)									
Botswana	10.1	8.9	0.8	9.7	4.9	13.0	17.9	8.9	1.4
Cape Verde	7.4	-7.9	2.9	-5.0	30.5	61.6	92.1	-8.8	6.9
Lesotho	11.4	-0.7	1.2	0.6	10.8	73.8	84.7	-3.6	5.1
Namibia	10.7	-2.1	0.5	-1.6	3.0	22.6	25.7	-2.1	0.4
Seychelles	3.1	0.7	0.4	1.1	6.6	82.3	88.9	-6.3	0.3
Swaziland	11.0	-0.1	0.9	0.8	8.3	26.3	34.5	-1.2	4.5
Other Sub-Saharan Countries									
Angola	420.2	-8.1	4.8	-3.3	9.0	...	…	-12.1	194,642
Burundi	10.5	-4.2	0.9	-3.3	8.2	114.6	122.9	-5.7	2.5
Congo, Dem. Rep. of	1,359.9	-3.1	9.2	6.1	13.6	476,000,000.0	476,000,013.6	-7.5	2,087
Ethiopia	5.8	-3.4	1.8	-1.7	14.7	93.0	107.7	-4.8	1.5
Gambia, The	10.6	-1.4	1.7	0.3	12.4	77.3	89.7	-5.6	3.4
Ghana	34.1	-2.0	2.4	0.4	9.5	77.2	86.7	-5.5	225.7
Guinea	16.9	-2.0	0.9	-1.2	6.8	95.4	102.2	-3.1	0.7
Guinea-Bissau (1980-1996)	54.8	-3.5	1.0	-2.5	3.0	9.1	12.1	-7.4	13.9
Kenya	12.8	1.7	0.9	2.6	8.0	64.4	72.3	-3.6	3.5
Madagascar	16.2	-3.3	1.4	-2.0	9.0	367.9	376.9	-5.6	8.8
Malawi	22.6	-1.8	1.9	0.1	8.9	137.5	146.4	-7.0	27.8
Mauritius	8.6	-1.0	1.3	0.4	12.1	46.2	58.3	-5.2	2.8
Mozambique	32.0	-4.6	0.0	-4.6	0.0	58.5	58.5	-5.6	0.4
Nigeria	23.0	-0.3	1.8	1.5	9.9	71.3	81.2	-2.3	32.7
Rwanda	9.9	-3.3	0.6	-2.7	6.1	59.0	65.0	-4.1	1.7
São Tomé & Príncipe	23.7	-17.7	5.4	-12.3	21.4	...	…	-25.0	9.1
Sierra Leone	43.1	-3.8	2.4	-1.4	9.3	112.3	121.6	-7.8	1,512
South Africa	10.6	0.5	0.6	1.1	4.6	50.0	54.6	-3.3	1.7
Tanzania	21.4	0.3	1.9	2.2	9.4	111.6	121.0	-3.5	50.3
Uganda	54.7	1.7	1.9	3.6	6.5	59.9	66.4	-4.3	2,924
Zambia	49.7	-6.3	2.5	-3.8	8.5	185.7	194.2	-8.0	2,148
Zimbabwe	62.7	-1.8	2.7	0.9	7.5	59.8	67.3	-7.3	15.7
All Countries [5]	16.0	-2.4	1.5	-0.9	11.4	93.7	105.1	-5.3	167.2
CFA Countries	5.4	-1.5	0.9	-0.6	12.1	112.9	125.0	-4.1	0.7
NCFA-Fixed Countries	8.9	-0.2	1.1	0.9	10.7	46.6	57.3	-2.2	3.1
Floating Countries [5]	26.2	-2.8	1.7	-1.1	8.8	97.4	106.2	-6.2	349.3

Sources: International Financial Statistics, WEO, and authors' computation.

[1] Annual percent change.

[2] Central government, including grants.

[3] Change in reserve money in percent of GDP.

