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Fiscal inertia, donor credibility, and the monetary management of aid surges

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ABSTRACT

Donors cannot pre-commit to support scaled-up public spending programs on a continuing basis, nor can governments credibly commit to curtail expenditure rapidly in the event that aid revenues contract. An aid boom may therefore be accompanied by a credibility problem. When this is the case, the *absorb-and-spend* strategy recommended by the IMF leads to capital flight, higher inflation, and large current account surpluses inclusive of aid. The right policy package combines a critical minimum degree of fiscal restraint with *reverse sterilization*.

1. Introduction

> To *absorb and spend* the aid would appear to be the appropriate response under "normal" circumstances. (Berg et al., 2007, p.19)

> Surprisingly, a full absorb-and-spend response is not observed in any of the sample countries. (Berg et al., 2007, p.36)

> In all countries, part of the aid increment was lost through reductions in the rate of capital inflow. In Ghana, the deterioration in the non-aid capital account exceeded the entire increment in the aid inflow. In Tanzania and Uganda, the reduction in the rate of non-aid capital inflows was comparable to the aid surge. (Berg et al., 2007, p.28)

Aid flows fluctuate considerably over the medium run.[1] This complicates macroeconomic management of aid booms because political realities and institutional constraints limit the use of reserve buffer stocks. In developing countries almost every branch of the public sector other than the Ministry of Finance has a long list of projects that are supposed to receive funding as soon as budgetary conditions ease. The internal pressures to spend aid money as it arrives are thus very strong. Moreover, donors are also highly averse to fiscal prudence; they want to see their money spent doing good, not piling up as reserves in central bank vaults. Economists' counsel that the country should spend only the annuity value of the aid boom may be tolerated awhile, but if the government ignores donor sentiment for too long it could provoke a suspension of aid (Eifert and Gelb, 2005; Berg et al., 2007). As Adam and Bevan (2003) observe, "to treat aid as temporary is to risk making it so."

Since a full-fledged reserve buffer stock is policy non grata, expenditure cuts and/or tax increases are essential to maintain macroeconomic stability when aid flows decline to a normal level. Fiscal retrenchment, however, is generally slow and painful (Heller, 2005). The ends of resource and aid booms invariably witness large and persistent financing gaps as governments struggle to reverse prior spending commitments.[2] This reality is widely accepted in the policy world. Most IMF programs, for example, include "adjusters" that allow the fiscal deficit to increase by 50–100% of a negative aid shock (Berg et al., 2007).

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[1] Bulir and Hamann (2003, 2008) estimate aid flows to be 4–13 times more volatile than other types of fiscal revenue. In Arellano et al.'s dataset, the standard deviations of the ratio of aid to national income and of the ratio of aid commitments to disbursements are 7 and 10 times their respective means.

[2] See Collier and Gunning (1999), Tornell and Lane (1999), and the section on Lessons from Commodity Booms in Foster and Killick (2006).

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In all likelihood the private sector is aware of the connection between aid surges and the path of the fiscal deficit. Donors cannot pre-commit to support scaled-up public spending programs on a continuing basis, nor can the government credibly commit to curtail expenditure rapidly in the event that aid revenues contract. The public has ample grounds therefore to fear that today's aid boom threatens future fiscal stability. This adds another layer of complexity to the task facing policy makers. Success on the macroeconomic front requires not only a "fiscal exit plan" for coping with a possible aid collapse (Heller, 2005), but also a strategy for managing private sector expectations.

This paper investigates the credibility problem inherent in the interaction of aid volatility and fiscal inertia. Our analysis is structured with two objectives in mind. The positive objective is to gain a better understanding of the stylized facts associated with aid booms. Country studies recently completed at the IMF (Berg et al., 2007) and the ODI (Foster and Killick, 2006) found that the current account deficit typically increases by less than half of the rise in aid flows and that aid surges often coincide with large capital outflows. These are disconcerting correlations. The current account deficit has to increase by the same amount as aid to effect a complete transfer of resources. The case study data indicate this did not happen; most aid appeared to finance capital flight rather than an increase in net imports.

The Fund blames low absorption rates (measured by the change in the current account) on the reluctance of central banks to sell aid dollars and let the exchange rate appreciate. It also conjectures that low absorption lies behind the recycling of aid into capital outflows: on this view, when absorption rises less than the fiscal deficit, some of the aid-induced increase in government spending is effectively financed by printing money; if the excess liquidity is not withdrawn through bond sales, it then flows out via the capital account.[3]

For several reasons, the Fund's conceptual framework and its interpretation of the data are problematic (more on this later). The alternative explanation advanced here is that low absorption rates and large capital outflows stem from an unsolved credibility problem. Elaborating, we show that the Fund's preferred strategy of spending all the aid and floating the exchange rate (what the Fund calls the *absorb-and-spend* approach) works well when the public believes the aid surge is permanent: in the numerical simulations we report for this scenario, absorption quickly rises to 90–100%, inflation decreases 1–1.4 percentage points, and private capital outflows fluctuate between .5 and 1% of GDP. But everything goes wrong if the public fears the aid boom may be temporary and that larger fiscal deficits and rapid money growth loom on the horizon. Even though the government is committed to a full absorption policy and all extra public sector spending is financed by the sale of aid dollars, the absorption rate then drops to 35–65% while capital flight claims 30–60% of the aid inflow and inflation soars from 15% to 22–33%. The Fund is right when it asserts that *absorb and spend* (really float and spend) is the correct approach under "normal" circumstances. But circumstances are often not normal. When aid volatility and fiscal inertia undermine credibility, *absorb and spend* is a recipe for disaster.

Our second objective is to ascertain the best policy response to the credibility problem. To frame the normative analysis, we assume policy makers are unable to allay private sector concerns about the durability of aid and the government's capacity for expeditious fiscal retrenchment. In this situation, the challenge for the government is to devise a strategy that keeps macroeconomic instability at bay until the passage of time reveals whether the aid boom is truly permanent.

It turns out that successful intervention requires a *policy package*. Operating on their own, neither fiscal nor monetary policy can resolve the country's macroeconomic problems. Reducing expenditure and selling bonds are reflex, business-as-usual responses to inflation and capital flight. They treat the symptoms of the credibility problem but do not give the private sector any reason to alter its view that the aid boom is a fiscal and money growth time bomb. The right strategy combines a critical minimum degree of fiscal restraint with *reverse sterilization*. During the low-credibility phase, the government uses part of the aid inflow ($\approx$ 25%) to cut the fiscal deficit and pay down the internal debt. Crucially, the reverse sterilization component of the package buys extra time to adjust to future adverse aid shocks. If the aid boom subsequently collapses, the central bank sells the bonds it purchased earlier, maintaining control of money growth and inflation while the fiscal authorities take steps to realign spending with revenue. Thus the fiscal time bomb is no longer an inflation time bomb. The resulting shift from pessimistic to neutral expectations in the private sector repairs much of the damage done by the *absorb-and-spend* strategy: inflation stays below its previous level, capital outflows decrease 25%, and the absorption rate rises 10 points. *Temporary fiscal restraint + reverse sterilization* is not a perfect solution to the credibility problem; it does, however, go a long way toward making the problem manageable.

Our analysis is complementary to research by Lensink and Morrissey (2000), Pallage and Robe (2003), Arellano et al. (2009), and Celasun and Walliser (2008) on the welfare costs of aid volatility. The central finding in this literature is that the losses from induced variability in consumption and from changes in the levels of public and private investment are sizable. Our results add another item to the list of potential welfare costs: prolonged bouts of high inflation when policy makers fail to address the aid credibility problem with the right policy package.

The rest of the paper is organized into seven sections. In Sections 2 and 3 we develop an optimizing model of a small open economy and calibrate it to the data for low-income countries in Sub-Saharan Africa. Section 4 demonstrates that the *absorb-and-spend* approach works well when the aid boom is known to be permanent but is fraught with problems when it is expected to be temporary. Section 5 examines alternative policy responses to the credibility problem and Section 6 tests the robustness of the results to a wider range of parameter values. Section 7 concludes.

2. The Model

We extend the model in Buffie et al. (2008) to allow for temporary aid shocks and fiscal inertia. The specification of the real economy is primitive. Competitive firms produce a nontraded good and a composite traded good. Real output is fixed in both sectors, the exchange rate system is a pure float, and the world price of the traded good equals unity.[4] On the financial side, the private sector divides its wealth between domestic currency M, foreign currency F, and government bonds B. Bonds are indexed to the price level P, so $B = Pb$, where $b \equiv B/P$. Other notational conventions are as follows: C_i and Q_i are consumption and output in sector i; e is the nominal exchange rate; and P_n and E are the relative price of the nontraded good and aggregate real expenditure measured in dollars (i.e., units of the traded good).

