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Tight Money, Real Interest Rates, and Inflation in Sub-Saharan Africa

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The consequences of tight monetary policy are analyzed in an optimizing currency-substitution model of a small, open economy that operates under an open capital account and a flexible exchange rate. There is a reasonably good fit between the dynamics generated by the model and the stylized facts in the tight-money episodes that occurred in Kenya in 1993 and Nigeria in 1989–91. The study's results shed light on two issues: why tight money has provoked stupendous increases in inflation and the real interest rate in some episodes, and whether tight money is a foolish, unsustainable policy that always worsens the fiscal deficit and raises the inflation rate in the long run. [JEL F41, E52, E63]

Active markets for short-term government debt now exist in much of sub-Saharan Africa. This positive development has been associated with some interesting and controversial experiments in monetary policy. In different periods, the central banks of Kenya, Zambia, Zimbabwe, The Gambia, Ghana, and Nigeria have financed more of their fiscal deficits through bond sales on the assumption that slower money growth alone would reduce inflation. These attempts to exercise *independent* tight monetary policy have produced mixed, and at times disastrous, results. In some episodes, inflation and the real interest rate have decreased in the short-to-medium run. But when Kenya reduced monetization of the deficit in 1993, the real interest rate shot up to 15–40 percent, the shilling depreciated 85 percent, and the inflation rate jumped from 34 percent to 67 percent. Remarkably,

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the numbers were even worse a bit further to the south; in the same year, tight money triggered larger increases in the real interest rate and more extreme inflationary pressures in Zambia.

Existing theory is of limited help in enabling one to understand the strange effects of tight money in sub-Saharan Africa. The potentially relevant literature consists of Calvo's work on repudiation risk and a small set of papers that analyze the consequences of slower money growth in highly stylized, closed-economy models. The central hypothesis in Calvo (1988) is that high real interest rates stem from fears of debt repudiation and that such fears may prove self-fulfilling even when policy is controlled by a benevolent government. On first acquaintance, this hypothesis seems attractive. It runs into problems, however, when confronted with the large, erratic fluctuations of the real interest rate seen in different tight-money episodes. Maybe the real interest rate in Kenya fell sharply between July and November of 1993 because the public judged the government to be more trustworthy by the latter month; but surely the more natural explanation is that the country's tight-money policy had been abandoned two months earlier. Moreover, the perception that high real interest rates have discouraged private investment and strongly influenced capital flows is wrong if the high rates reflect only high risk premiums; since treasury bills are comparable to junk bonds, the high yields on these securities should not disturb the capital account or adversely affect the incentives for private capital accumulation. This and the preceding point suggest that temporarily high real interest rates are rooted in the fundamentals of the adjustment process rather than abnormally large risk premiums.

The other place to look for insights is in the developed country literature on "monetarist arithmetic." Sargent and Wallace (1981) argued in a seminal paper that tight money is an ill-advised policy: at best, it trades lower inflation in the short run for higher inflation in the long run; at worst, it leads to higher inflation in both the short and long runs. The explanation for this paradoxical conclusion is that tight money must eventually give way to loose money when expenditure cuts or tax increases are not introduced concurrently to lower the primary fiscal deficit. In the absence of supporting adjustments in expenditure or taxes, slower money growth leads to more bond sales, higher interest payments on government debt, and progressively larger fiscal deficits. If there is an upper limit to the amount of government bonds the public can absorb, slow money growth will be succeeded by rapid money growth and higher inflation. The anticipation of higher inflation may then provoke a flight from real money balances that drives up inflation immediately after the announcement of a new tight-money policy. This result has come to be known as the tight-money paradox.

While monetarist arithmetic makes the key point that tight money may worsen the fiscal deficit and immediately exacerbate inflationary pressures, it fails to explain the volatile responses of other important macroeconomic variables. The models employed by Sargent and Wallace (1981), Liviatan (1984), and Drazen (1985) assume a closed economy and are structured so that the real interest rate is constant not only across steady states but also on the transition path. These are major limitations. Closed-economy models miss the potentially destabilizing feedback effects running from higher inflation to capital flight to depreciation of the real exchange rate and greater outlays to service the public sector foreign debt. The assumption of a constant real interest rate is sharply at variance with the facts and rules out spectacular failures of the sort seen in Kenya and Zambia, where the macroeconomy spiraled out of control when high real interest rates, rapid debt accumulation, and accelerating inflation proved mutually reinforcing.

In this study, I analyze the effects of tight monetary policy in an optimizing, currency-substitution model of a small, open economy that operates under an open capital account and a flexible exchange rate. The interactions in the model among the exchange rate, capital flows, the real interest rate, and the fiscal deficit generate rich dynamics that shed light on (i) why tight money has provoked stupendous increases in inflation and the real interest rate in some episodes, and (ii) whether tight money is a foolish, unsustainable policy that always worsens the fiscal deficit and raises the inflation rate in the long run. The paper's most important results, previewed below, speak directly to these two issues:

- Open economy factors are critical when trying to understand the *magnitude* of the increase in inflation in failed tight-money episodes. In the closed-economy models of Liviatan (1984) and Drazen (1985), inflation rises steadily over time and arrives at its higher long-run level without a jump. In an open economy, by contrast, inflation typically overshoots its steady-state level. Moreover, overshooting is often extreme: in many cases, inflation is 2–10 times higher than its steady-state level at the end of the tight-money phase. When domestic and foreign currency are sufficiently close substitutes, this produces an ultra-strong form of the tight-money paradox: inflation is continuously higher and rises far above the level that prevails after larger fiscal deficits are fully monetized.
- When the elasticity of intertemporal substitution is low (< 0.30) and domestic and foreign currency are close substitutes, tight money has catastrophic effects that recall the experiences of Kenya and Zambia in 1993: the real interest rate rises 10–40 percentage points and inflation and the internal debt increase at explosive rates. The perverse dynamics are compatible with normal values for the elasticity of money demand with respect to inflation and the interest rate.
- Monetarist arithmetic is not always unpleasant. On the transition path, extra seigniorage and fiscal gains from transitory decreases in the real interest rate and temporary appreciation of the real exchange rate may enable the government to permanently reduce inflation by paying down the internal debt. This outcome—*pleasant* monetarist arithmetic—occurs in a sizable part of the relevant parameter space. It constitutes, therefore, a serious challenge to the conventional wisdom that tight money cannot work unless it is coordinated with measures to reduce the primary fiscal deficit. Attempting to beat inflation down with tight money alone is risky but not foolish.
- The form of the policy rule is important. Tight money is much less likely to succeed if the government commits only to monetize a smaller share of the deficit. Pleasant monetarist arithmetic then disappears or is confined to a small part of the parameter space that requires domestic and foreign currency to be much closer substitutes than when the policy rule fixes the growth rate of the money supply.

