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## Foreseeing another HIPC: The response of a post-HIPC economy

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**Paper by:**

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**FORESEEING ANOTHER HIPC:**  
**THE RESPONSE OF A POST-HIPC ECONOMY**

**ABSTRACT**

A perfect foresight OLG model is set up to study the dynamic response of a small open economy to a temporary fiscal impetus (bond-financed government deficit) anticipated to be closed by a mix of taxes, money finance and grant aid. The model is solved for the general *mixed tax-money-aid finance* case with a focus on the conclusions for the *full-grant finance* case in the hope to inform the ongoing debate on debt sustainability in post-HIPC Africa and to some extent crisis-prone emerging markets like Turkey and Argentina. The conclusions emanating from the model are that anticipated aid (or debt forgiveness) works like a “pro-borrowing policy” inducing the economy to consume more, save less and hence run bigger current account deficits; the size of the immediate responses to the impetus as well as the long-term trajectory of the economy depends critically on whether domestic agents start off as net debtors or net creditors, outcomes being much less desirable in the former case; if future aid expects to replace taxes, consumption and the current account jump more when the real interest rate is low, consumption less important in the utility function relative to real balances, the instantaneous probability of death higher, and the bond-financed deficit regime of longer duration. To the extent that these conditions hold in the current HIPC context, and given the earlier results, the paper reinforces existing doubts over about the prospects of attaining long-term debt sustainability in Africa.

**October, 2004**

## **FORESEEING ANOTHER HIPC: THE RESPONSE OF A POST-HIPC ECONOMY**

### **INTRODUCTION AND MOTIVATION**

The highly indebted poor country (HIPC) initiative, launched jointly by the IMF and the World Bank in 1996, is now almost a decade old. The aim of the initiative was to: i) provide a permanent exit from debt sustainability/overhang problems to the poorest countries of the world, and ii) release funds (including foreign exchange) for vital social sector spending (and imports) in these countries. The “HIPC contract”, if one were permitted to label it that way, entails the following: donors waive their debt claims on HIPCs (in either flow or stock terms, or a mix thereof) while providing additional financing on concessional terms. In return, HIPCs undertake reforms, while channelling both the released resources (HIPC relief) and the new financing towards priority (poverty-reducing) sectors in a bid to achieve their Millennium Development Goals (MDGs).<sup>1</sup>

While providing many countries with the opportunity to make a fresh start, the HIPC initiative has also been the subject of great controversy. NGOs and anti-debt groups, the real pioneers of the debt-reduction movement of the 1990s, have described it as “too little too late” (OXFAM, 1999), calling instead for a full write-off of all HIPC debt. HIPCs themselves, including those past Completion Point, have described HIPC relief as “woefully insufficient for reaching” the MDGs, and urged donors to offer more grant and concessional financing (DRI, 2001:3). Other independent think-tanks have highlighted HIPCs’ continued vulnerability to shocks (external: commodity prices, and internal: AIDS etc.) and the associated risks to long-term external and fiscal sustainability.

Economists have had their say as well. Some, like Sachs (2002), have encouraged poor countries to repudiate their debts and devote all their resources to fighting challenges like AIDS. Others have criticised the HIPC debt sustainability evaluation framework, questioning the “one-ratio-fits-all” approach given countries’ differential “tolerance” for similar debt burdens (Reinhart et al, 2003).<sup>2</sup> More have reaffirmed concerns over the adequacy of the HIPC relief treatment, highlighting cases of countries like Uganda, which have seen their debt-ratios re-soar soon after being “treated” (IMF and World Bank, 2001). Then there are those who have subtly hinted at the free-rider/moral hazard problems associated with debt forgiveness, and the need, therefore, for donors to quickly move to a more “selective debt game” that rewards reformers more than non-reformers (Birdsall et al, 2002).