[3] See Berg et al. (2007, p. 30). The authors acknowledge that the argument is speculative and that the relationship between aid and private capital flows is not well understood: "Identifying the conditions under which aid would lead to a capital outflow or inflow is therefore a nontrivial undertaking, which is left to future work." (p. 30).

[4] The assumption of constant output is innocuous. With variable output, price changes in the nontradables sector depend on both demand and supply responses. All of the results in the paper go through with η redefined to be the sum of the compensated elasticity of demand and the general equilibrium elasticity of supply for nontradables.

2.1. Preferences and the private agent's optimization problem

All economic decisions in the private sector are controlled by a representative agent who derives utility from consumption of traded and nontraded goods and from the liquidity services generated by holdings of domestic and foreign currency.[5] To obtain concrete results, we assume preferences take the form

$$U=\int_0^\infty\left[\frac{C(C_n,C_T)^{1-1/\tau}}{1-1/\tau}+h\frac{\phi(M/P,eF/P)^{1-1/\tau}}{1-1/\tau}\right]e^{-\rho t}dt, \tag{1}$$

where

$$C(C_n,C_T)=\left[k_oC_T^{(\beta-1)/\beta}+k_1C_n^{(\beta-1)/\beta}\right]^{\beta/(\beta-1)},$$
$$\phi(M/P,eF/P)=\left[k_2(M/P)^{(\sigma-1)/\sigma}+k_3(eF/P)^{(\sigma-1)/\sigma}\right]^{\sigma/(\sigma-1)},$$

are linearly homogeneous CES aggregator functions; h and k_o–k_3 are positive constants; ρ is the pure time preference rate; τ is the intertemporal elasticity of substitution; β is the elasticity of substitution between traded and nontraded consumer goods; and σ is the elasticity of substitution between domestic and foreign currency.

The private agent solves his optimization problem in two stages. In the first stage, C_n and C_T are chosen to maximize $C(C_n, C_T)$ subject to the constraint $P_nC_n+C_T=E$. The optimal choices $\bar{C}_n$ and $\bar{C}_T$ are subsumed in the indirect utility function

$$V(P_n,E)=C[\bar{C}_n(P_n,E),\bar{C}_T(P_n,E)]=E/c(P_n),$$

where

$$c(P_n)=\left(k_o^\beta+k_1^\beta P_n^{1-\beta}\right)^{1/(1-\beta)}.$$

As a byproduct of optimization, we get the solution for the exact consumer price index:

$$P=ec(P_n). \tag{2}$$

For future use, note also that

$$\pi=\chi+\gamma\dot{P}_n/P_n, \tag{3}$$

where $\pi=\dot{P}/P$ is the inflation rate; $\chi=\dot{e}/e$ is the rate of currency depreciation; and $\gamma=k_1^\beta P_n^{1-\beta}/[k_o^\beta+k_1^\beta P_n^{1-\beta}]$ is the consumption share of the nontraded good.[6]

In the second stage of optimization, the private agent chooses asset holdings and expenditure to maximize

$$U=\int_0^\infty\left[\frac{E^{1-1/\tau}}{1-1/\tau}+h\frac{\phi(m,F)^{1-1/\tau}}{1-1/\tau}\right]c(P_n)^{(1-\tau)/\tau}e^{-\rho t}dt, \tag{1'}$$

subject to the wealth constraint

$$A=m+\frac{P}{e}b+F \tag{4}$$

and the budget constraint

$$\dot{A}=P_nQ_n+Q_T+g+(r+\pi-\chi)\frac{P}{e}b-E-\chi m, \tag{5}$$

where $m\equiv M/e$; r is the real interest rate; and g is real lump-sum transfers received from the government (fixed in units of the traded good).[7]

The *Maximum Principle* furnishes the necessary conditions for an optimum. These consist of

$$E^{-1/\tau}c(P_n)^{(1-\tau)/\tau}=\omega, \tag{6}$$

$$h\phi(m,F)^{-1/\tau}\phi_m(m,F)=E^{-1/\tau}(r+\pi), \tag{7}$$

$$h\phi(m,F)^{-1/\tau}\phi_F(m,F)=E^{-1/\tau}(r+\pi-\chi), \tag{8}$$

$$\dot{\omega}=\omega(\rho+\chi-r-\pi) \tag{9}$$

where ω is the multiplier attached to Eq. (5). Eqs. (6)–(8) hold no surprises. As expected, the marginal utility of consumption equals the shadow price of wealth and the marginal rate of substitution between consumption and m or F equals the income foregone from holding that type of money. The co-state Eq. (9) may look less familiar, but it is nothing more than a standard Euler equation. Differentiate Eq. (6) with respect to time and substitute for $\dot{\omega}$. This gives

$$\dot{E}/E-\gamma\dot{P}_n/P_n=\tau(r-\rho), \tag{10}$$

where the term on the left side is the percentage change in aggregate real consumption.

2.2. The nontradables sector

P_n adjusts to clear the goods market in the nontradables sector. This requires

$$C_n=Q_n, \tag{11}$$

where C_n is retrieved from the indirect utility function by invoking Roy's Identity

$$C_n=-\frac{\partial V/\partial P_n}{\partial V/\partial E}=E\frac{k_1^\beta P_n^{-\beta}}{k_o^\beta+k_1^\beta P_n^{1-\beta}}. \tag{12}$$

2.3. The public sector budget constraint

The fiscal deficit net of aid may be financed by printing money, by selling bonds, or by selling foreign exchange reserves Z. For simplicity, we ignore interest earned by reserves. The consolidated public sector budget constraint is thus

$$\dot{m}+c(P_n)\dot{b}-\dot{Z}=g+c(P_n)rb-X-\chi m, \tag{13}$$

where X is sale of aid dollars and we have substituted $c(P_n)$ for P/e.

2.4. Net foreign asset accumulation

Summing the private and public sector budget constraints produces the accounting identity that total foreign asset accumulation equals national saving or the current account surplus:

$$\dot{F}+\dot{Z}=P_nQ_n+Q_T+X-E. \tag{14}$$

In a pure float, the overall balance of payments, $\dot{Z}$, is zero. The capital account deficit ($\dot{F}$) then equals the current account surplus inclusive of aid.

[5] A large and growing body of work concludes that currency substitution and private capital flows are important to the macroeconomic picture in Sub-Saharan Africa. See Fielding (1994), Asea and Reinhart (1996), Bhindra et al.(1999), Adam (1999), Henstridge (1999), Nachega (2001), Collier et al.(2002), Fedderke and Liu (2002), International Monetary Fund (2004), and Munoz (2006).

[6] It easy to confirm that $\gamma=P_nC_n/E$. See Eq. (12) that follows in the text.

[7] Since $\phi(\cdot)$ is homogeneous of degree one and $P/e=c(P_n)$, the liquidity services function can be written as $\phi(M/P,eF/P)=\phi(m,F)/c(P_n)$. Note also that the artificial capital gains term $(\pi-\chi)(P/e)b$ shows up in the budget constraint because the traded good is the numeraire but bonds are indexed to the price level.

2.5. Temporary aid surges and fiscal inertia

We use the game-theoretic analysis in O'Connell et al. (2008) to discipline the specification of aid flows and fiscal policy. To fix ideas, suppose policy makers find it difficult to distinguish between short- and long-term aid surges because temporary donors mimic permanent donors in a pooling equilibrium. When aid flows jump from X_o to X_1 at $t=0$, the government and the private sector conjecture that the aid surge will end at $t=T$ with probability p. During this low-credibility period, the government may decide to err on the side of caution and spend only a fraction of the extra money on transfers to the "poor" (i.e., the representative agent):

$$g_1 = g_o + \psi(X_1 - X_o), \ \psi \le 1, \ 0 < t < T. \quad (15)$$

The objective of the permanent donor is to increase annual transfers to the poor by $X^* - X_o$. (This increase equates the marginal benefit of aid for the donor to its opportunity cost.) In the pooling equilibrium, however, the aid recipient has an incentive to divert some aid to a buffer stock. To discourage underspending, optimizing long-term donors give more aid in the short run than in the full-information/no-uncertainty case. This carrot is paired with a stick: aid cuts in the medium run equal to the full amount of any buffer stock the recipient accumulated while the duration of the aid surge was in doubt. Since *use-it-or-lose-it* is a perfectly credible threat on the part of long-term donors (see O'Connell et al., 2008), recipients have to balance the potential gains from consumption smoothing against the potential loss of future aid.