The paper is organized into five sections. Section I lays out the model and Section II calibrates it to the data for Kenya in 1993 and Nigeria in 1989–91. Following this, I show in Sections III and IV that there is a reasonably good fit between the stylized facts in these two tight-money episodes and the dynamics generated by the model. The final section contains concluding remarks.

A much longer version of this article is available at *http://php.indiana.edu/~ebuffie*. The long version contains detailed accounts of tight-money episodes in Kenya, Zambia, and Nigeria; derivations of the dynamic systems generated by different variants of the model; more extensive numerical results; and analysis of how failed tight-money policies affect capital accumulation, employment, and real output.

I. A Simple Currency-Substitution Model

Table 1 provides a broad overview of the outcomes in different tight-money episodes. It is clear from the overview and other sources that there are strong interactions among capital flows, the real exchange rate, inflation, and real interest rates. The diversity of outcomes, however, is bewildering. Apart possibly from the Zambian case, there is no support for the textbook proposition that tight money raises real interest rates and attracts capital inflows that lead to appreciation of the currency. All sorts of other combinations appear in the data; the only general guideline for theory is that tight money should be analyzed in an open-economy setting.

I work with a simple currency-substitution model. The economy produces a nontraded good and a composite traded good. World prices equal unity, so the domestic price of the tradable good is set by the nominal exchange rate e. The capital account is open and the private sector holds three financial assets: domestic currency M, foreign currency F, and indexed treasury bonds B. The consumer price index is P, and $m \equiv M/P$, $b \equiv B/P$, and $v \equiv e/P$ denote, respectively, real holdings of domestic currency, the real stock of bonds, and the real exchange rate. Real consumption expenditure E is measured in units of the traded good and γ is the consumption share of the nontraded good at current prices. P is a geometric weighted average of the prices of the two goods; expressed in terms of e and the relative price of the nontraded good P_n,[1]

$$P = eP_n^{\gamma}, \quad 0 < \gamma < 1. \tag{1}$$

All economic activity in the private sector is undertaken by a representative agent who possesses an instantaneous utility function of the form $V(P_n, E) + \phi(m, vF)$. $V(\bullet)$ is a standard indirect utility function that measures utility from goods consumption, while $\phi(\bullet)$ reflects liquidity services generated by holdings of domestic and foreign currency. The private agent chooses m, b, F, and E to maximize

$$U = \int_0^{\infty} \left[V\left(P_n, E\right) + \phi(m, vF) \right] e^{-\rho t} dt, \tag{2}$$

[1]The analysis is based on small changes, so γ can be treated as constant and equation (1) yields the same solution for changes in the price level as the exact consumer price index.

Table 1. Quick Overview of Loose Correlations in Different Tight-Money Episodes

Episode	Exchange Rate System	Inflation	Real Interest Rate	Current Account	Capital Account	Real Exchange Rate
Kenya, March–August 1993	Lightly managed float	Rises from 34% to 67%	29–40% for June–August 1993	Improves	Worsens (but large inflows in 1993:Q1 and 1993:Q4)	Depreciates strongly
Zambia, January–July 1993	Managed float	Rises from 160% to more than 400%	Highly volatile, 50–100% in some months	Unclear	Probably improves	Appreciates strongly
Kenya, January–September 1999	Lightly managed float	Rises from 2.5% to 7.2%.	Decreases 3–5 percentage points from January–May, 1–3 percentage points higher by September	Improves	Worsens	Depreciates strongly
The Gambia, July 1986–90	Pure float	Decreases from 35–46% to 10–12%[1]	Rises, fluctuating between 5% and 12%	Improves	Improves	Depreciation in FY 1986/87, partially offset by appreciation in FY 1987/88 and FY 1988/89
Zimbabwe, September 1994–1998:Q3	Crawling peg	28% in 1993, 19–22% for 1995–97, 32% in 1998, and 58% in 1999	5% in 1993, 8–9% for 1994:Q3–1995:Q1, 3–7% for 1995:Q2–1998:Q3	Worsens in 1994–95, improves in 1996–97, worsens sharply in 1998–99	Improves in 1995 and 1996, then worsens sharply in 1997	Appreciation in 1995 and 1996, large real depreciations in 1997:Q4 and 1998:Q3
Nigeria, 1989–91	Managed float	Drops from 49% in 1988 to 3.5% in 1990,[2] then rises to 23% in 1991, 49% in 1992, and 61% in 1993	Negative in 1989 and first half of 1990, then rises to 11% by end of 1990	Improves	Worsens	Depreciations in 1989–90 and 1992–93, appreciation in 1991

Sources: The Gambia: Hadjimichael, Rumbaugh, and Verreydt (1992); and IMF, *International Financial Statistics.* Zimbabwe: Reserve Bank of Zimbabwe, *Monthly Bulletin;* African Development Bank, *African Development Report;* and IMF, *International Financial Statistics.* Kenya, Zambia, and Nigeria: see references following the capsule summaries in Section II of this article.

[1] Fiscal adjustment and increased foreign aid helped reduce inflation.

[2] Most of the reduction in inflation in 1990 was owing to good harvests and tighter fiscal policy.

subject to the wealth constraint

$$A = m + b + vF \tag{3}$$

and the budget constraint

$$\dot{A} = v\left(Q_T + P_n Q_n\right) + g + rb + \left(\chi - \pi\right)vF - \pi m - vE(1+z), \tag{4}$$

where ρ is the time preference rate, Q_i is output in sector i, g is lump-sum transfers, r is the real interest rate, $\chi \equiv \dot{e}/e$ is the rate of currency depreciation, $\pi \equiv \dot{P}/P$ is the inflation rate, and z is a consumption-based value-added tax (VAT). The output variables in equation (4) are constant. (This assumption is relaxed in the long version of the paper.)

The optimal choices for the three assets and consumption spending satisfy the first-order conditions

$$V_E = v\beta(1+z), \tag{5}$$

$$\phi_m = \phi_f + \beta\chi, \tag{6}$$

$$\frac{\phi_f}{\beta} + \chi = r + \pi, \tag{7}$$

and the co-state equation

$$\dot{\beta} = \beta\left(\rho - r\right), \tag{8}$$

where β is the multiplier attached to the budget constraint (4). Equation (5) is a variant of the familiar condition that the shadow price of wealth β should equal the marginal utility of consumption V_E. The term $1 + z$ captures the consumption tax paid to the government, and v enters because the deflator for consumption (e) differs from the deflator for wealth (P).