[4] Computed as reserve money growth times real money balances, in percent of GDP. Real money balances are reserve money in constant prices.

[5] Computation excluding Angola and Congo, Dem. Rep. (outliers).

Table 2. Identification Criteria for Fiscal and Monetary Dominance Regimes.

Criteria[1]	Response of future Liabilities to current Surpluses [2]	Response of future Surpluses to current Liabilities	Autocorrelation of the Surpluses	Regime
Criterium 1	negative (—)	positive (+)	positive (+)	Monetary Dominance (MD)
Criterium 2	negative (—)	non-positive (0 or —)	positive (+)	Non-idenfied (NI)
Criterium 3	non-negative (0 or +)	negative or positive (—, 0, or +)	positive (+)	Fiscal Dominance (FD)
Criterium 4	negative or positive (—, 0, or +)	negative or positive (—, 0, or +)	negative (—)	Non-idenfied (NI)

[1] Variables are in real terms as they are expressed in percentage of GDP. Surplus is primary surplus, including grants and seigniorage; Liabilities include public debt, and reserve money.

[2] When VAR ordering is Primary Surplus→Liabilities, the interpretation is consistent with an FD regime characterized by an 'active' fiscal policy. When VAR ordering is Liabilities→Primary Surplus, the interpretation is consistent with a MD regime characterized by a passive fiscal policy and active monetary policy. Results are, however, consistent under both orderings.

Table 3. Identification Criteria of Monetary Policy Responsiveness

Criteria [1]	Response of reserve money growth to a shock in inflation [1]	Response of inflation to a shock in money growth [1]	Response of discount rate to a shock in inflation [1]	Response of inflation to a shock in discount rate [1]	Monetary policy
Criterium 1	negative (—)	positive (+)	positive (+)	negative (—)	correct responsiveness
Criterium 2	non-negative (0 or +)	positive (+)	non-negative (0 or +)	non-negative (0 or +)	incorrect or no responsiveness

[1] Based on the sign of the impulse response function of the following VAR model: Output gap → Reserve money growth → Inflation

Table 4: Sub-Saharan Africa Selected Countries: CCD Approach
VAR model: public liabilities→primary surplus (including seigniorage)

SSA sample[1]	Exchange Rate regime[2]	Response of future real Liabilities to a shock in current real Surplus[3,4]	Response of future real Surplus to a shock in current real Liabilities[3,4]	Surplus autocorrelation[5]	Regime Identified[6]	Cointegration Relations (FD Test)[7]
Botswana	Fixed Non-CFA	+	+	+	FD	0
Burundi	Others	+	+	+	FD	0
Cameroon	CFA	–	+	+	MD	1
Ethiopia	Others	+	+	–	NI	1
Ghana	Others	–	–/+	–	NI	1
Kenya	Others	–	+	+	MD	0
Lesotho	Fixed Non-CFA	–	–	–	NI	1
Mali	CFA	–	0	–	NI	1
Malawi	Others	–	+	–	NI	0
Mauritius	Others	–	–/+	–	NI	0
Nigeria	Others	–	+	+	MD	1
Rwanda	Others	–	+	+	MD	1
Seychelles	Fixed Non-CFA	–	–/+	–	NI	0
Senegal	CFA	–	+	–	NI	2
Sierra Leone	Others	–	–	–	NI	0
South Africa	Others	–	+	+	MD	0
Swaziland	Fixed Non-CFA	–/+	–/+	–	NI	2
Tanzania	Others	+	–/+	+	FD	0
Togo	CFA	+	+	–	NI	1
Uganda	Others	0	–/+	–	NI	0
Zambia	Others	–	0	+	NI	1
Zimbabwe	Others	+	0	+	FD	1
CFA		–	+	+	MD	2
Fixed Non-CFA		–	–/+	+	NI	1
Others		–	+	+	MD	2
SSA (whole sample)		–	+	+	MD	2

Sources: International Financial Statistics, WEO, and authors' computation.