These results fix the path of aid. In the period (0,T), the permanent donor gives

$$X_1 = X_o + \frac{X^* - X_o}{\psi}, \ 0 < t < T, \quad (16a)$$

to induce the recipient to increase spending by $g_1 - g_o = X^* - X_o$. The temporary donor mimics the permanent donor.

Uncertainty is resolved at T. If the donor is the temporary type, aid falls back to X_o:

$$X(t)|_{\text{temporary donor}} = X_o, \ t > T. \quad (16b)$$

When the donor is the permanent type, the path depends on how much of the extra aid was spent in the preceding period (0,T). Under the use-it-or-lose-it clause, the donor reduces aid to $X^* - (1-\psi)(X_1 - X_o)$ for T years before fixing X at X^*:

$$X(t)|_{\text{permanent donor}} = \{X^* - (1-\psi)(X_1 - X_o), \ T < t < 2T \ X^*, \ t > 2T \quad (16c)$$

The path of spending also divides at T. If the aid boom collapses, the government must either curtail expenditure or tolerate a higher fiscal deficit and higher inflation. We assume policy makers are averse to higher inflation but find it difficult to terminate spending programs initiated during the boom phase. Transfer payments decrease at the rate

$$\dot{g} = v(g_o - g), \ t > T, \quad (17)$$

where $v > 0$ determines the degree of fiscal inertia.

When the government draws a permanent donor, transfers stay at g_1.[8] In the period $T < t < 2T$, the buffer stock carried over from the low-credibility period [$Z(T) > Z_o$ or $b(T) < b_o$] pays for $(1-\psi)(X_1 - X_o)$ of the extra spending.[9] After the "punishment phase" is over, $X = X^*$ and all extra spending is financed by extra aid.

2.6. The transition at T

Most of the numerical results presented in Sections 4–6 admit of straightforward intuitive explanations. The transition at T, however, is complicated. In a longer version of the paper available at http://mypage.iu.edu/~ebuffie, we derive the intertemporal arbitrage conditions

$$E(T^-)^{-1/\tau}c[P_n(T^-)]^{(1-\tau)/\tau} = pE_1^{-1/\tau}c(P_{n1})^{(1-\tau)/\tau}e(T^-)/e_1 + (1-p)E_2^{-1/\tau}c(P_{n2})^{(1-\tau)/\tau}e(T^-)/e_2, \quad (18)$$

$$E(T^-)^{-1/\tau}c[P_n(T^-)]^{(1-\tau)/\tau} = pE_1^{-1/\tau}c(P_{n1})^{(1-\tau)/\tau} + (1-p)E_2^{-1/\tau}c(P_{n2})^{(1-\tau)/\tau}. \quad (19)$$

The first condition says that the ratio of the marginal utility of consumption to its price as $t \to T^-$ equals the expected ratio of the marginal utility of consumption to its price as $t \to T^+$. To see the logic of the second condition, substitute for $E(T^-)^{-1/\tau}c[P_n(T^-)]^{(1-\tau)/\tau}$ in Eqs. (18) from (19). After collecting terms, we have

$$p \underbrace{E_1^{-1/\tau}c(P_{n1})^{(1-\tau)/\tau}}_{\substack{\text{mu of consumption at} \\ T^+ \text{ for temporary aid}}} \left[\frac{e_1 - e(T^-)}{e_1}\right] + (1-p)\underbrace{E_2^{-1/\tau}c(P_{n2})^{(1-\tau)/\tau}}_{\substack{\text{mu of consumption at} \\ T^+ \text{ for permanent aid}}} \left[\frac{e_2 - e(T^-)}{e_2}\right] = 0. \quad 20$$

E and m jump onto the appropriate saddle path at T. Since the nominal money supply is predetermined, the requisite jump in m is achieved through a jump in the nominal exchange rate. Now compute the return to buying one dollar of the foreign currency as t approaches T from below. When the aid surge ends at T, the currency depreciates and the private agent reaps a capital gain of $e_1 - e(T^-)$. This buys $[e_1 - e(T^-)]/e_1$ additional units of consumption at T^+. The utility gain from a winning bet is therefore $[e_1 - e(T^-)]/e_1$ multiplied by $E_1^{-1/\tau}c(P_{n1})^{(1-\tau)/\tau}$, the marginal utility of consumption at T^+. Conversely, $E_2^{-1/\tau}c(P_{n2})^{(1-\tau)/\tau}$ $[e_2 - e(T^-)]/e_2$ measures the utility loss from a losing bet when the aid surge proves permanent and the currency appreciates. The sum of the two terms on the left side in Eq. (20) is thus the expected utility gain from swapping m for F a second before T. Arbitrage drives the expected gain to zero.

2.7. The benchmark model

The benchmark model corresponds to the IMF's *absorb-and-spend* strategy. In this variant of the model,

$$\dot{b} = \dot{Z} = 0, \ X_1 = X^*, \ \psi = 1,$$

$$X(t)|_{\text{permanent donor}} = X^*, \ t > 0.$$

The government spends all of the extra aid and the central bank refrains from foreign exchange and open market operations. No aid dollars are diverted to a rainy-day fund, so the permanent donor gives X^* every period.

[8] There is no point in reducing transfers to avoid an increase in the primary fiscal deficit in the period (T, $2T$). This simply extends the length of the punishment phase.

[9] The case where the government engages in temporary fiscal restraint but does not accumulate a buffer stock is analyzed in Section 5.2.

2.8. Discussion of the model

Several aspects of the model merit discussion. First, it is not necessary to assume that uncertainty about aid flows stems from uncertainty about the donor's type. O'Connell et al. (2008) show that donors and recipients behave in the same way when future aid flows depend on the donor's re-election prospects or on business cycle conditions that affect the opportunity cost of aid funds. The two setups differ only in the permissible range of values for p, the recipient's prior probability of an aid reversal. The game with temporary vs. permanent donors restricts p to be less than .70; for higher values of p, pooling is not a perfect Bayesian equilibrium. By contrast, in the game with a single donor and symmetric but incomplete information, p can take any value between zero and one.

Second, aid in the model is program aid, not project aid. The distinction between volatility and *unpredictability* motivates this choice. Both program and project aid are highly volatile; project aid is much more predictable, however, because donors usually commit to a timetable for delivery of funds once a project is approved.[10]

Despite the difference in predicability, the macroeconomic problems involved in managing a surge in project aid are broadly similar to the problems involved in managing a surge in program aid. Project aid ceases when construction of the capital asset is completed at T. What is uncertain is the path of the fiscal deficit after the LDC government assumes responsibility for recurrent costs. If the public fears that the government may not immediately cut other expenditures or increase taxes to cover higher outlays on operations and maintenance, then a surge in project aid threatens future fiscal and monetary stability. Many of the insights in the current model carry over, but the supply-side effects of project aid complicate the story and could change some of the results.[11] The issue deserves attention in future research.

Finally, the precise form of the use-it-or-lose-it (UILI) penalty is not important. We have solved the model for two less punitive versions of UILI where the permanent donor (a) maintains the higher level of aid but requires the recipient to increase spending in the period (T, $2T$) by the amount of aid hoarded in period (0,T) or (b) tolerates a modest amount of underspending in period (0,T) provided the recipient spends all aid after T (i.e., after the recipient is assured that the aid surge is permanent). These modifications produce different post-T paths for aid and the fiscal deficit in the permanent donor scenario. But the credibility problem stems from the volatility of aid flows and the difficulty of fiscal adjustment in the aftermath of an aid collapse, not from the post-T transition path with permanent aid. The results are highly robust therefore to alternative plausible specifications of UILI.

From here we proceed directly to calibration of the model. The longer version of the paper available at http://mypage.iu.edu/ebuffie explains how to solve the model.