The other two first-order conditions are straightforward arbitrage conditions. The total return on foreign currency is χ, the percentage depreciation of the currency, plus ϕ_f/β, the value of additional liquidity services. Domestic currency yields only liquidity services ϕ_m and government bonds pay the nominal interest rate $r + \pi$. Equations (6) and (7) thus require equal returns on the three assets.

Tight Monetary Policy and Bond-Financed Fiscal Deficits

The exchange rate is determined entirely by market forces. Since the government does not buy or sell foreign currency, the change in the money supply equals the change in the domestic credit component of the monetary base. To economize on notation, I assume the central bank holds no foreign exchange reserves. This makes the stock of central bank credit to the government identical to the money supply.

In the initial steady-state equilibrium, seigniorage pays for the entire fiscal deficit, the real interest rate equals the time-preference rate, and the real money supply and the real stock of bonds are constant. That is,

$$\mu_o = \pi_o \quad \text{(Pre-tight-money phase)}$$

and

$$\pi_o m_o = g + \rho b_o + v_o X - z v_o E_o,$$

where μ is nominal money growth and an o subscript indicates the initial value of a variable (omitted for variables that do not change). The term X on the right side of the government budget constraint represents either revenue from a state export monopoly ($X < 0$) or interest payments on the public sector foreign debt. When X equals zero, changes in the real exchange rate are fiscally neutral. (The expression zv_oE_o denotes nominal tax revenues deflated by the consumer price index (CPI) because, to repeat, E is measured in dollars.)

When the government switches to a tight-money policy, nominal money growth decreases to μ_1 and bond sales adjust as needed to cover the rest of the fiscal deficit. Hence, during the tight-money phase, m and b evolve according to

$$\dot{m} = (\mu_1 - \pi)m, \quad 0 \le t < t_1 \quad \text{(Tight-money phase) and} \tag{9}$$

$$\dot{b} = g + rb + vX - \mu m - zvE, \quad 0 \le t < t_1. \quad \text{(Tight-money phase)} \tag{10}$$

At time t_1, bond sales/purchases cease and the deficit is fully monetized. From t_1 onward, therefore, $\dot{b} = 0$ and

$$\dot{m} = g + rb(t_1) + vX - zvE - \pi m, \quad t \ge t_1. \quad \text{(Post-tight-money phase)} \tag{11}$$

Following the standard practice in the literature on monetarist arithmetic, I assume the switch from loose to tight money at $t = 0$ catches the public by surprise. The subsequent policy reversal at t_1, however, is perfectly anticipated: the public realizes from the outset that the tight-money regime is not sustainable.

Capital Flows, the Current Account, and the Market-Clearing Condition in the Nontradables Sector

The price of the nontraded good adjusts continuously to equate demand and supply. Since consumer purchases D_n are the only source of demand, the market clears when

$$D_n(P_n, E) = Q_n. \tag{12}$$

Finally, the model is closed with the aid of Walras's Law. Adding the budget constraints of the private sector and the government yields

$$\dot{F} = P_n Q_n + Q_T - E - X, \tag{13}$$

which says that capital outflows are paid for, dollar for dollar, by current account surpluses.

Even in this simple model, the dynamics are complicated enough to place analytical results out of reach. It is necessary therefore to rely on numerical methods. To prepare the model for calibration, I assume that preferences are homothetic, that the elasticity of money demand with respect to consumption expenditure is unity, and that V(•) and φ(•) are CES-CRRA functions. In this case, the steady-state solutions for m, π, and F are

$$\bar{m} - m_o = -\frac{\rho\varepsilon}{\pi(1-\varepsilon)}\left[b(t_1) - b_o\right], \tag{14}$$

$$\bar{\pi} - \pi_o = \frac{\rho}{m(1-\varepsilon)}\left[b(t_1) - b_o\right], \tag{15}$$

$$\bar{F} - F_o = \frac{(\sigma-\tau)\theta_m \rho F}{(\rho+\pi)m(1-\varepsilon)}\left[b(t_1) - b_o\right], \tag{16}$$

where τ is the intertemporal elasticity of substitution; σ is the elasticity of substitution between m and vF; θ_m and θ_f are the shares of liquidity services provided by domestic and foreign currency; and $\varepsilon = (\tau\theta_m + \sigma\theta_f)\pi/(\rho+\pi) < 1$ is the elasticity of money demand with respect to inflation.[2] The solutions in equations (14) and (15) indicate that inflation rises and real money balances fall if tight money leads to the accumulation of more debt. Equation (16) says that higher inflation causes flight from domestic to foreign currency provided it is easier to substitute between the two currencies than to substitute intertemporally in consumption (that is, provided $\sigma > \tau$).

II. Calibration of Model

In simulations for the Kenyan episode in 1993 and the Nigerian episode of 1989–91, I set

Kenya: $\eta = 0.25$, $\gamma = 0.50$, $\pi_o = 0.30$, $\rho = 0.10$, $X/GDP = 0.036$, $z = 0.20$, $m/GDP = 0.08$, $F/GDP = 0.08$, $b/GDP = 0.31$, $t_1 = 0.5$, $\tau = 0.10, 0.25$, $\sigma = 2$–6;

Nigeria: $\eta = 0.25$, $\gamma = 0.33$, $\pi_o = 0.45$, $\rho = 0.10$, $X/GDP = -0.09$, $z = 0.04$, $m/GDP = 0.08$, $F/GDP = 0.16$, $b/GDP = 0.13$, $t_1 = 2,3$, $\tau = 0.10, 0.25$, $\sigma = 2$–6.

The choice of parameter values was guided by a mixture of hard data and diverse empirical estimates:

- *Compensated elasticity of demand for the nontraded good* (η). The value for η agrees with the finding in empirical studies that compensated elasticities of demand tend to be small at high levels of aggregation (Deaton and Muellbauer, 1980; Blundell, 1988).
- *Consumption share of the nontraded good* (γ). The value of γ is 0.50 in the two Kenyan episodes. This is consistent with the share of nongovernment services

[2]The assumption $\varepsilon < 1$ is necessary to rule out perverse comparative-statics results and to ensure well-behaved dynamics. On the downward-sloping portion of the seigniorage Laffer curve, higher fiscal deficits are associated with lower inflation and the dynamics are indeterminate because an infinity of paths converge to the stationary equilibrium.

in GDP (0.50 in the 1992 national income accounts) and the allocation of weights in the country's CPI. In Nigeria, nongovernment services accounted for only 24.1 percent of GDP in 1988 (Moser, Rogers, and van Til, 1997). But high tariffs and import restrictions protected most of the manufacturing sector from external competition (World Bank, 1994, p. 230). The assigned value of 33 percent assumes that industrial output was effectively nontradable.