Finally, there are those who have highlighted the important policy dilemma that “post-HIPC” economies currently face in relation to new external financing for social sectors. “Additional funding is needed to meet key development objectives, but too much new financing in the form of debt can exacerbate debt problems” (Radelet and Chiang, 2003:2). In view of my own

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<sup>1</sup> In this paper, governments, financial institutions and organisations “providing” debt relief will be frequently referred to as “donors” while countries receiving debt relief as “recipient countries” or “HIPCs”. The term post-HIPCs refers to countries that have reached Completion Point, but is also used occasionally for countries that have reached Decision Points but already received a large part of the promised debt relief.

<sup>2</sup> Recent work at the IMF has also recognised these concerns about country-specific risks (vulnerability to shocks etc.) suggesting stress-testing (or stochastic simulations) as a preferred method for monitoring sustainability (IMF, 2003b).

experience of working in Tanzania's Ministry of Finance<sup>3</sup>, I feel that this last concern, perhaps, merits the most attention. Given the inadequacy of HIPC debt relief, and of alternative domestic funding possibilities (taxes or domestic debt), many HIPCs see donor aid as the only possible way to finance their ambitious social sector development programmes. While this external aid financing could technically take the form of grants (with no apparent debt sustainability implications), so far it has come essentially in the form of concessional loans (with nuanced debt sustainability implications). However, since much of the African debt that was waived under the HIPC initiative was equally concessional, the mere concessionalism of this new debt should not be deemed sufficient to guarantee its sustainability.<sup>4</sup>

Moreover, future growth expectations are not much better than what they were at the time of the first borrowing spree (in the 1960s-80s). In fact, there may, even, be a case for expecting slower growth in future, for at least three reasons. One, the bulk of the new borrowing is being channelled into social sector development programmes that typically have long payback periods (up to at least a generation). Two, the focus on poverty-reduction has precluded a full-blown discussion on what Africa's future long-term growth strategy should really be (especially in relation to its industry and exports). And three, Africa is beset with the AIDS problem which, to many, is the real "weapon of mass destruction" in the modern world.

The foregoing helps locate the premise for the call raised by many for pursuing "growth-enhancing" poverty reduction initiatives.<sup>5</sup> Indeed, in the absence of such initiatives, or with growth outcomes determined by factors outside the remit of policy, the view that Africa is "flirting" with the old ghost of external debt cannot immediately be rejected. Neither is it reasonable to assume that the key protagonists in this game, donors and HIPC governments, are somehow unaware or unwary of the painful consequences of such flirtation. As Radelet and Chiang (2003:8) put it, "the costs – financial and otherwise – to both creditors and debtors of high debts followed by exercises like HIPC that turn these debts into grants are simply too high to be repeated again."

Yet, despite this knowledge, donors and HIPCs seem to be playing the same game all over again, while making claims that are, quite possibly, time-inconsistent. Why?<sup>6</sup> One possible reason for this could be that the current political equilibrium obtaining in donor countries does not permit them to provide new financing in the form of grants. As a result, they must content themselves with providing concessional loans, on the implicit understanding, that the implied debt service and associated fiscal deficits will be closed by a future grant injection.

Another complementary explanation could be that donors would like to retain their influence and policy leverage vis-à-vis HIPCs, something that would be impossible under full grant-

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<sup>3</sup> As an Overseas Development Institute (ODI) Fellow appointed to the Debt Policy Unit of the Tanzanian Treasury (2000-02), I oversaw Tanzania's Completion Point in November 2001, and was closely involved with devising the country's first National Debt Strategy document (approved by Cabinet in August 2002).

<sup>4</sup> In another paper, I hope to investigate the long-term impact of real exchange rate depreciations on the burden of external debt, and what that implies for the choice between external and domestic debt. This work will build on existing research on the issue by Beaugrand et al (2002), Edwards (2002) and most recently by Adam and Bevan (2004).

<sup>5</sup> See for example, Burnside and Fanizza (2001:3) who also, incidentally, underscore the importance for long-term fiscal sustainability of fiscal reform backed by stronger aid commitments.