3. Model calibration

Table 1 lists the parameter values used to calibrate the model. m_o, π_o, b_o, γ_o and X_o are close to the values seen in the poorest countries in Sub-Saharan Africa, but the values for the deep parameters β, σ, and τ are based on econometric estimates for other LDCs. Below we comment briefly on the rationales for the numbers assigned to these parameters and to ρ, p and F_o:

- *Elasticity of substitution in consumption between traded and non-traded consumer goods* (β). Fixing β at .50 implies that the compensated elasticity of demand for the nontraded good is .25 initially. This agrees with the finding in empirical studies that compensated elasticities of demand tend to be small at high levels of aggregation.[12]
- *Elasticity of substitution between domestic and foreign currency* (σ). There are no reliable estimates of σ for any country in Africa. For Latin America the numbers range from one to seven (Ramirez-Rojas, 1985; Marquez, 1987; Giovannini and Turtleboom, 1994; Kamin and Ericsson, 1993). Not trusting the high-end estimates (7??), we decided to carry out runs for $\sigma = .75$, 1.50.
- *Time preference rate* (ρ). The time preference rate is 8% because the real interest rate on government debt—fixed by ρ across steady states—is high in countries likely to be large aid recipients.[13]
- *Elasticity of intertemporal substitution* (τ). Most estimates for LDCs place τ between .10 and .50 (Agenor and Montiel, 1999, Table 12.1). Since we have the poorest LDCs in mind, τ is fixed at .25.
- *Ratio of foreign currency to national income* (F_o). Foreign currency deposits in the domestic banking sector range from 50% to 200% of reserve money in Ghana, Mozambique, Tanzania, and Uganda. In addition, a good deal of foreign currency is held outside of the domestic banking system. We arbitrarily set F_o at .15. This is in line with dollarization ratios in other parts of the Third World.[14]
- *Degree of fiscal inertia* (v). Most runs assume $v = 1$. This implies an intermediate degree of fiscal inertia: 87% of spending increases introduced during the aid boom are reversed within two years. In the benchmark model, we also present results for a low degree of fiscal inertia ($v = .50$) where it takes four years to cut spending 87%.
- *Size of the aid surge*. The data presented in Bulir and Lane (2004) and Bulir and Hamann (2008) suggest that unpredictable aid surges are on the order of 1–4% of GDP.[15] Aid flows are also known to be more unpredictable in poor, highly aid-dependent countries. We fixed the aid surge therefore at 3% of national income.
- *Probability of an aid reversal* (p). $p = .65$ to reflect the high volatility of aid flows. Section 6 investigates the outcomes for $p = .25$ and $= .90$.

4. Aid booms with and without credibility

> Absorption depends on the response of the central bank … The combination of absorption and spending chosen by the authorities defines the macroeconomic response to aid. (International Monetary Fund, 2007, p.2)

The IMF uses a *spend and absorb* framework to classify macroeconomic responses to an aid boom. *Spend* is defined to be the increase in

[10] See Bulir and Lane (2004) and Celasun and Walliser (2008) for evidence that program aid is far more unpredictable than project aid. (Celasun and Walliser observe that the predictability of program/budget aid is "strikingly low.") The relative importance of the two types of aid varies across countries. Program aid is a large share of total aid, however, in Sub-Saharan Africa. It accounts for roughly 50% of total aid, for example, in Tanzania, Sierre Leone, Uganda, Rwanda, and Mozambique (Celasun and Walliser, 2008).

[11] Growth in productive capacity following completion of the project may blunt inflationary pressures for several years, buying the government a grace period for fiscal adjustment. But if the project crowds-in private investment, demand growth may outstrip supply growth in the short and medium run. Moreover, the scope for combating the credibility problem with a buffer stock scheme is reduced to the extent that aid-financed projects are not fungible with other projects the government intends to undertake.

[12] See Lluch et al. (1977, chapter 3), Deaton and Muellbauer (1980, p.71), Blundell (1988, p.35), and Blundell, Pashardes, and Weber (1993, Table 3b, p.581).

[13] In Ghana, for example, the IMF (2003, p.66) reports that short-term treasury bills have paid an average real interest rate of 8.25% since 1992.

[14] See Kamin and Ericsson (1993), Savastano (1996), and Balino, Bennett, and Borensztein (1999).

[15] In Bulir and Lane (2004), the difference between median aid projections and median aid disbursements ranges from 1.4% to 2.9% of GDP for program aid. In the dataset Bulir and Hamann (2008) assembled for 76 countries, the average maximum aid inflow exceeds the average mean level of aid by 5.6% of GDP. Not all of the 5.6% difference, however, reflects prediction error.

Table 1
Calibration of the model.

Parameter/variable	Assigned value
Reserve money (m)	10% of GNP
Inflation (π)	15%
Stock of internal debt (b)	10% of GNP
Consumption share of nontraded good (γ)	50%
Aid (X)	10% of GNP
Degree of fiscal inertia (v)	.50, 1
Time preference rate (ρ)	8%
Foreign currency (F)	15% of GNP
Elasticity of substitution between traded and nontraded consumer goods (β)	.50
Elasticity of substitution between domestic and foreign currency (σ)	.75, 1.50
Intertemporal elasticity of substitution (τ)	.25
Aid surge	3% of GNP
Prior probability of an aid reversal (p)	.65

Table 2
Transition path when the aid boom is known to be permanent.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=4$	$t=5$	Long run
$\sigma=.75$							
π	.144	.142	.141	.140	.140	.140	.139
r	.088	.085	.083	.082	.081	.081	.08
RER	.91	.90	.90	.90	.89	.89	.89
CA	.0042	.0028	.0018	.0012	.0008	.0005	0
CCF	0	.0037	.0062	.0079	.0090	.0097	.011
AR	–	.88	.90	.91	.93	.94	1
$\sigma=1.50$							
π	.139	.138	.137	.137	.137	.136	.136
r	.083	.082	.081	.081	.081	.080	.08
RER	.90	.89	.89	.89	.89	.89	.89
CA	.0017	.0012	.0009	.0006	.0004	.0003	0
CCF	0	.0016	.0027	.0035	.0041	.0045	.0054
AR	–	.95	.96	.96	.97	.97	1

Notation: π, r, RER, CA, CCF, and AR stand for the inflation rate, the real interest rate, the real exchange rate, the ratio of the current account surplus to initial national income, the ratio of cumulative capital flows to initial national income, and the absorption rate. The initial values for the inflation rate, the real interest rate, the real exchange rate, and the current account are .15, .08, 1, and 0.

the primary fiscal deficit and *absorb* the increase in the current account deficit, both measured as a percentage of the increase in aid. The IMF recommends that the central bank sell all the aid dollars and that the central government spend all the counterpart funds (i.e., the domestic currency proceeds of the aid).[16] It calls this the *absorb-and-spend* approach. *Absorb* is treated as a policy variable on the assumption that aggregate absorption is determined by the central bank's willingness to sell aid dollars. This is a stretch, however. Since the current account depends on how private sector spending responds to the aid inflow, absorption is an endogenous variable, not a policy instrument.[17] At the risk of violating the IMF's property rights, we relabel their approach *float and full spend (*FFS hereafter).

In this section we conduct a counterfactual exercise to test the sensitivity of the IMF's FFS strategy to credibility of the aid boom. The numerical simulations track the paths of inflation, the real exchange rate ($1/P_n$), the real interest rate, the current account surplus inclusive of aid, private capital flows, and the absorption rate.[18]

4.1. FFS with full credibility

Table 2 shows the outcome when the aid boom is permanent with probability one. In the long run, spending increases by the full amount of extra aid and the inflation tax (πm) adjusts to cover any change in the fiscal deficit. The increase in expenditure raises the demand for nontraded goods and real money balances. Across steady states, this causes the real exchange rate to appreciate 11% and the inflation rate to fall 1–1.4 percentage points. Higher expenditure directly increases the demand for foreign currency, but lower inflation has the opposite effect, inducing substitution toward domestic currency. The former effect dominates in Table 2; over time, small capital outflows cumulate to .5–1.1% of GDP.

Consistent with the IMF view, adjustment is smooth and problem-free in this scenario. The real exchange rate appreciates immediately by 9–10%. Aside from this necessary real adjustment, the aid shock is absorbed without macroeconomic volatility. Details differ depending on the value assigned to the currency substitution parameter σ, but the story is essentially the same in each case. At $t=0$ both the inflation rate and the price level fall, as appreciation of the exchange rate and lower prices for traded goods more than offset upward pressure on nontraded goods prices. Private capital flows are small and the transfer of real resources occurs quickly: in the low currency substitution run, the absorption rate rises from 88% in the first year to 92–94% in the second and third years; in the high currency substitution run, it exceeds 94% from the outset.