- *Initial inflation rate* (π_o). The period-average and end-of-period inflation rates differ by a nontrivial amount in the year preceding the tight-money episodes. I set the initial inflation rate equal to the average of the two.
- *Time preference rate* (ρ). For ρ, I chose the high value 0.10 because the only role the time preference rate plays in the model is to fix the real interest rate on government debt across steady states.
- *Net sales/purchases of foreign exchange by the public sector* (X/GDP). In theory, X should be determined by decomposing all government expenditure and revenue into tradable and nontradable components. Lacking the data to do this, I set X equal to interest payments on the foreign debt in the Kenyan episode and to government revenue from oil *less* interest payments on the foreign debt in the Nigerian episode.[3]
- *VAT* (z). The value of z (20 percent) is slightly higher than the standard VAT (18 percent) that prevailed in Kenya in 1992–93 (Central Bank of Kenya, 1993).[4] In the Nigerian case, z is much smaller (4 percent) because revenue from indirect taxes was only 3.5–4.1 percent of aggregate consumption in 1987–88 (Central Bank of Nigeria, 1990).
- *Ratio of high-powered money to GDP* (m/GDP). The sum of currency held by the public *plus* reserves of commercial banks was 7.9–8.1 percent of GDP in Nigeria for 1986–88 and in Kenya for 1988–91 (International Monetary Fund, *International Financial Statistics* (Washington), various issues).[5]
- *Ratio of foreign currency to GDP* (vF/GDP). Dollarization ratios (foreign currency deposits/M2) generally are between 20 percent and 60 percent in Latin American countries experiencing moderate inflation (Savastano, 1996). But data from several sources suggest that holdings of foreign currency assets may be much larger in sub-Saharan Africa. Cross-border deposits of the nonbank public were 7.2 percent of GDP in Nigeria in 1988 and an astounding 31.4 percent of GDP in Kenya in 1992 (IMF, *International Financial Statistics*). Ajayi (1997) estimates that in 1991 the stock of flight capital was 21–70 percent of GNP in Kenya and 103 percent of GNP in Nigeria (the third highest figure in the study's sample of 18 countries). Collier, Hoeffler, and Pattillo's (1999) estimate of capital flight for Nigeria is also huge (61 percent of a broad measure

[3]Sources are Ajayi (1997, Table 7) and *Kenya Monthly Economic Review* for Kenya and Moser, Rogers, and van Til (1997, Tables 5 and 6) for Nigeria.

[4]Revenue from indirect taxes was 22.2 percent of consumption spending in 1992–93 (Central Bank of Kenya, 1998).

[5]This measure is superior to total reserve money (line 14 in IMF, *International Financial Statistics*), since it does not include reserve money held by "other public entities." (The inflation tax is levied on only the private sector.) The stock of high-powered money was unusually high (10.1 percent of GDP) in Kenya in 1992 because of extra spending before the elections. Much of the extra money was withdrawn through open-market sales in the first two months of 1993 (before the start of the tight-money episode).

of private wealth that includes the value of the capital stock); puzzlingly, however, this study does not detect any evidence of capital flight for Kenya.[6]

Although corruption, tax evasion, and political instability may explain much of the capital flight, these huge figures suggest that the stock of foreign currency assets responsive to economic variables is large in Kenya and probably *very* large in Nigeria. Accordingly, the ratio of foreign currency to domestic currency is 1 in the Kenyan 1993 episode ($vF/GDP = 0.08$) and 2 in the Nigerian 1989–91 episode ($vF/GDP = 0.16$).

- *Ratio of government debt to GDP* (b/GDP). Central government debt held by the private sector was 13 percent of GDP in Nigeria at the end of 1988 (Central Bank of Nigeria, *Economic and Financial Review*). The internal debt in Kenya stood at 22 percent of GDP on June 30, 1992; a year later, the figure had risen to 31 percent of GDP. For technical reasons, simulations based on the latter value are more likely to provide an accurate approximation to the dynamics in the 1993 episode.[7]
- *Length of tight-money regime* (t_1). The Kenyan episode lasted six months. In the longer version of this study, I also carry out runs for $t_1 = 1$ to test the sensitivity of the results to longer-lived tight-money regimes.

  The right value of t_1 in the Nigerian episode depends on the specification of the policy rule. The IMF team headed by Moser, Rogers, and van Til (1997) treats 1990 as the last year of the adjustment program. Since money growth was approximately constant in 1989 and 1990, this is consistent with $t_1 = 2$ under a fixed-money-growth rule. But policymakers seemed to follow a rule of monetizing a smaller share of the fiscal deficit from 1989 until 1992: seigniorage financed 69 percent in 1988, 28 percent in 1989, 29 percent in 1990, 34 percent in 1991, and 51 percent in 1992. These numbers make a solid case that the tight-money episode lasted three years. I therefore set $t_1 = 3$ in the simulations that assume money growth was determined by a deficit-share rule.
- *Elasticity of intertemporal substitution* (τ). Needless to say, there is considerable uncertainty about the true value of τ in Kenya and Nigeria. Most estimates place the elasticity of intertemporal substitution somewhere between 0 and 0.5 in developing countries (Agénor and Montiel, 1996, Table 10.1). A value of 0.25 is in line with these estimates and the mean estimate for the poorest countries in

[6] I wish to thank Catherine Pattillo of the IMF for sending me the estimates for Nigeria and Kenya.

[7] The solutions presented in the next section are elasticities with respect to μ (nominal money growth) for small changes based on a linearized version of the model. This creates problems in tracking the term involving real interest payments in the government budget constraint. The true variation in the term rb is $d(rb) = r_t\,db + b_t\,dr$. The linearized approximation, however, is $\rho db + b^* dr$, where b^* is the new steady-state value of government debt. For small changes, $b^* \approx b_o$; but then both terms in the linear approximation are *considerably* smaller than in the true variation ($r_t > r$ and $b_t > b_o$). On June 30, 1993, four months into the tight-money program, the value of the internal debt was 31 percent of GNP. This figure is larger than b_o but much less than $b(t_1)$—the tight-money regime lasted another two months and real interest rates peaked in July. Thus, the solutions from the linearized model, where the debt is 31 percent of GDP, certainly underestimate the adverse macroeconomic effects in the later stages of the tight-money regime and probably in its earlier stages as well: $b^* dr > b_t\,dr$ until $t > 0.25$, but $\rho db < r_t\,db$; and with forward-looking agents, underestimation of the future impact on inflation and the real interest rate results in underestimation of the impact in earlier periods.