[1] 1980-2005. SSA countries with less than 17 continous observations are not included in the sample.

[2] CFA indicates Franc Zone; Fixed Non-CFA indicates fixed exchange rate outside Franc zone; 'others' indicate all other regimes.

[3] Variable are in real terms as they are expressed in percentage of GDP. Surplus is primary surplus, including grants and seigniorage; Liabilities includes public debt, and reserve money. When VAR ordering is Primary Surplus→Liabilities, the interpretation is consistent with a FD regime characterized by an 'active' fiscal policy. When VAR ordering is Liabilities→Primary Surplus, the interpretation is consistent with a MD regime characterized by a passive fiscal policy and active monetary policy. Results are however consistent under both orderings.

[4] A plus sign indicates a positive impulse response over the time horizon analyzed (7 periods). A –/+ sign indicates that the impulse responses switched from negative to positive (or vice-versa) during the time horizon analyzed.

[5] A plus sign indicates positive autocorrelation of at least 5 periods; a minus sign indicates otherwise.

[6] MD and FD indicate prevalence of, respectively, monetary dominant regime, and fiscal dominant regime. NI indicates not identified regime.

[7] Number of cointegrating relations using a Johansen cointegration test on a VAR with lagged public liabilities and primary surplus (including grants and seigniorage) in percent of GDP. When the number of cointegrating relations is zero, Ricardian Equivalence does not hold according to Haug (1991).

Table 5: Sub-Saharan Africa Selected Countries: Variance Decomposition on Inflation Variability

VAR Model: nominal domestic public debt → nominal reserve money growth → real output gap → inflation

Country [1]	SSA Group [2]	Regime Identified [3]	Inflation variability due to nominal domestic public debt [4]	Inflation variability due to nominal growth in money reserves [4]
Burundi	Others	FD	18%	5%
Cameroon	CFA	MD	29%	40%
Ethiopia	Others	NI	23%	17%
Ghana	Others	NI	5%	0%
Kenya	Others	MD	13%	31%
Lesotho	Fixed Non-CFA	NI	12%	3%
Malawi	Others	NI	21%	41%
Mauritius	Others	NI	25%	7%
Nigeria	Others	MD	15%	15%
Rwanda	Others	MD	0%	4%
Seychelles	Fixed Non-CFA	NI	13%	17%
Sierra Leone	Others	NI	6%	39%
South Africa	Others	MD	34%	3%
Swaziland	Fixed Non-CFA	NI	28%	33%
Tanzania	Others	FD	9%	15%
Uganda	Others	NI	18%	13%
Zambia	Others	NI	46%	27%
Zimbabwe	Others	FD	28%	49%
Inflation variability (average, whole sample)			19%	20%

Sources: International Financial Statistics, WEO, and authors' computation.

[1] 1980-2005. SSA countries with less than 16 continous observations are not included in the sample.

[2] CFA indicates Franc Zone; Fixed Non-CFA indicates fixed exhange rate outside Franc zone; 'others' indicate all other regimes.

[3] MD, FD, and NI indicate, respectively, monetary dominant regime; fiscal dominant regime; and not identified regime in Table 4.

[4] Average value of the variance decomposition for ten periods.

Table 6. Sub-Saharan Africa Selected Countries: VAR Test on Monetary Policy Responsiveness