4.2. FFS without credibility

> Over the medium and longer term, once a government scales up its expenditure program in response to more foreign aid, it faces the challenge of how to finance these programs if the new aid isn't sustained by donors … Such obligations are not easily shed or reduced … If governments are not able to reduce expenditures …. budgetary policy pressures may jeopardize the *macroeconomic* policy framework. (Heller, 2005, p.12)

Credibility is the Achilles' heel of the FFS strategy. In Tables 3 and 4 the public fears an aid collapse at year three and a subsequent transitory phase of high fiscal deficits and high inflation. Naturally, this creates inflationary pressures during the boom period by reducing money demand. At $t=0$, the price level jumps 2–15% and inflation increases from 15% to 18–25%. Following this bad start, things deteriorate further. Inflation rises monotonically, reaching 22–34% at the end of year three. When the resolution of uncertainty reveals a temporary donor, the currency depreciates 12–28%, the price level jumps 11–26%, and inflation soars to 31–60%.[19] Observe also that private capital outflows are very large and that absorption is far less than 100%. For $v=1$, the private sector spends only 58–65% of aid-generated income; this figure drops to 46–59% when fiscal inertia is high. Disturbingly, in a pure float, the flip side of low absorption and large current account surpluses (inclusive of aid) has to be extensive capital flight. In the worst-case scenario where $\sigma=1.50$ and $v=.50$, 54% of aid is wasted in paying for capital flight during the surge period. Not all of this is the fault of FFS. Some worsening in the capital account is unavoidable because the private sector saves to smooth the impact of a temporary aid shock on consumption. But the pure saving motive accounts for only 30–50% of the outflows.[20] The rest—which *is*

[16] In high-inflation economies, the Fund also endorses an *absorb and partial spend* approach in which part of the extra aid is used to reduce domestic financing of the fiscal deficit.

[17] When the exchange rate floats and the capital account is closed, the trade deficit equals sales of foreign exchange by the central bank as assumed in the Fund's *absorb and spend* framework (Mirzoev, 2007). This is a special and unrealistic case, however.

[18] Since the integral of the current account surplus over the year equals the increase in holdings of foreign currency, the annual absorption rate is measured by $1-[F(t)-F(t-1)]/.03$. (National income equals unity initially, so the absolute increase in aid is .03.) The cumulative absorption rate through year t equals $1-[F(t)-F_o]/(.03t)$.

[19] The inflation burst is short-lived. By the end of year four, π is close to 20%.

[20] The outflows attributable to the pure saving motive can be approximated by the solution in a run where $\sigma=\tau$ (so that F does not depend on π) and the government runs a reserve buffer stock scheme of the type described in Section 5.4.

Table 3
Transition path under FFS when $v=1$.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e, $\tilde{P}_n$ and P at $t=3$	% change in e, $\tilde{P}_n$ and P at $t=0$
$\sigma=.75$							
π	.18	.19	.20	.24	.32, .13	$e=12.5, -19.6$	$e=-2.0$
r	.091	.084	.080	.079	.085, .071		
RER	.93	.93	.93	.93	.96, .86	$\tilde{P}_n=8.5, -13.4$	$\tilde{P}_n=5.2$
CA	.012	.010	.010	.011	−.009, −.008		
CCF	0	.011	.021	.032	.032	$P=10.5, -16.5$	$P=1.5$
AR	–	.63	.65	.65	–		
$\sigma=1.50$							
π	.20	.21	.21	.22	.31, .12	$e=15.8, -23.4$	$e=3.2$
r	.095	.090	.087	.086	.098, .071		
RER	.94	.94	.93	.93	.97, .85	$\tilde{P}_n=11.1, -16.6$	$\tilde{P}_n=9.2$
CA	.016	.013	.012	.011	−.008, −.011		
CCF	0	.014	.026	.038	.038	$P=13.3, -19.9$	$P=6.2$
AR	–	.53	.56	.58	–		

The initial values for the inflation rate, the real interest rate, the real exchange rate, and the current account are .15, .08, 1, and 0. In the two columns at the far right, e, P_n, and P denote the nominal exchange rate, the nominal price of the nontraded good, and the exact consumer price index. The first/second entry in the sixth and seventh columns is the value of the variable (or its percentage change) just after the public learns that aid is temporary/permanent.

Table 4
Transition path under FFS with $v=.50$.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e, $\tilde{P}_n$ and P at $t=3$	% change in e, $\tilde{P}_n$ and P at $t=0$
$\sigma=.75$							
π	.20	.22	.25	.33	.56, .12	$e=20.6, -27.7$	$e=1.5$
r	.093	.086	.084	.086	.103, .070		
RER	.94	.93	.93	.93	.97, .86	$\tilde{P}_n=15.7, -21.2$	$\tilde{P}_n=8.0$
CA	.014	.012	.012	.012	−.007, −.010		
CCF	0	.013	.025	.037	.037	$P=18.1, -24.4$	$P=4.7$
AR	–	.57	.57	.59	–		
$\sigma=1.50$							
π	.25	.26	.29	.33	.60, .11	$e=29.2, -34.6$	$e=12.3$
r	.106	.099	.098	.101	.140, .069		
RER	.96	.95	.94	.94	.98, .84	$\tilde{P}_n=22.9, -27.3$	$\tilde{P}_n=16.3$
CA	.021	.017	.015	.013	−.004, −.015		
CCF	0	.019	.035	.048	.048	$P=26.0, -31.0$	$P=14.3$
AR	–	.37	.42	.46	–		

the fault of FFS—reflects the public's desire to amass foreign currency as a hedge against inflation.

It would be easy to read these results as supporting the Fund's contention that spending in excess of absorption fuels higher inflation and capital flight. The right conclusion, however, is quite different. The Fund's conceptual framework and its interpretation of the empirical evidence rest on the premises that (i) absorption is a policy variable and (ii) the money supply increases ex ante when the central bank does not allow absorption to rise by the same amount as the fiscal deficit. Neither premise is valid in our model. There is no increase in the money supply, ex ante or ex post, and absorption is endogenous because foreign currency is a vehicle for private saving. The government aims for full absorption, but this is not feasible when the private sector fears that the current aid boom portends future fiscal and monetary instability. In Tables 3 and 4, low absorption, capital flight, and high inflation are symptoms of an unsolved credibility problem. Bad policy is not to blame.

5. Policy options

The default policy, FFS, fares poorly when the aid boom is not credible. This raises the question of whether other policies do better. Accordingly, we move on to examine tight money, temporary fiscal restraint, and policy packages that combine modest fiscal restraint with either reverse sterilization or a reserve buffer stock. This list is not exhaustive but it includes policies that win the battle against weak credibility.[21]

To economize on space, all numerical simulations from this point forward assume an intermediate degree of fiscal inertia ($v=1$). The results with a high degree of fiscal inertia are qualitatively similar.

5.1. Tight money

Weak credibility stokes inflationary pressure by depressing money demand. In this section, the central bank reacts by selling securities to reduce money growth:

$$\dot{b} = \alpha[b(t)-b_o],\ \alpha>0,\ t<T. \tag{21}$$

Let $J \equiv b(0)-b_o$ denote bond sales at $t=0$. The path for b is then

$$b(t) = b_o + Je^{\alpha t},\ t<T. \tag{22}$$

The values assigned to J and α define the central bank's tight money rule. We search over these two parameters to find the policy rule that delivers the best results. This is not meant to be realistic. It is rather a debating tactic: we want to demonstrate that tight money is the wrong policy even under assumptions favorable to its success.

The introduction of bond sales alters a couple of equations in the model. During the low-credibility period, part of the fiscal deficit is financed by issuing debt. The public sector budget constraint changes to

$$\dot{m} = g_1 + c(P_n)rb - X^* - c(P_n)\alpha(b-b_o) - \chi m,\ t<T. \tag{13'}$$

Bond sales cease at T. When aid is temporary, the government reduces expenditure gradually to bring the fiscal deficit and inflation back to their original levels.[22] This requires more fiscal adjustment than in the benchmark model. Transfer payments have to drop below g_o in order to offset higher interest payments on the internal debt:

$$\dot{g} = v(\bar{g}-g),\ v>0, \tag{17c}$$

where

$$\bar{g} = g_o - \rho[b(T)-b_o].$$

Table 5 shows the limits of monetary policy acting on its own. What stands out in the comparison with the counterfactual (FFS with $v=1$) is the almost complete futility of tight money. Inflation is lower in the first two years but higher in years three and four. There is only one achievement worthy of note: tight money eliminates the nasty spike in the price level at the start of the aid boom.