<sup>6</sup> An answer to this question would, perhaps, obtain most naturally from a political economy model involving two agents and cast in a game-theoretic setting. However, this is beyond the remit of this paper (although not of this DPhil).

financing. Such an explanation would be consistent with donors' own past experience with unconditional aid as well, and the now generally-accepted view that aid works best in countries with "good policies" (Burnside and Dollar, 2000). The argument is similar to the one about granting flow vs. stock debt relief. While the latter has the advantage of "cleaning" the debtor's balance sheet, the former preserves the creditors' influence on the debtor and hence the incentive for the latter to remain committed to reform.

The above hypothesis that the present external debt-financed fiscal expansion in post-HIPC Africa will eventually have to be closed by grants is not without support. As IMF-IDA (2004:32) note while proposing their new stress-testing framework for evaluating debt sustainability for HIPC, "the application of the framework will likely generate the need for significant grant financing over the coming years to enable these countries to achieve their development objectives on a durable basis." Also, the recent IDA-13 replenishment process has resulted in a larger share of World Bank money being made available as grants, reflecting that there is in fact quite a broad appreciation of the merits of grant-financing of social sector projects in Africa. At the same time, however, there is the recognition that full grant-financing is, realistically, only a "long-term solution", and that in the near-term HIPCs "must operate within today's budget constraints" (Radelet and Chiang, 2003: 8).

It is also equally, if not more, important to develop an appropriate hypothesis for the recipient countries, whose economic performance remains the real focus of attention. Thus, we should ask: how does the public at large in HIPCs view the current debt game being played out between HIPC governments and donors? In particular, assuming knowledge of the government's inter-temporal budget constraint and the associated need to eventually close the deficit, how does the representative HIPC consumer perceive the future of the current deficit regime? Does she expect the government to close the deficit by higher domestic taxes, increased money finance, or as discussed above, foreign grant inflows? Since agents' perceptions can never be accurately deciphered, a sensible answer would be: keep all options open, and focus instead on studying the response of the economy under each option.

Public economics literature boasts only a handful of studies exploring such questions. Frenkel and Razin (1987), Buiter (1988) and Daniel (1993) present overlapping generations models featuring agents endowed with finite lives and perfect foresight to show the dynamic (and sectoral, in the case of Buiter's two-good model) effects of a bond-financed deficit anticipated to be closed by higher future taxes. These models, however, abstract from monetary issues, hence omitting an important source of finance (esp. for HIPCs). Drazen and Helpman (1987, 1988) include money into the model but assume infinite horizons, which means outcomes are constrained to be Barro-Ricardian. Kawai and Maccini (1990) develop a more general framework by including both finite horizons and the possibility of money finance to show how fiscal deficits might not necessarily cause higher interest rates and inflation. Finally, Kawai and Maccini (1995) employ an open economy model with finite horizons and money to show that the twin deficit hypothesis –fiscal deficit causing current account deficit – might not hold if agents anticipate the fiscal deficits to be closed by money finance – a more likely possibility in the more fiscally impotent HIPCs.

Since all these models assume an essentially developed country focus, the question of grants as a possible future financing source does not arise.<sup>7</sup> As such, this is the gap that this paper hopes to target. In other words, it aims to investigate the dynamic response of a small open

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<sup>7</sup> Buffie (2001) uses the same framework of analysis in the context of developing countries. However, his focus is trade policy and temporary regime shifts therein.

economy to a temporary fiscal deficit anticipated to be closed by partial or full grant finance in the future, given taxes and seigniorage as the other two financing options. The variables whose responses would be studied are consumption, real money balances, private sector bond-holdings, government debt and the current account.

Within this broad setting, the model should enable us to address a number of important sub-questions, for instance:

1. Will the private sector respond one-to-one to the government's dissaving? In particular, will the fiscal deficit induce an equal current account deficit?
2. To what extent would the economy's response, especially consumption and current account, depend on agents' horizons, real interest rates, the duration of the deficit finance regime, and other factors, such as whether the private sector starts off with positive or negative bond-holdings?
3. How does news of a higher future grant inflow affect the long-term equilibrium (final steady state) of the economy? How do these effects differ when aid is expected to replace tax financing vs. when it is expected to replace money financing?