Ogaki, Ostry, and Reinhart (1996). This value, however, could be too high. Numerous estimates suggest that τ might be only 0.10–0.30 in the United States (see, for example, Deaton, 1992, p. 73). In each episode, therefore, I compare outcomes for $\tau = 0.25$ and $\tau = 0.10$.

- *Elasticity of substitution between domestic and foreign currency* (σ). There are no reliable estimates of σ for Kenya, Nigeria, or most other African countries. For Latin America, the estimates range from 1.5 to 8 (see Ramirez-Rojas, 1985; Márquez, 1987; Giovannini and Turtelboom, 1992; and Kamin and Ericsson, 1993). There is ample room for disagreement, however, about how much specification error, noisy data, and other problems distort the estimates; that said, they accord with the general sentiment in the literature that currency substitution is strong and highly responsive to changes in expected inflation and depreciation (Mizen and Pentecost, 1996). In deference to this view and the range of empirical estimates, I allow σ to vary between 2 and 6.

III. Numerical Solutions

The numerical solutions for the Kenyan and Nigerian episodes are presented in the first and third subsections of Section III. In the Kenyan case, credibility may be the difference between success and failure in a sizable part of the parameter space. This point is developed in the second subsection of Section III.

Kenya in 1993

Although the model is too complicated to solve analytically, it is not an impenetrable black box. It is fairly easy to trace the interactions that link asset demands to the paths of inflation, the real interest rate, and the fiscal deficit. The single most important variable is the capital account. When tight money fails, inflation and the demand for foreign currency increase in the long run. At some point, therefore, the expectation of higher future inflation provokes capital flight. This is not incompatible with temporary capital inflows in response to a temporary decrease in inflation. But the pull of the long-run fundamentals usually overwhelms the effect of transitory, lower inflation. Consequently, from the very outset, two factors tend to increase the fiscal deficit. First, revenues collected from the VAT decline, because in general equilibrium capital outflows are financed by current account surpluses and lower consumption spending. Second, since a cut in consumption spending raises the real exchange rate, capital flight indirectly increases real interest payments on the public sector's foreign debt.

The adverse effects of lower tax revenues and higher external debt service will be compounded by an immediate increase in the real interest rate on internal debt if consumption rises monotonically after its initial downward jump. To see this, write the Euler condition (derived from equations (5), (8), and (12)) with r on the left side:

$$r = \rho + \frac{\eta}{(\eta+\gamma)\tau}\frac{\dot{E}}{E}. \qquad (17)$$

As usual, what matters is the trajectory of E after its initial downward jump. In some cases, consumption rises monotonically after the jump; the real interest rate is then higher throughout the tight-money regime. In other cases, the initial downward jump is followed by further decreases in E that push r below ρ. This phase, however, comes to an end before t_1, so in the later stages of the tight-money regime the real interest rate climbs above its previous level. In all cases, when the policy collapses, consumption continues to increase, but at a slower rate. The return to fully monetized fiscal deficits is accompanied therefore by steady decreases in the real interest rate. I should acknowledge here that I have not found a mathematical proof that these are the only possible paths of E and r. The justification for ignoring other scenarios is what Kenneth Judd calls a "virtual proof": other paths may exist, but they never materialized in the simulations generated for this section or in wide-ranging sensitivity tests.

The magnitudes of the various adverse fiscal effects depend principally on how much inflation increases across steady states and how strongly this raises the demand for foreign currency. Both the long-run outcome and the dynamics are highly sensitive, therefore, to σ, the elasticity of substitution between domestic and foreign currency. Obviously, any given increase in inflation induces more capital flight when σ is large. Moreover, the larger is σ, the flatter is the slope of the seigniorage Laffer curve and the more inflation increases in the long run when the fiscal deficit rises. Thus, as σ assumes higher values, the macroeconomic dynamics become more volatile and there is a greater risk that tight monetary policy will trigger explosive increases in the real interest rate, the inflation rate, and the fiscal deficit.

But this is not the whole story. Lower inflation is also a potential steady-state outcome. If the private sector expects tight money to succeed, the fiscal effects *change sign*: on impact, expectations of lower inflation induce capital inflows and an upward jump in consumption spending; while consumption declines toward its original level, tax revenues are higher and the real interest rate, the real exchange rate, and external debt service are lower. Since the entire fiscal windfall is dedicated to reducing the internal debt, the saving in interest payments may lower the fiscal deficit enough to validate expectations of permanently lower inflation. But the parameter values have to be right for events to play out in this way; more specifically, the elasticity of substitution between domestic and foreign currency must be large enough to ensure that the transitory fiscal gains and the paydown of the debt offset the loss in seigniorage. If this critical elasticity is large, but not quite large enough, the switch to tight money leads instead to rising inflation and extremely high real interest rates.

Turning now to the results, in Table 2 the numbers under the columns headed by $\pi(0)$, $\pi(t_1)$, $r(0)$, and $r(t_1)$ are the elasticities of inflation and the semi-elasticities of the real interest rate (that is, $\frac{dr}{d\mu/\mu}$) at $t = 0$ and $t = t_1$, while those in the columns for $b(t_1)$ and π_{ss} refer, respectively, to the elasticity of debt at t_1 and the elasticity of steady-state inflation. All of the elasticities are calculated with respect to μ (money growth during the period (t_1)) and multiplied by –1, so that they take the same sign as the change in the variable. The table also shows how ε, the elasticity of (domestic) money demand with respect to inflation, varies with σ. I report the value of ε to emphasize that normal values for this elasticity are

Table 2. Solutions for Kenya 1993 Variant of Model

$\pi(0)$	$\pi(t_1)$	π_{ss}	$r(0)$	$r(t_1)$	$b(t_1)$	ε	σ
Intertemporal Elasticity of Substitution Equals 0.25							
–0.29	0.23	0.09	–0.02	0.01	0.04	0.45	2.00
–0.09	0.53	0.17	–0.01	0.03	0.05	0.60	3.00
0.21	0.99	0.28	0.01	0.05	0.07	0.67	3.50
0.60	1.60	0.43	0.03	0.08	0.10	0.71	3.75
1.92	3.64	0.94	0.10	0.18	0.18	0.75	4.00
4.08	7.00	1.79	0.21	0.35	0.33	0.76	4.10
PMA[1] Starts at σ = 4.22 (ε = 0.78)							
–1.16	–1.15	–0.25	–0.06	–0.06	–0.02	0.90	5.00
Intertemporal Elasticity of Substitution Equals 0.10							
–0.59	0.41	0.07	–0.04	0.03	0.03	0.36	2.00
–0.49	0.69	0.09	–0.04	0.05	0.04	0.43	2.50
–0.25	1.40	0.16	–0.02	0.10	0.06	0.51	3.00
0.09	2.43	0.26	0.00	0.17	0.09	0.55	3.25
1.57	6.88	0.71	0.11	0.50	0.23	0.58	3.50
PMA[1] Starts at σ = 3.65 (ε = 0.61)							
–1.21	–1.49	–0.12	–0.09	–0.11	–0.03	0.73	4.50

[1]PMA denotes pleasant monetarist arithmetic.

compatible with quite large values of σ. The results would not provide a convincing explanation of the stylized facts if they required values of ε greater than 0.90—that is, if they exploited the extreme sensitivity of inflation to small changes in the fiscal deficit at equilibria close to the top of the seigniorage Laffer curve.