VAR Model: real output gap→inflation→nominal reserve money growth 1/

SSA sample [2]	Exchange Rate regime [3]	Response of nominal reserve money growth to a shock in inflation[4]	Response of inflation to a shock in nominal reserve money growth [4]
Botswana	Fixed Non-CFA	–	+
Burundi	Others	+	+
Cameroon	CFA	–/+	–/+
Ethiopia	Others	0	+
Ghana	Others	–	+
Kenya	Others	+	–/+
Lesotho	Fixed Non-CFA	0	0
Mali	CFA	–/+	–/+
Malawi	Others	–/+	+
Mauritius	Others	0	+
Nigeria	Others	0	0
Rwanda	Others	+	–/+
Seychelles	Fixed Non-CFA	–	+
Senegal	CFA	–/+	–
Sierra Leone	Others	+	+
South Africa	Others	+	0
Swaziland	Fixed Non-CFA	–/+	+
Tanzania	Others	0	0
Togo	CFA	+	–
Uganda	Others	–/+	–/+
Zambia	Others	+	0
Zimbabwe	Others	+	+
CFA		+	–
Fixed Non-CFA		+	+
Others		+	+
SSA (whole sample)		+	+

Sources: International Financial Statistics, WEO, and authors' computation.

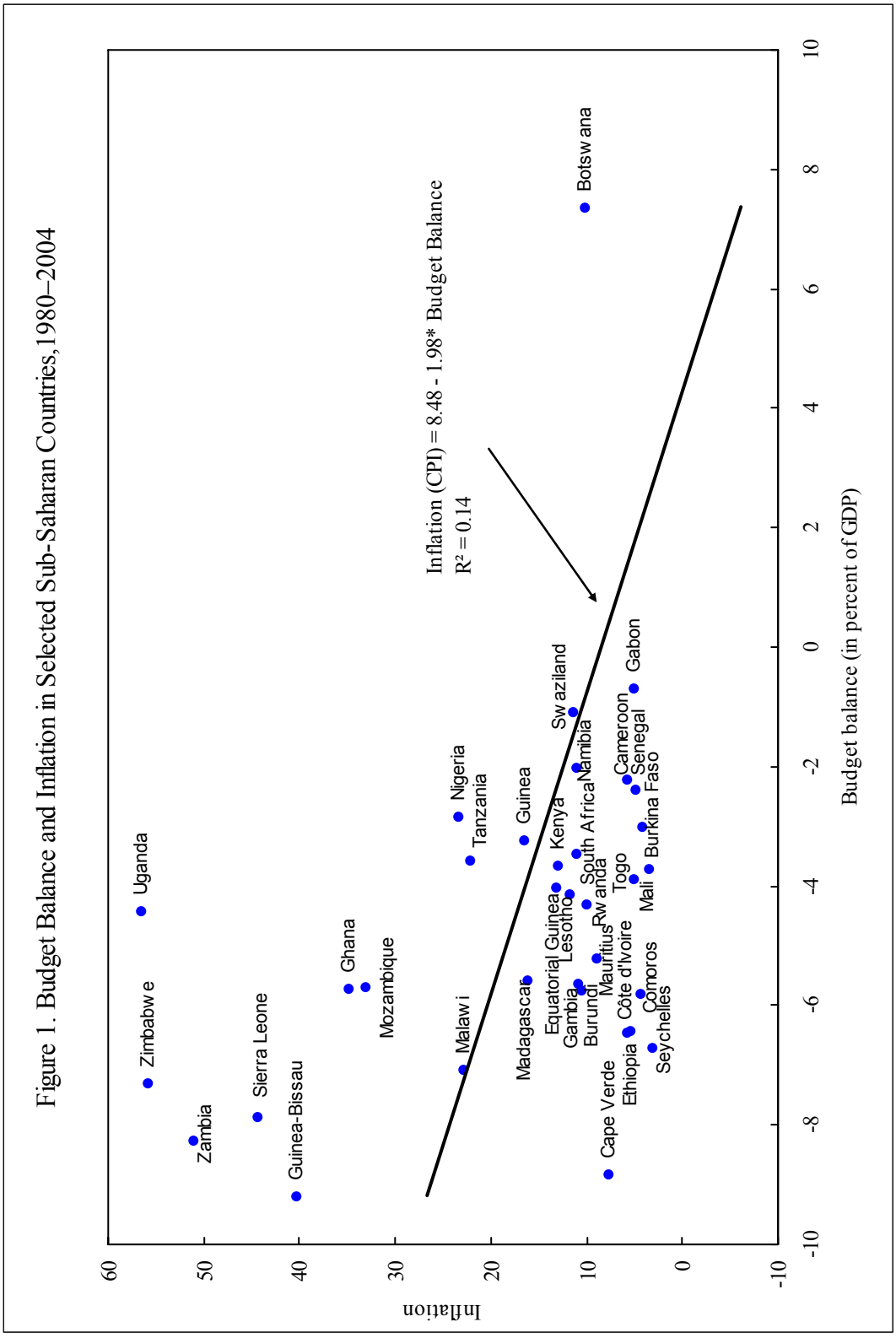
[1] A VAR was also estimated with discount rate instead of nominal reserve growth providing similar results.