It is clear that such questions are not merely of theoretical interest, but will help in directly tackling some of the policy issues raised earlier. For instance, an answer to questions 1 and 2 would help us determine whether anticipation of future grant finance that replaces debt is as good as current grant finance. Then, a comparison of the adjustment paths of the economy with the actual trends in post-HIPC Africa could help us make some preliminary judgements about what private agents in HIPC countries really expect about the future policy switch. If actual trends, for instance, are seen to align closely with the prediction of the full grant-finance model, we might tentatively conclude that recipient countries have fully internalised the debt game being played between HIPC governments and donors.

## **A: THE MODEL**

The basic framework of the model is similar to the one that Kawai and Maccini (1995) develop for a small open developed market economy. Whether the assumptions underlying the framework can be extended to low income economies as well, especially the highly dependent African HIPC countries, is an important question. I attempt to address this by listing the battery of assumptions that go into the Kawai and Maccini model, and tentatively identifying which of them could be considered more and less problematic.

We begin with the most distinguishing assumption of the model: that agents have perfect foresight, so that, *inter alia*, a) expected inflation equals actual inflation, and b) the timing and nature of all future government policies are fully known in advance. While the methodological convenience granted by the perfect foresight assumption renders it an attractive choice, it is difficult to argue *ex-ante* whether the assumption is behaviourally justified or not. A case could be made either way.

The remaining assumptions of the model, however, appear more amenable to *ex-ante* comment and tentative pre-judgment. Keeping the post-HIPC African context in mind, the assumptions that seem *less* problematic are:

- i. The economy is small and open, and takes both world prices and interest rates as given. With a single consumption good, the constant world price is  $p_t^*$  in foreign currency, and the constant world real interest rate is  $r_0$ .
- ii. The private sector is composed of a non-growing population comprising overlapping generations of consumers. The stationary population assumption is probably truer for Africa than other low-income countries, given that AIDS, malaria, violent conflict, droughts etc. have significantly retarded population growth in the region relative to that in other low-income countries around the world.
- iii. The government impacts agents' disposable incomes through lump-sum taxes and transfers, but does not enter their utility functions. Given the past record of government spending in Africa and its impact on economic growth and welfare, this is perhaps not a reasonable assumption (for a corroborative view, see Adam and Bevan (2004)). *As mentioned earlier, while Kawai and Maccini (1995) assume that the government can only use taxes, money finance or debt to finance its expenditures, I relax this assumption by introducing foreign grant aid as a source of budgetary funding. Given the centrality of aid in post-HIPC fiscal adjustment, this extension is pertinent and, as such, my key value-addition to their model.*
- iv. There are no firms, and thus no capital accumulation or growth. The abstraction from capital accumulation, while indeed, limiting, has been common in most models of anticipated regime switches, the focus whereof is essentially consumption behaviour (Kawai and Maccini, 1990). Incidentally, the main focus of the ongoing HIPC contract has also been consumption, albeit within the context of eradicating poverty and disease, and delivering essential social services to long-deprived consumers. Promoting private investment, exports or growth has certainly not been a priority in HIPC discussions.
- v. In line with Yaari (1965) and Blanchard (1985), consumers face a non-zero constant probability of death  $\theta$  (horizon =  $1/\theta$ , so that  $\theta = 0$  gives infinite horizons). The presence of AIDS and other killer diseases like Malaria, poor health services for children and elders, and wars and violent conflicts have all served to keep life expectancy low in Africa, and also make the instantaneous probability of death less insensitive to age. A child in his formative years exposed to poor vaccination etc. might be as likely to die as a youth exposed to AIDS or an old person at the mercy of inadequate state healthcare. The constant and non-zero  $\theta$  assumptions would, therefore, at least not apply any *less* to African HIPCs than to developed market economies given that the latter are, by contrast, characterised by increasing life-spans (so perhaps moving in the Ramsey direction) and where the distribution of death is skewed in the usual way towards the elderly.
- vi. The utility function is logarithmic containing both, consumption and real money balances, the latter to reflect the state of the transactions technology. Again, this is not entirely inconsistent with the actual situation obtaining in most developing countries, and in particular Africa. A primitive transactions technology in many HIPCs implies that real money balances play an important part in determining agents' ability to transact and hence increase their utility.