The most striking and robust result is that the elasticities for inflation at the end of the tight-money phase are very large in absolute terms and 2–10 times larger than the elasticities for steady-state inflation. This reflects the impact of tight money on the real interest rate, real expenditure, and the real exchange rate. As explained earlier, at the end of the tight-money phase, revenue from the consumption tax is always lower and external debt service and the real interest rate are always higher. All of these variables are unchanged across steady states; consequently, the fiscal deficit and nominal money growth always exceed their long-run levels just after the policy reversal at t_1. Since the private sector anticipates this development, inflation overshoots its steady-state level while the tight-money policy is in force. The *degree* of overshooting is surprising and might be judged implausible were it not for the empirical record: tight money was massively inflationary in Kenya and Zambia in 1993; and when each country abandoned the policy, its inflation rate declined rapidly.

It is less clear whether the model successfully explains the impact of tight money on the real interest rate. The solution grid contains some large semielasticities for $r(t_1)$, but they are limited to a narrow range of values for the elasticity of currency substitution: σ = 3.75–4.2 in the upper panel and σ = 3.0–3.65 in the lower panel. At first glance, therefore, the results suggest that the high real interest rates seen in the Kenyan and Zambian episodes are an unusual phenomenon confined to a small part of the parameter space. This conclusion is specific, however, to the fixed-money-growth rule; it does not apply to the deficit-share rule analyzed in Section IV. In addition, it ignores the possibility that high real interest rates themselves provoke the policy reversal—that for $\tau = 0.25$ the policy reversal occurs at $t_1 = 0.5$ when $\sigma = 4$, at $t_1 = 1$ when $\sigma = 3.5$ [$r(t_1) = 0.28$ in this case], and so on. On this interpretation, the parameter space consistent with high real interest rates expands to 3.0–4.7 for $\tau = 0.25$ (2.75–4.15 for $\tau = 0.10$), the union of relevant parameter spaces for $t_1 = 0.25–4.0$.

Credibility, Outcome-Based Policy Rules, and Multiple Equilibria

The penultimate row in each panel shows the critical value of σ that divides the region where tight money fails from the region where it succeeds. Since time is needed for cumulative fiscal gains on the transition path to pay down the debt enough to make tight money sustainable, the borderline value of σ decreases with t_1. This has important implications for policy, the most obvious being that the efficacy of tight money may depend solely on credibility. To illustrate, suppose that σ equals 3.5. A grid search over t_1 then shows that pleasant monetarist arithmetic (PMA) is the unique equilibrium if the government can precommit to slower money growth for at least 1.64 years.[8] Success does not require perfect credibility—just enough to induce the private sector to coordinate on the PMA equilibrium.

This sounds too easy, and it is. The precommitment solution demands that the government abide by the tight-money policy *irrespective* of its consequences. The consequences, however, may be awful. Consider what happens when the reduction in money growth is 50 percent and, despite government pronouncements to the contrary, the public expects rapid money growth to resume after one year. In this case, the first year of the tight-money regime sees the real interest rate rise from 10 percent to 18 percent and the inflation rate soar from 30 percent to 84 percent. (The entries for the semielasticity of r and the elasticity of π are, respectively, 0.18 and 3.61 at $t = 1$.) Is there really any doubt that the commitment to tight money would then go by the wayside? Policymakers are practical people, not theorists; when faced with brute facts which indicate that a policy has failed, they are apt to accept those facts. Outcome-based policy rules are thus inherently fragile; by opening the door to multiple equilibria, they allow private sector beliefs alone to determine whether tight money succeeds or fails.

Nigeria in 1989–91

Since the government was a large net seller of foreign exchange and its internal debt was only 13 percent of GDP in 1988, Nigeria enjoyed a fair degree of natural protection against explosive, unstable debt dynamics. This is reflected in the data. The inflation rate decreased in 1989 and 1990 (albeit with help from good harvests and

[8]This statement is a bit loose. Obviously money growth is permanently lower on equilibrium paths characterized by pleasant monetarist arithmetic. But slower money growth after t_1 is guaranteed only if the government can precommit to a sufficiently long initial period of tight money.

tighter fiscal policy in the second year); it rose rapidly in 1991 and 1992, but on a trajectory consistent with undershooting of the new steady-state inflation rate. Real interest rates were low or negative until mid-1990, and the real rate on treasury bills peaked at 11 percent before controls were reimposed on bank rates in January 1991. Tight money failed in Nigeria, but the adverse macroeconomic effects materialized more slowly and were far less extreme than in Zambia and Kenya.

The numbers in Table 3 are broadly consistent with the outcome in the Nigerian tight-money episode. Inflation always decreases on impact, and undershooting occurs in 9 of the 10 cases, with π_{ss} being considerably larger than $\pi(t_1)$ when $\sigma = 3.5–4.2$. The real interest rate decreases initially but is 1–6 points higher by the end of the tight-money episode.

While many parameter values differ in the simulations for Kenya and Nigeria, the one that matters most is X, net sales of foreign exchange by the public sector. Inflation undershoots its long-run level, as shown in Table 3, because in Nigeria, unlike in the Kenyan case, depreciation of the real exchange rate greatly reduces the fiscal deficit. Lower revenue from consumption taxes and higher real interest rates near the end of the tight-money regime pull in the opposite direction, but these effects are comparatively weak when the internal debt is small (13 percent of GDP) and the consumption tax low (4 percent). Hence the fiscal deficit is usually *below* its steady-state level at time t_1. After the policy reversal, the real exchange rate appreciates until it regains its original level (v is unchanged across steady states). The deficit then increases steadily as the revenue losses from appreciation swamp the gains from falling real interest rates and collection of more consumption taxes ($\dot{E} > 0$ for $t > t_1$). Since nominal money growth rises monotonically in the post-tight-money phase, so does the inflation rate.