[21] Heller et al.(2006) recognize the fiscal credibility problem. This section can be viewed as a response to their appeal for analysis of “self-protection” policies that “use aid inflows in a way to increase the resilience of the economy in the event of future aid shortfalls…” (p21).

[22] In the case of permanent aid, we assume the central bank slowly repurchases the debt sold in period (0,T). (At $t=T$, α changes from a positive number to −.001.) The solution paths are virtually identical under the alternative assumption that none of the debt is redeemed after year T.

Table 5
Transition path with tight money during the aid boom.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e, $\tilde{P}_n$ and P at $t=3$	% change in e, $\tilde{P}_n$ and P at $t=0$
$\sigma=.75$							
π	.15 (.18)	.15 (.19)	.17 (.20)	.26 (.24)	.33, .15 (.32, .13)	$e=11.3, -18.3$ ($e=12.5, -.19.6$)	$e=-7.4$ ($e=-2.0$)
r	.087	.080	.077	.082	.087. 073	$\tilde{P}_n=7.1, -11.7$ ($\tilde{P}_n=8.5, -13.4$)	$\tilde{P}_n\approx 0$ ($\tilde{P}_n=5.2$)
RER	.93	.92	.93	.93	.97, .87		
CA	.010	.010	.010	.011	−.009, −.006	$P=9.2, -15.0$ ($P=10.5, -16.5$)	$P=-3.7$ ($P=1.5$)
CCF	0	.010	.020	.030	.030		
AR	–	.67 (.63)	.67 (.65)	.67 (.65)	–		
$\sigma=1.50$							
π	.16 (.20)	.16 (.21)	.18 (.21)	.28 (.22)	.33, .17 (.31, .12)	$e=11.4, -19.2$ ($e=15.8, -23.4$)	$e=-6.9$ ($e=3.2$)
r	.085	.082	.083	.097	.103, .078	$\tilde{P}_n=6.1, -10.5$ ($\tilde{P}_n=11.1, -16.6$)	$\tilde{P}_n=-.2$ ($P_n=9.2$)
RER	.93	.93	.93	.93	.97, .88		
CA	.012	.012	.012	.011	−.007, −.004	$P=8.6, -14.8$ ($P=13.3, -19.9$)	$P=-3.6$ ($P=6.2$)
CCF	0	.012	.023	.034	.034		
AR	–	.61 (.53)	.61 (.56)	.62 (.58)	–		

Cumulative bond sales are 1.4% of initial national income in the run for $\sigma=.75$ and 2.3% of national income in the run for $\sigma=1.50$. The numbers in parentheses in the rows for π and AR show the outcome for FFS with $v=1$.

These results are not particularly surprising. Tight money tries to neutralize inflationary pressure and inhibit capital flight by aligning money growth with money demand. This is sensible, intuitive, and simplistic. Bond sales imply higher interest payments in the future and even larger fiscal deficits after the aid boom disappears. Viewed from this angle, the tight money strategy is ill-conceived; it slows money growth but exacerbates the credibility/fiscal inertia problem.

5.2. Temporary fiscal restraint

Under a policy of temporary fiscal restraint, the government spends less than 100% of the extra aid while credibility is low:

$$g_1 = g_o + \psi(X_1 - X_o),\ 0 < \psi < 1,\ t < T. \tag{15}$$

The primary fiscal deficit decreases by $(1-\psi)(X_1-X_o)$, the portion of aid not spent. This reduces money growth without compounding the difficulties of fiscal retrenchment when and if the aid boom collapses. Ceteris paribus, therefore, inflationary pressures should be less than in the counterfactual scenario.

Unfortunately, there is a catch. Because of use-it-or-lose-it, the scenario with a permanent donor now includes an intermediate phase $(T, 2T)$ in which the fiscal deficit and money growth are *higher*.[23] More difficult adjustment on this branch of the transition path offsets some of the gains from lower money growth during the low-credibility phase. It is not clear ex ante therefore that temporary fiscal restraint enhances overall macroeconomic stability. But perhaps there is a presumption of net stabilization gains for plausible parameter values?

The answer in Table 6 is discouraging. Fiscal restraint helps only for a couple of years. For $\psi=.75$, there is not enough restraint to sustain absorption and inhibit capital outflows after year one or to stop inflation from rising to 18–24% in year three.[24] Moreover, temporary control of inflation is achieved by importing a new problem. Battered by incipient capital *inflows*, the nominal exchange rate appreciates 18–25% at $t=0$. Consequently, to keep demand equal to supply, the nominal price of the nontraded good has to decrease immediately by 8–12%. This a bit far-fetched. If prices are not exceptionally flexible in the downward direction, adjustment will be accompanied by a demand-switching recession in the nontradables sector (Buffie et al., 2008).

[23] Before the aid boom, the primary fiscal deficit was $g_o - X_o$. In the period $(T, 2T)$, this increases to $g_o + (1-\psi)(X_1 - X_o) - X_o$.

[24] Note also that there are large upward jumps in the exchange rate and the price level when $\sigma=1.50$ and aid is temporary.

5.3. Reverse sterilization + temporary fiscal restraint

Allocating 25% of aid flows to budget support causes excessive appreciation of the nominal exchange rate in the short run and fails to prevent inflation from rising far above 15% in year three. This suggests that fiscal restraint combined with purchases of domestic debt will produce better paths for both the exchange rate and inflation. At $t=0$, the central bank stabilizes the nominal exchange rate by purchasing bonds and pumping money into the economy. The initial purchase is followed either by further purchases or small sales, so the stock of internal debt is lower at the beginning of year four when all uncertainty is resolved. If aid falls, the central bank sells the bonds it purchased earlier to keep a firm grip on money growth during the difficult period of fiscal retrenchment. The logic behind the strategy is to attack the credibility problem at its source: paying down the internal debt mitigates inflationary pressure during the boom phase by creating the perception that future money growth and inflation will remain low even if current high aid flows prove temporary.

For this variant of the model,

$$g_1 = g_o + \psi(X_1 - X_o),\ 0 < \psi < 1,\ t < T, \tag{15}$$

$$\dot{b} = \alpha[b(t) - b_o],\ \alpha > 0,\ t < T, \tag{24}$$

$$b(t) = b_o + Je^{\alpha t},\ J = b(0) - b_o < 0,\ t < T, \tag{25}$$

$$\dot{m} = g_1 + c(P_n)rb - X_1 - c(P_n)\alpha(b - b_o) - \chi m,\ t < T, \tag{26}$$

$$\dot{b} = \delta(b_o - b),\ \delta > 0,\ t > T, \tag{27}$$

$$\dot{m} = g + c(P_n)rb - X - c(P_n)\dot{b} - \chi m,\ t > T, \tag{28}$$

where the donor's type determines the paths of g and X after T.

Reverse sterilization changes J in Eq. (25) from a positive to a negative number. In Eq. (27), the parameter δ determines how fast the central bank sells bonds after aid contracts fully or partly at T. This parameter is set to prevent larger fiscal deficits from increasing money growth. Take the case of a temporary donor. Since

$$g(t) = g_o + \psi(X_1 - X_o)e^{-v(t-T)},\ t \geq T,$$

and

$$\dot{b} = \delta[b_o - b(T)]e^{-\delta(t-T)},\ t \geq T,$$

Table 6
Transition path with temporary fiscal restraint.

	$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e, $\tilde{P}_n$ and P at $t=3$	% change in e, $\tilde{P}_n$ and P at $t=0$
$\sigma=.75$ and $\psi=.75$							
π	.10 (.18)	.12 (.19)	.16 (.20)	.24 (.24)	.31, .24 (.32, .13)	$e=2.4, -4.6$ ($e=12.5, -19.6$)	$e=-18.1$ ($e=-2.0$)
r	.082	.081	.081	.086	.081, .078	$\tilde{P}_n=-.2, .2$ ($P_n=8.5, -13.4$)	$\tilde{P}_n=-7.8$ ($P_n=5.2$)
RER	.89	.89	.90	.92	.95, .88		
CA	.010	.011	.014	.020	−.013, −.013	$P-1.1, -2.2$ ($P=10.5, -16.5$)	$P=-13.0$ ($P=1.5$)
CCF	0	.010	.023	.039	.039		
AR	–	.75 (.63)	.72 (.65)	.56 (.65)	–		
$\sigma=1.50$ and $\psi=.75$							
π	.08 (.20)	.10 (.21)	.13 (.21)	.18 (.22)	.32, .19 (.31, .12)	$e=13.2, -21.3$ ($e=15.8, -23.4$)	$e=-24.5$ ($e=3.2$)
r	.080	.085	.092	.102	.103, .072	$\tilde{P}_n=7.9, -13.0$ ($P_n=11.1, -16.6$)	$\tilde{P}_n=-12.1$ ($P_n=9.2$)
RER	.86	.88	.90	.93	.98, .84		
CA	.001	.007	.013	.021	−.005, −.016	$P=10.5, -17.1$ ($P=13.3, -19.9$)	$P=-18.4$ ($P=6.2$)
CCF	0	.004	.013	.030	.030		
AR	–	.91 (.53)	.83 (.56)	.75 (.58)	–		

The numbers in parentheses in the rows for π and AR show the outcome for FFS with $v=1$.