*The assumptions that appear to be more limiting are:*

- vii. Purchasing power parity (PPP) holds continuously, so that domestic prices  $p_t$  equal the nominal exchange rate. Since the case for PPP, especially absolute PPP needs to be made rather than assumed in most contexts (including that of HIPC), it would have obviously been instructive to relax this condition by introducing a tradable/non-tradable distinction along the lines of Buiter (1988). Hoping to attempt this in a subsequent paper, for now, I stay with the PPP assumption for reasons of tractability.
- viii. There are no bequests (intended or unintended), consumers maximising their utility subject to a flow budget constraint in which wealth grows at the rate  $\theta + r_0$ , where  $\theta$  here denotes the insurance premium received by a surviving individual. Negative bequests by debtors, together with the absence of well-developed insurance markets (which imply that agents might leave unintended positive bequests) would both form cogent reasons for violation of the no-bequests assumption.
- ix. Finally, financial wealth is assumed to be held by consumers as either real money or real (indexed) bonds. Capital markets are assumed to be perfect, which is clearly a restrictive assumption, given strong evidence of credit constraints in developing countries. At best, therefore, our representative agent can be seen as representing the less credit constrained sections of these developing countries. However, noting the high concentration of wealth in some of these countries, and the fact that such agents might actually account for a large proportion of the value of their nation's formal domestic and international economic transactions, the assumption can be partly justified.
- x. The model abstracts from real exchange rate issues and capital controls, implying that there is no difference between domestic and foreign assets or liabilities – the equivalent of saying that interest parity holds continuously and for both government and the private sector. Given the context of a typical African HIPC, where capital controls are rife, domestic debt is non-tradable and external debt carries a large concessional component, some violation of the interest parity condition will necessarily occur. While I hope to tackle this issue in a subsequent paper, for the purposes of this one, I assume that agents can indeed vary, costlessly, their net financial wealth between domestic and foreign bonds.

It must be noted that the above assumptions become slightly less restrictive in the context of emerging markets like Turkey and Malaysia. I do not wish to overstate this point because the motivation of the paper remains African HIPC; however, to the extent that the model and its conclusions might apply to an emerging market context, the assumptions must be deemed less problematic.

Given these assumptions, and acknowledging the limits they place on the extent to which the model can be used to derive policy conclusions in the context of post-HIPC Africa, let us proceed with setting up the aggregate behavioural equations for the economy.

### **Intertemporal maximisation:**

Each individual born at time  $s$  maximises:



$$\int_t^\infty (\ln c_u^s + \beta \ln m_u^s) e^{-(\rho+\theta)(u-t)} du \quad \text{s.t.} \quad \frac{dv_u^s}{du} = (\theta + r_0)v_u^s - i_u m_u^s + y_u^s - \tau_u^s - c_u^s, \text{ where } v_u^s = m_u^s + b_u^s$$

Where  $c_u^s$ ,  $m_u^s$ ,  $b_u^s$ ,  $v_u^s$ , and  $h_u^s$  are the consumption, real money balances, real bond-holdings, real financial wealth and real human wealth for time  $u$  of an individual born at time  $s$ ;  $\rho$ ,  $\theta$ ,  $\beta > 0$ ;  $r_0$  is the fixed real interest rate and  $i_u$  its nominal counterpart at time  $u$  and dependant on inflation  $\pi_u$ ;  $\tau_u^s$  is the non-distortionary lump-sum tax (net of lump-sum transfers) collected by the government.