The fiscal impact of real appreciation explains another important aspect of the solutions—namely that there is little hope of achieving PMA. In the simulations

Table 3. Solutions for Nigeria 1989–91 Variant of Model

$\pi(0)$	$\pi(t_1)$	π_{ss}	$r(0)$	$r(t_1)$	$b(t_1)$	ε	σ
Intertemporal Elasticity of Substitution Equals 0.25							
–0.89	0.40	0.39	–0.05	0.02	0.44	0.59	2.00
–0.84	0.53	0.55	–0.05	0.02	0.46	0.70	2.50
–0.74	0.83	0.96	–0.05	0.03	0.52	0.80	3.00
–0.62	1.24	1.52	–0.04	0.05	0.59	0.86	3.25
–0.15	2.75	3.65	–0.02	0.10	0.87	0.91	3.50
PMA[1] Starts at $\sigma = 3.68$ ($\varepsilon = 0.95$)							
Intertemporal Elasticity of Substitution Equals 0.10							
–0.96	0.35	0.38	–0.08	0.02	0.41	0.61	2.50
–0.93	0.43	0.54	–0.08	0.03	0.42	0.71	3.00
–0.88	0.61	0.92	–0.07	0.03	0.45	0.82	3.50
–0.81	0.81	1.42	–0.07	0.05	0.48	0.88	3.75
–0.59	1.46	3.08	–0.05	0.08	0.57	0.93	4.00
PMA[1] Starts at $\sigma = 4.22$ ($\varepsilon = 0.98$)							

[1]PMA denotes pleasant monetarist arithmetic.

for Kenya, PMA is a potential equilibrium when $\varepsilon = 0.6-0.99$ because real appreciation, higher consumption spending, and lower real interest rates all work powerfully to reduce the fiscal deficit on the transition path. But in the Nigerian case, the gains conferred by lower real interest rates and higher consumption taxes have to overcome the losses caused by real appreciation. This is not easily done when the government's net sales of foreign exchange amount to 9 percent of GDP. As a result, failure claims almost the entire parameter space—PMA is confined to a small segment of the seigniorage Laffer curve where $0.95 < \varepsilon < 1.0$.

IV. An Alternative Specification of the Tight-Money Rule

I have followed Sargent and Wallace (1981) in assuming that the government exercises perfect control over the growth rate of high-powered money during the tight-money regime. This may be unrealistic. From 1989–91, the Nigerian government seemed to follow the rule that seigniorage was to finance no more than 35 percent of the fiscal deficit. In the Kenyan case, the underlying policy rule may have changed during the course of the tight-money episode. Policymakers started out with the intention of adhering to a fixed-money-growth rule. But as rising interest payments on the internal debt pushed the fiscal deficit above 6 percent of GDP (versus 1.9 percent in fiscal year (FY) 1991/92), it became increasingly difficult to control money growth (Roe and Sowa (1997), pp. 257–58). It is desirable therefore to know how the earlier results for the Kenyan 1993 episode change when tight money is implemented through a deficit-share rule instead of a fixed-money-growth rule.

Adopting this alternative specification, let α denote the fraction of the fiscal deficit financed by printing money. It is readily shown that during the tight-money phase,

$$\dot{m} = \alpha\left[g + rb + v(X - zE)\right] - \pi(m - \alpha b), \text{ and} \tag{18}$$

$$\dot{b} = (1-\alpha)\left[g + rb + v(X - zE)\right] - \alpha\pi b. \tag{19}$$

At the initial steady state, $\mu = \pi$ and $\alpha = m/(m + b)$. Tight monetary policy takes the form of an announced reduction in α. The rest of the model is the same as in Section I.

Kenya in 1993

The deficit-share rule weakens, but does not sever, the link between variations in the fiscal deficit and money growth. Consequently, in those parts of the parameter space where a rising fiscal deficit causes tight money to fail, the stock of government bonds grows more slowly than under a fixed-money-growth rule. And since the price dynamics are sensitive to the path of the internal debt, the increase in inflation is often less not only across steady states but also on the transition path. Compare the results in Table 2 with those in Table 4 for $\sigma = 2-4$. In all but two cases, the numbers for $b(t_1)$, π_{ss}, and $\pi(t_1)$ are lower under the deficit-share rule; the impact effect on π is also smaller whenever the tight-money paradox obtains

Table 4. Solutions for Kenya 1993 Variant of Model When Tight Monetary Policy Is Implemented Through a Deficit-Share Rule

$\pi(0)$	$\pi(t_1)$	π_{ss}	$r(0)$	$r(t_1)$	$b(t_1)$	ε	σ
Intertemporal Elasticity of Substitution Equals 0.25							
–0.30	0.23	0.09	–0.01	0.01	0.04	0.45	2.00
–0.07	0.40	0.13	0.00	0.02	0.04	0.60	3.00
0.12	0.55	0.16	0.01	0.03	0.04	0.67	3.50
0.41	0.77	0.20	0.02	0.04	0.04	0.75	4.00
0.92	1.17	0.28	0.05	0.06	0.04	0.82	4.50
2.15	2.12	0.47	0.12	0.11	0.04	0.90	5.00
8.51	7.08	1.46	0.47	0.37	0.03	0.98	5.50
No PMA[1]							
Intertemporal Elasticity of Substitution Equals 0.10							
–0.48	0.67	0.09	–0.04	0.05	0.04	0.43	2.50
–0.15	0.91	0.11	–0.01	0.07	0.04	0.51	3.00
0.30	1.26	0.13	0.02	0.09	0.04	0.58	3.50
1.00	1.78	0.16	0.07	0.13	0.04	0.66	4.00
2.21	2.70	0.22	0.17	0.20	0.05	0.73	4.50
4.83	4.68	0.35	0.36	0.35	0.05	0.81	5.00
PMA[1] Starts at $\sigma = 5.87$ ($\varepsilon = 0.94$)							

[1]PMA denotes pleasant monetarist arithmetic.

(that is, whenever $\hat{\pi}(0) > 0$).[9] More importantly, the difference in the numbers is often quantitatively large. When $\sigma = 4$ and $\tau = 0.25$, for example, the elasticities for $\pi(t_1)$, π_{ss}, $r(t_1)$, and $b(t_1)$ are four times larger in Table 2 than in Table 4. The deficit-share rule is less harmful in this case because it allows for a partial, endogenous retreat from bad policy during the period $(0, t_1)$.