Eq. (28) can be written as

$$\dot{m} = \underbrace{(g_o + \rho b_o - X_o)}_{\text{initial fiscal deficit}} + \underbrace{[c(P_n)rb - \rho b_o]}_{\text{change in real interest payments}} + \psi(X_1 - X_o)e^{-v(t-T)} - c(P_n)\delta[b_o - b(T)]e^{-\delta(t-T)} - \chi m. \quad (28')$$

The first term is the fiscal deficit before the aid surge and the second is the change in real interest payments on the internal debt measured in dollars. Strictly speaking, we cannot say anything about the latter term without closed-form solutions for r and $c(P_n)=P/e$. But while P/e is close to unity after the aid reversal, $b(T)$ is at least 20% lower than b_o; hence Pb/e is invariably less than b_o.[25] Furthermore, intuition argues that consumption smoothing by the private agent will be accompanied by declining consumption and a continuously lower real interest rate after T.[26] Thus

$$\psi(X_1 - X_o)e^{-v(t-T)} - c(P_n)\delta[b_o - b(T)]e^{-\delta(t-T)} \le 0 \Rightarrow \delta e^{(v-\delta)(t-T)} \ge \frac{\psi(X_1 - X_o)}{b_o - b(T)} \quad (29)$$

is *almost* sufficient to guarantee $\pi(t) \le \pi_o$, $t \ge T$. This condition holds for all $t \ge T$ iff

$$\frac{\psi(X_1 - X_o)}{b_o - b(T)} \le \delta \le v. \quad (30)$$

When $\delta=v$ and $b_o - b(T) = (1-\psi)(X_1 - X_o)T$, so that the buffer stock equals the amount of unspent aid in the period $(0,T)$, the condition in Eq. (30) collapses to

$$\psi \le \frac{vT}{1+vT}. \quad (31)$$

It is equally easy to derive a joint restriction on δ and ψ that virtually guarantees lower inflation for $t>T$ and a permanent donor.[27] In the case at hand where $v=1$ and $T=3$, 75% of aid is spent during the low-credibility phase [.75 is the borderline value of ψ in Eq. (31)] and $\delta=1$ for temporary aid and .60 for permanent aid. The runs reported in Table 7 pair these values with values of α and J (which control the path of debt for $t<T$) chosen to ensure stability of the price level at $t=0$.

This strategy works extremely well. Thanks to the reverse sterilization component, the government can spend more of the aid money—the real objective—without running into macroeconomic problems during the low-credibility phase. Inflation stays below 15%, the initial jump in the CPI is negligible, and appreciation of the nominal exchange rate at $t=0$ is reduced to 6%. Moreover, price and exchange rate stability promote absorption by lessening the incentives for capital flight: the absorption rate is 72% vs. 64% in the counterfactual.

5.4. A reserve buffer stock

The last scheme we analyze is a reserve buffer stock. As before, there are positive and normative aspects to the analysis. The positive aspect is especially important, however, for there is no hope of a complete and consistent rendering of the stylized facts unless the model incorporates some type of reserve buffer stock. In the IMF and ODI case studies, most aid booms were associated with reserve accumulation, spending in excess of absorption, private capital outflows, and stable or declining inflation. The model variants examined thus far cannot explain the co-movements of all of these variables. The counterfactual (FFS) accounts for spending in excess of absorption and capital outflows but not stable/decreasing inflation.[28] The transition path for the Reverse Sterilization + Temporary Fiscal Restraint strategy reconciles capital flight with lower inflation, but absorption differs little from spending (72% vs. 75%). And none of the policy rules, of course, factor in reserve accumulation.

Turning to the details, when the central bank operates a reserve buffer stock, it sells only the aid that is spent and puts the rest into foreign exchange reserves. A little reflection suggests that this is probably another good way to combat the credibility problem. The strategy is essentially the same as in Reverse Sterilization + Temporary Fiscal Restraint. Once again, the government makes it clear that a sudden decrease in aid will not bring higher inflation: reserves banked during the boom phase will be sold to control money growth while fiscal adjustment takes place.

In this case,

$$\dot{Z} = (1-\psi)(X_1 - X_o), \; t < T, \quad (32)$$

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[25] The reserve buffer stock equals total unspent aid during $(0,T)$. When $\psi=.75$, this amounts to 3% of initial national income, so $b(T)=.07$ vs. $b_o=.10$.

[26] The Euler Eq. (10) reads $r=\rho+(\dot{E}/E-\gamma\dot{P}_n/P_n)/\tau$, where the term in parentheses is the instantaneous rate of change of aggregate real consumption. Before T, the private agent adds to their holdings of foreign assets by consuming less than income (inclusive of aid). After T, consumption is above the level of income but falling. When consumption is falling over time, $r<\rho$.

[27] The simplest strategy is to set δ so that almost all of the buffer stock is used up by time $2T$. This ensures that the buffer stock is used to control money growth during the period $(T, 2T)$ when the primary fiscal deficit is temporarily high.

[28] Another problem with appealing to the FFS results is that no country followed the FFS strategy.

Table 7
Transition path when 75% of the aid is spent, the government buys back internal debt, and $\sigma = .75$.

	Low-credibility period				
	$t=0$	$t=1$	$t=2$	$t=3$	% change in $\tilde{P}_n$, e and P at $t=0$
π	.07	.08	.09	.12	$e=-6.4$
r	.076	.074	.073	.074	
RER	.88	.89	.90	.92	$\tilde{P}_n=6.7$
CA	.006	.009	.013	.020	
CCF	0	.007	.018	.034	$P\approx 0$
AR	–	.82	.78	.72	
	Aid is temporary				
	$t=3+$	$t=4$	$t=5$	$t=6$	% change in $\tilde{P}_n$, e and P at $t=3$
π	.12	.13	.14	.14	$e=.7$
r	.065	.069	.072	.074	
RER	.95	.96	.98	.98	$\tilde{P}_n=-1.7$
CA	−.014	−.009	−.006	−.004	
CCF	.034	.022	.015	.010	$P=-.5$
	Aid is permanent				
	$t=3+$	$t=4$	$t=5$	$t=6$	% change in $\tilde{P}_n$, e and P at $t=3$
π	.15	.16	.15	.11	$e=-1.5$
r	.072	.078	.083	.085	
RER	.88	.89	.89	.90	$\tilde{P}_n=3.4$
CA	−.013	−.010	−.009	−.008	
CCF	.034	.022	.012	.003	$P=1.0$

Cumulative purchases of internal debt equal 3% of initial GNP at the end of year three.

Table 8
Transition path when $\sigma = .75$, 75% of the aid is spent, and the central bank runs a reserve buffer stock.