Solving the resultant Hamiltonian, and aggregating over  $s$  yields the equations characterising aggregate and per capita behaviour:<sup>8</sup>

$$\begin{aligned} c_t &= \frac{\rho + \theta}{1 + \beta} (v_t + h_t) \\ m_t &= \frac{\beta c_t}{i_t} \quad \dots \text{Equations 1-4,}^9 \text{ where } y_t = y_0; \text{ i.e. we abstract from growth.} \\ \dot{v}_t &= r_0 v_t + y_0 - \tau_t - c_t - i_t m_t \\ \dot{h}_t &= (r_0 + \theta) h_t - (y_0 - \tau_t) \end{aligned}$$

Equation 1 relates consumption to a fixed share of human and non-human wealth; equation 2 is a money demand relationship; equations 3 and 4 are the accumulation equations for financial wealth and human wealth.

Up till here the results follow Kawai and Maccini (1995). Now comes the major point of departure: i.e., in the characterisation of the government's budget constraint.

### **The Government:**

As mentioned earlier, the government in my model issues real bonds  $z_t$  (domestic or foreign), collects seigniorage revenues  $\dot{M}_t/p_t$ , raises lump-sum taxes  $\tau_t$ , **and** receives **foreign grant aid inflows**  $a_t$  to finance interest payments on debt and government expenditures  $g_t$ .

$$\dot{z}_t + \frac{\dot{M}_t}{p_t} + \tau_t + a_t = r_0 z_t + g_t \quad \dots \text{Equation 5}$$

The no-Ponzi game restriction applies to the government (as it does to the private sector). More importantly, the private sector knows the government's budget constraint and hence anticipates a debt-financed fiscal expansion to be closed in future by some combination of money finance, taxes or aid.

<sup>8</sup> As mentioned earlier, there is no growth in the economy. That is: the population is normalised to 1 and is stationary, i.e. birth rate equals death rate.

<sup>9</sup> The money demand equation (equation 2) is yielded by combining a)  $H_c=0$ :  $\lambda=1/c_t$ ; and b)  $H_m=0$ :  $\lambda i_t=\beta/m_t$ .

The net external assets of the economy are given by  $b_t - z_t$ , so that the current account ( $x_t$ ) is described by:  $\dot{b}_t - \dot{z}_t$ .

### **The basic equations of the model:**

Combining the government and private sector behaviour, we can write down the following basic equations of the model:

$$\begin{aligned}\dot{c}_t &= (r_0 - \rho)c_t - \frac{\theta(\rho + \theta)}{1 + \beta}(m_t + b_t) \\ \dot{m}_t &= (r_0 + \mu_t)m_t - \beta c_t \quad \dots\dots\dots \text{Equations 6-10} \\ \dot{b}_t &= r_0 b_t + y_0 - \tau_t - c_t - \mu_t m_t \\ \dot{z}_t &= r_0 z_t + g_t - \tau_t - a_t - \mu_t m_t\end{aligned}$$

### **The two fiscal regimes:**

We recall our question of interest: to study the dynamic behaviour of the economy over  $[0, \infty]$  given the two constituent fiscal policy regimes:

***$0 < t < T$ ; bond-financed tax cut ( $\tau_0 > \tau_1$ ) leads to fiscal deficit,  $\bar{d}$***

In the first fiscal regime, which starts at time 0 and end at time T, the government gives a lump-sum tax cut to the private sector. [This can equivalently be thought of as the government increasing its net transfers to its citizens, which perhaps would be a more accurately depiction of the form that the current fiscal impetus is taking in HIPC's.] The three equations for the private sector are as above, while  $z_t$  can be obtained as a function of time and known parameters. By end-period ( $t = T$ -)

$$\begin{aligned}\text{deficit } \bar{d} &= r_0 z_T + g_0 - \tau_1, \text{ and debt has risen to :} \\ z_T &= z_0 + \frac{\tau_0 - \tau_1}{r_0} [e^{r_0 T} - 1], \text{ where } z_0 = \frac{\tau_0 - g_0}{r_0} \quad \dots\dots\dots \text{Equation 11}\end{aligned}$$

As is obvious from 11, the system during this regime will be unstable.