Although the comparison generally favors the deficit-share rule for $\sigma < 4$, the overall ranking of the two rules is uncertain. The deficit-share rule has a major shortcoming. Observe that the tight-money paradox combines with very high real interest rates when $\sigma = 3$–5.5 in Table 4. The zone of ugly macroeconomic failure is thus much larger for the deficit-share rule and covers most of the region where a fixed-money-growth rule generates pleasant monetarist arithmetic. In a sizable part of the parameter space, the deficit-share rule leads to failure when success was there for the taking with the right policy rule.

Nigeria in 1989–91

The choice of policy rule does not matter much in the Nigerian case. Inflation and the real interest rate decrease more in the short run when the government opts for the deficit-share rule. Otherwise, the results follow the same pattern as in Table 3.

[9]The solutions for π and b are elasticities with respect to α, while those for r are semielasticities. When comparing results across tables, note that at the initial equilibrium a 10 percent reduction in α generates an equal 10 percent reduction in money growth. Ex post, however, the reduction in money growth will differ under the deficit-share and fixed-money-growth rules.

Under both policy rules, the real interest rate rises sharply toward the end of the tight-money regime and inflation undershoots its steady-state level on the transition path.

Policy Rules, Capital Flows, and the Puzzle of Transitory High Real Interest Rates

The distinction between the two tight-money rules is relevant to the high real interest rate puzzle. Under a fixed-money-growth rule, very high real interest rates are "unusual," in the sense that they are confined to a small part of the parameter space: $\sigma = 3.75–4.2$ for $\tau = 0.25$ and $\sigma = 3.0–3.65$ for $\tau = 0.10$. The parameter space associated with high real interest rates is somewhat larger when $\tau = 0.25$ and the government follows a deficit-share rule, but explanation of the puzzle requires values of σ in the 4.5–5.5 range. Such values may be implausibly large, evidence of easy currency substitution notwithstanding.

Table 4's lower panel suggests another, perhaps more convincing explanation for transitory high real interest rates. Estimates of the intertemporal elasticity of substitution indicate that τ might be as low as 0.10–0.15 in sub-Saharan Africa. If this is actually the case, then high real interest rates are consistent with a wide range of plausible values for σ. For $\tau = 0.10$, the zone of high real interest rates in Table 4 is 3.0–5.8. The zone is smaller at higher values of t_1, but tight money still gives rise to very high real rates when $t_1 = 2–3$ and $\sigma = 3–5$. Observe also that the elasticities for $b(t_1)$ are extremely small. This is relevant to Zambia's experience: the real internal debt increased very little in 1993. Nevertheless, it would be wrong to conclude that something other than tight money must have been the principal cause of high inflation and high real interest rates.

While the zone of high real interest rates differs for the two policy rules, in both cases high rates are associated with capital *outflows* and depreciation of the real exchange rate. It is hard to judge whether this or the alternative combination of high real interest rates, capital inflows, and appreciation of the real exchange rate fits the stylized facts better. In the Nigerian episode, capital outflows were associated with continuous, strong depreciation of either the official or the parallel exchange rate and with high real interest rates after the second quarter of 1990. According to some accounts (see, for example, Roe and Sowa (1997), p. 242), Kenya's high interest rates attracted large capital inflows in 1993. A closer examination of the data, however, reveals sizable net capital outflows during the tight-money period, with the outflows being very large in the later stages when nominal and real interest rates were at their peaks. And regardless of what happened earlier, Kenya's latest experiment with tight money seems to have led to higher interest rates, substantial depreciation of the real exchange rate, and capital outflows. Zambia in 1993 is certainly a case where the real exchange rate appreciated strongly. But the exchange rate system was far from a pure float in 1993; moreover, the impact on the capital account is hard to gauge, because the current account figures may conceal substantial capital flight and because some of the observed gross inflows were probably a response to the loosening of exchange controls and the extreme liquidity shortage the economy faced at the end of 1992.

Summing up, the facts are thoroughly confusing; almost every conceivable combination of changes in the real interest rate, the real exchange rate, and capital flows can be found—or arguably might exist—in the empirical record. I suspect that a satisfactory account of the full range of outcomes seen in different tight-money episodes requires both better data and further theoretical analysis that allows for different initial conditions and alternative rules for management of the exchange rate (for example, different types of managed floats).

V. Concluding Remarks

In this article, I have analyzed tight monetary policy in various models of small, open economies in sub-Saharan Africa. The results contradict the conventional wisdom that tight money must fail if there is no change in the fiscal regime. The conventional view errs in concluding that lower seigniorage across steady states implies unstable growth of government debt. In focusing on steady states, it overlooks the possibility that transitory decreases in the real interest rate, transitory appreciation of the real exchange rate, transitory gains in seigniorage, and transitory increases in tax revenues may enable the government to reduce the internal debt to a level compatible with permanently lower money growth and, hence, permanently lower inflation. This outcome, dubbed pleasant monetarist arithmetic, does not require an unusually high value for the elasticity of money demand with respect to inflation. The transitory fiscal gains may be large enough to engender PMA when the elasticity is as low as 0.5 or 0.6. Credibility and the form of the policy rule, however, are quite important. It is essential that the government's commitment to slower money growth be unconditional. Multiple equilibria rear their ugly heads when the public knows that sharp increases in inflation and/or the real interest rate will provoke a policy reversal: because policy is outcome-dependent, both expectations of success and expectations of failure are likely to be self-fulfilling equilibrium outcomes. The chance of getting onto an equilibrium path that delivers PMA is also much lower if the government commits only to monetize a smaller share of the deficit. The problem, once again, is that the policy rule does not embody a firm commitment to slower money growth. It says, implicitly, that money growth will be slower only if the fiscal deficit does not increase too much.

None of this denies that tight money is a dangerous, risky policy and that governments would be well advised to attack inflation by coordinating slower money growth with expenditure cuts and tax increases. The relevant parameter space includes horrendous macroeconomic failure as well as PMA. When the intertemporal elasticity of substitution is low and domestic and foreign currency are close substitutes, the real interest rate may shoot up to 20–40 percent while inflation soars and the fiscal deficit spirals out of control. Adverse supply-side effects also add to the misery. In the longer version of the paper on which this article is based, I show that the output losses from capital decumulation and rising unemployment are small but highly persistent. Although the real interest rate falls rapidly after the tight-money policy is reversed, recovery to the initial level of GDP is exceedingly slow and real output losses of 1–4 percent may endure 10–30 years. Moreover, this slow pace of recovery presumes a moderate degree of real wage flexibility (in the formal sector). If workers refuse real wage cuts, the economy never recovers from the shock of temporary high real interest rates—the decreases in the capital stock, GDP, and employment become permanent.

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