	Low-credibility period				
	$t=0$	$t=1$	$t=2$	$t=3$	% change in $\tilde{P}_n$, e and P at $t=0$
π	.15	.14	.14	.14	$e=-7.8$
r	.087	.082	.077	.073	
RER	.92	.91	.91	.92	$\tilde{P}_n=.7$
CA	.018	.016	.016	.018	
CCF	0	.007	.013	.020	$P=-3.6$
AR	–	.58	.59	.58	
	Aid is temporary				
	$t=3+$	$t=4$	$t=5$	$t=6$	% change in $\tilde{P}_n$, e and P at $t=3$
π	.14	.14	.14	.14	$e=2.2$
r	.072	.069	.070	.072	
RER	.94	.95	.96	.97	$\tilde{P}_n\approx 0$
CA	−.016	−.013	−.009	−.006	
CCF	.020	.024	.020	.015	$P=1.1$
	Aid is permanent				
	$t=3+$	$t=4$	$t=5$	$t=6$	% change in $\tilde{P}_n$, e and P at $t=3$
π	.13	.14	.14	.14	$e=-4.3$
r	.075	.077	.078	.078	
RER	.88	.88	.88	.89	$\tilde{P}_n\approx 0$
CA	−.011	−.010	−.009	−.009	
CCF	.020	.017	.015	.014	$P=-2.1$

Reserve buffer stock equals 3% of initial GNP at the end of year three.

$$\Rightarrow Z(T) = (1-\psi)(X_1-X_o)T, \ (Z_o = 0) \tag{33}$$

during the low-credibility period. Should the aid bonanza disappear at T, the central bank sells reserves aggressively to maintain control of money growth and the path of the exchange rate:

$$\dot{Z} = -\delta Z, \ \delta > 0, \ t > T. \tag{34}$$

As in the reverse sterilization strategy, $\delta = v$ and

$$\psi \leq \frac{vT}{1+vT}$$

virtually guarantee $\pi(t) \leq \pi_o$ after T. In the case of a permanent donor, sale of foreign exchange reserves neutralizes the reduction in aid throughout the punishment phase[29]:

$$\dot{Z} = -(1-\psi)(X_1-X_o), \ T < t < 2T, \tag{35}$$

$$\Rightarrow \dot{Z}(2T) = Z(2T) = 0. \tag{36}$$

Table 8 shows the outcome when the government spends 75% of the extra aid. For the most part, the strategy succeeds. Inflation stays between 14% and 15% and the nominal exchange rate appreciates only 8% at $t=0$, avoiding the need for price decreases to clear the nontradables market. On the other hand, the absorption rate is slightly less than in the counterfactual (58% vs. 64%). Overall, therefore, the results are not as good as for the reverse sterilization strategy. We hasten to add that this is the normative conclusion. From a positive standpoint, the results are superior. The combination of reserve accumulation, spending in excess of absorption, and private capital outflows despite stable inflation is frequently seen in aid booms. It is impressive, akin to a loose validation of the model, that the same quartet appears in Table 8.

6. Sensitivity analysis

We have subjected each of the scenarios in Sections 4 and 5 to a wide-ranging sensitivity analysis. The numbers in Table 9 for the FFS scenario are indicative of how alternative parameter values affect the outcome in other scenarios. Four results stand out:

1. *Aid reversals are more (less) traumatic when their probability of occurrence is low (high)*. Inflation increases less and absorption is significantly higher during the low-credibility period when p drops from .65 to .25. Note also, however, that actual aid reversals are more traumatic: since an aid collapse is a bigger surprise, the increases in the price level and the exchange rate at $t=3$ are $2\frac{1}{2}$ times as large as in the benchmark model. All of this runs in reverse for $p=.90$.[30] Inflation at $t=3$ rises from 22–33% to 27–48% and the cumulative absorption rate decreases from 46–58% to 30–45%, but the spikes in the price level and the exchange rate are much smaller following an aid collapse.
2. *Higher capital mobility increases the costs of low credibility*. When $\sigma=3$, capital outflows are more sensitive to expectations of higher inflation and hence low credibility inflicts more damage than in the benchmark model. The absorption rate drops to 36–56%, and the price level, the exchange rate, and the inflation rate increase much more both at the outset and at the time of collapse.
3. *Absorption is insensitive to the intertemporal elasticity of substitution*. Higher values of τ diminish the incentive to save during the low-credibility period. The effect is very weak, however. Doubling τ increases the absorption rate only 9–15%. This reflects a point emphasized earlier: private saving is driven mainly by the desire to accumulate foreign currency as a hedge against future inflation; the root cause of low absorption is low credibility.
4. *Both absorption and inflation are sensitive to the expected duration of the aid surge*. The urgency to acquire foreign assets through saving and through substitution away from domestic assets is much greater when an aid collapse looms at $t=1$ instead of $t=3$.

[29] There are slight changes in the government budget constraint and the equation for net foreign asset accumulation. See the longer version of the paper for details.

[30] Political economy pressures can explain full spending of aid even when the probability of an aid reversal is extremely high.

Table 9
Sensitivity analysis for the float and full spend scenario.

		Benchmark model with $\sigma=1.50$						
		$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e and P at $t=3$	% change in e and P at $t=0$
$v=.50$	π	.25	.26	.29	.33	.60	$e=29.2$	$e=12.3$
	AR	—	.37	.42	.46	–	$P=26.0$	$P=14.3$
$v=1$	π	.20	.21	.21	.22	.31	$e=15.8$	$e=3.2$
	AR	–	.53	.56	.58	–	$P=13.3$	$P=6.2$
		$p=.25$						
		$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e and P at $t=3$	% change in e and P at $t=0$
$v=.50$	π	.18	.18	.18	.19	.67	$e=69.4$	$e=-3.2$
	AR		.71	.73	.76		$P=59.9$	$P=.7$
$v=1$	π	.16	.16	.16	.17	.34	$e=36.5$	$e=-6.3$
	AR	–	.78	.79	.81	–	$P=30.2$	$e=-2.1$
		$p=.90$						
		$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e and P at $t=3$	% change in e and P at $t=0$
$v=.50$	π	.31	.33	.38	.48	.57	$e=7.9$	$e=23.0$
	AR		.19	.25	.30		$P=7.1$	$P=23.7$
$v=1$	π	.23	.24	.25	.27	.30	$e=4.3$	$e=9.4$
	AR		.39	.43	.45		$P=3.7$	$P=11.5$
		$\sigma=3$						
		$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e and P at $t=3$	% change in e and P at $t=0$
$v=.50$	π	.31	.31	.31	.33	.65	$e=45.0$	$e=25.3$
	AR	—	.22	.30	.36		$P=40.3$	$P=26.2$
$v=1$	π	.22	.22	.21	.21	.31	$e=21.8$	$e=6.9$
	AR	–	.49	.53	.56	–	$P=18.6$	$P=9.7$
		$\tau=.50$						
		$t=0$	$t=1$	$t=2$	$t=3$	$t=3^+$	% change in e and P at $t=3$	% change in e and P at $t=0$
$v=.50$	π	.23	.24	.25	.27	.43	$e=38.9$	$e=18.3$
	AR		.48	.52	.54		$P=35.7$	$P=21.3$
$v=1$	π	.19	.19	.19	.20	.25	$e=18.6$	$e=4.6$
	AR		.60	.62	.63		$P=16.2$	$P=8.1$
		$T=1$						
		$t=0$	$t=1$			$t=1^+$	% change in e and P at $t=1$	% change in e and P at $t=0$
$v=.50$	π	.33	.36			.66	$e=29.4$	$e=25.4$
	AR		.21				$P=26.2$	$P=26.2$
$v=1$	π	.24	.24			.33	$e=15.8$	$e=10.2$
	AR		.37				$P=13.4$	$P=12.2$

$p=.65$ and $\tau=.25$ in the benchmark model. Entries for $t=3$ refer to the outcome for an aid collapse.

Consequently, the price level, the exchange rate, and inflation increase another 6–17 percentage points at $t=0$, while the absorption rate sinks to 21–37%.

7. Concluding remarks

Aid flows are highly volatile. This would not be a source of macroeconomic trouble if donors were amenable to full-fledged buffer stock schemes or if African governments could quickly reduce spending when aid flows contract. More often than not, however, donors insist that aid be spent right away. When prior spending commitments are hard to reverse, the recipient country then faces a potentially serious credibility problem. If the public fears that the aid boom might be temporary, it also fears that the future might bring a period of large fiscal deficits and high inflation while the government struggles to curtail expenditure. According to our numerical simulations, the fear of a contingent fiscal time bomb leads to high inflation, capital outflows, and current account surpluses (inclusive of aid) during the aid boom. This is consistent with patterns in the data and with the general reluctance of governments in SSA to spend 100% of higher aid flows.

We investigated various policy responses to the credibility problem. Tight monetary policy and fiscal restraint are ineffective as they do nothing to counteract the fear that a sudden decline in aid flows will be inflationary. The right strategy is to dedicate a small fraction of aid (20–25%) to reserve accumulation or to deficit reduction supported by purchases of internal debt. Both policy packages create a financial cushion that enables the government to control money growth when aid flows contract and the fiscal deficit rises. Inflation stays low during the aid boom because the fiscal time bomb is no longer an inflation time bomb.

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