***$t \geq T$ ; inherited debt level  $z_T$  sustained forever by taxes, money growth & foreign grant aid***

In the second period, the general form of the private sector equations (6-9) remains the same, but the effects of the change in financing regime kick in. Specifically, the government during this regime is characterised by:

$$\begin{aligned}\tau_t - \tau_0 &= n_1 \bar{d}, \\ \mu_t m_t &= n_2 \bar{d}, \\ a_t &= n_3 \bar{d}, \\ \text{where } a_0 &= \mu_0 = 0, \text{ and } n_1 + n_2 + n_3 = 1\end{aligned} \quad \dots\dots\dots \text{Equations 12-14}$$

Since the private sector has perfect foresight, the values of  $n_1$ ,  $n_2$  and  $n_3$  are known at time zero.

## **B: OBTAINING THE GENERAL SOLUTION**

Needless to say, given perfect foresight, and an unstable system in the deficit regime, we must solve backwards, i.e. solve the model for the stable regime ( $t \geq T$ ) first, and then solve the unstable system for  $0 < t < T$ . The solution procedure, as such, consists of three distinct steps (Buffie, 2001: 233-242):

1. solving for the starting and ending steady states,
2. obtaining the general solutions for the two regimes, and
3. solving for the initial jumps and dynamic adjustment paths.

### **1a: Initial steady states:**

Putting  $\dot{c} = \dot{b} = \dot{m} = \dot{z} = t = 0$  in the system 6-10 above, we get:

$$\begin{aligned} c_0 &= \gamma(y_0 - \tau_0) \\ m_0 &= \frac{\beta\gamma}{r_0}(y_0 - \tau_0) \\ b_0 &= \frac{\gamma-1}{r_0}(y_0 - \tau_0) \\ z_0 &= \frac{\tau_0 - g_0}{r_0} \end{aligned} \quad \dots\dots \text{Equations 15-19}^{10}$$

$$\gamma = \frac{\theta(\rho + \theta)}{(1 + \beta)(\rho + \theta - r_0)(r_0 + \theta)} > 0, \text{ assuming } \rho + \theta - r_0 > 0$$

### **1b: Final steady states:**

To solve for these, we proceed as follows:

- i. We put  $\dot{c} = \dot{b} = \dot{m} = 0$  in 6–9, noting that  $z_t$  now equals  $z_T$ , and denoting steady states as  $\bar{c}, \bar{b}, \bar{m}$ , &  $z_T$
- ii. We obtain expressions for  $\bar{\tau}, \bar{\mu}\bar{m}, \bar{a}, \bar{g}$  and  $\bar{d}$  from the deficit closure rules, as follows:

$$\begin{aligned} \bar{\tau} - \tau_1 &= n_1 \bar{d} & \bar{\tau} &= \tau_1 + n_1 \bar{d} \\ (\bar{\mu} - \mu_0) \bar{m} &= n_2 \bar{d} \text{ so that: } & \bar{\mu}\bar{m} &= n_2 \bar{d} \\ \bar{a} - a_0 &= n_3 \bar{d} & \bar{a} &= n_3 \bar{d} \\ & & \bar{g} &= g_0 \end{aligned} \quad , \text{ where } \bar{d} = (\tau_0 - \tau_1)e^{r_0 T}$$

Plugging this into the expressions for  $\bar{c}, \bar{b}, \bar{m}$  we can obtain the reduced form steady states in terms of the parameters:

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<sup>10</sup> We assume  $\mu_0 = a_0 = 0$ .

$$\begin{aligned}
\bar{c} &= \gamma(y_0 - \tau_0) - \gamma n_1 \bar{d} \\
\bar{m} &= \frac{\beta \gamma}{r_0} (y_0 - \tau_0) - \frac{\beta \gamma n_1 + n_2}{r_0} \bar{d} \\
\bar{b} &= (1/r_0) \{ (\gamma - 1)(y_0 - \tau_0) - (\gamma n_1 - (1 - n_3)) \bar{d} \} \\
\bar{d} &= r_0 z_T + g_0 - \tau_1 = (\tau_0 - \tau_1) e^{r_0 T}
\end{aligned}$$