[2] 1980-2005. SSA countries with less than 17 continous observations are not included in the sample.

[3] CFA indicates Franc Zone; Fixed Non-CFA indicates fixed exhange rate outside Franc zone; 'others' indicate all other regimes.

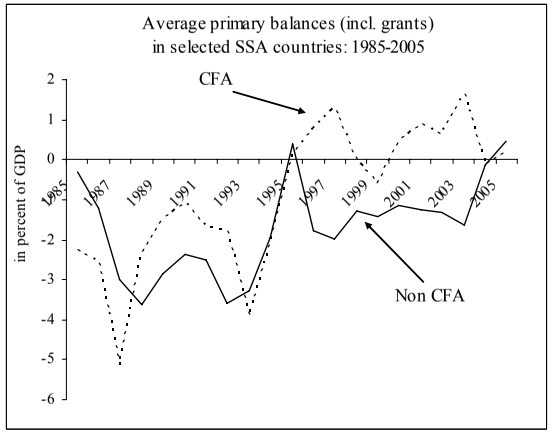
[4] Inflation is measured as annual percentage change in CPI. VAR ordering is Output Gap→Inflation→Reserve money growth.

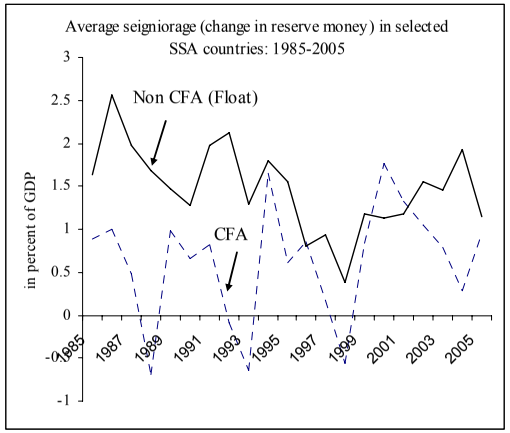
Figure 1. Budget Balance and Inflation in Selected Sub-Saharan Countries,1980–2004

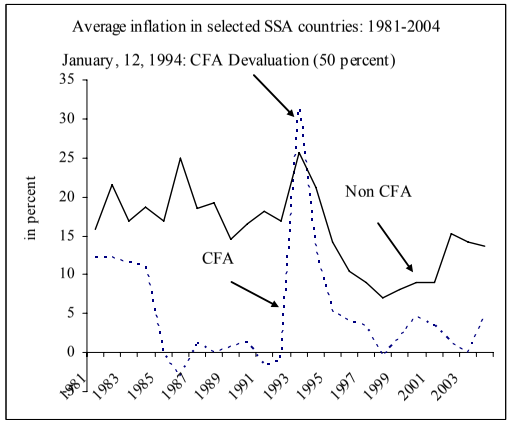


Sources: International Financial Statistics, WEO, and authors' computation.

Figure 2. Primary Balances, Seigniorage, and Inflation in Selected Sub-Saharan Countries: 1985–2005







Sources: International Financial Statistics, WEO, and authors' computation.

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