..... Equations 20-23

## **2a: Solving the system for $t \geq T$ :**

The system of equations for this regime is saddle-point stable, with  $-(\rho + \theta - r_0)$  as the stable (negative) root. There are two unstable (positive) roots,  $r$  and  $r + \theta$ , as indeed there should be given the two jump (forward-looking) variables,  $c$  and  $m$ .  $b$  (and  $z$ ), of course, is backward-looking:

$$\begin{pmatrix} \dot{c}_t \\ \dot{b}_t \\ \dot{m}_t \end{pmatrix} = \begin{pmatrix} r_0 - \rho & -\frac{\theta(\theta + \rho)}{1 + \beta} & -\frac{\theta(\theta + \rho)}{1 + \beta} \\ -1 & r_0 & 0 \\ -\beta & 0 & r_0 \end{pmatrix} \begin{pmatrix} c_t - \bar{c} \\ b_t - \bar{b} \\ m_t - \bar{m} \end{pmatrix}$$

Eigenvectors:  $\begin{pmatrix} \rho + \theta & 0 & -\theta \\ 1 & 1 & 1 \\ \beta & -1 & \beta \end{pmatrix}$

*corresponding to*  
-ve root  
 $\downarrow$

Since the system is stable, we can solve for the deviations from steady state as follows:

$$\begin{pmatrix} c_t - \bar{c} \\ b_t - \bar{b} \\ m_t - \bar{m} \end{pmatrix} = \begin{pmatrix} \rho + \theta & 0 & -\theta \\ 1 & 1 & 1 \\ \beta & -1 & \beta \end{pmatrix} \begin{pmatrix} K_1 e^{-(\rho + \theta - r_0)t} \\ K_2 e^{r_0 t} \\ K_3 e^{(r_0 + \theta)t} \end{pmatrix}$$

by putting  $K_2 = K_3 = 0$  (the constants corresponding to the unstable roots).  $K_1$  can be obtained by plugging in the initial condition for  $b$ , i.e.  $b_T$ , so that  $K_1 = (b_T - \bar{b}) e^{-(\rho + \theta - r_0)T}$ . Thus, we obtain:

$$\begin{aligned}
c_t - \bar{c} &= (\rho + \theta)(b_T - \bar{b}) e^{-(\rho + \theta - r_0)(t-T)} \\
b_t - \bar{b} &= (b_T - \bar{b}) e^{-(\rho + \theta - r_0)(t-T)} \\
m_t - \bar{m} &= \beta(b_T - \bar{b}) e^{-(\rho + \theta - r_0)(t-T)}
\end{aligned}$$

..... Equations 24-26

so that,

$$b_t - \bar{b} = \frac{1}{\rho + \theta} (c_t - \bar{c}) = \beta(m_t - \bar{m}), \text{ or, } \dot{b}_t = \frac{1}{\rho + \theta} \dot{c}_t = \beta \dot{m}_t \dots \dots \text{Equation 27}$$

Equation 27 simply notes that the variables  $c$ ,  $b$  and  $m$  move along the same manifold in the same direction for  $t \geq T$  and given  $b_T$ .

## **2b: Solving the system for $0 < t < T$ :**

The system for this regime can also be written as:

$$\begin{pmatrix} \dot{c}_t \\ \dot{b}_t \\ \dot{m}_t \end{pmatrix} = \begin{pmatrix} r_0 - \rho & -\frac{\theta(\theta + \rho)}{1 + \beta} & -\frac{\theta(\theta + \rho)}{1 + \beta} \\ -1 & r_0 & 0 \\ -\beta & 0 & r_0 \end{pmatrix} \begin{pmatrix} c_t - \tilde{c} \\ b_t - \tilde{b} \\ m_t - \tilde{m} \end{pmatrix}$$

where  $\tilde{c}, \tilde{b}$  and  $\tilde{m}$  now replace  $\bar{c}, \bar{b}$  and  $\bar{m}$ . While the characteristic roots and eigenvectors are the same as for the system for  $t \geq T$ , since there is no requirement for the system to be saddle-point stable in this regime, we have three constants, say  $J_1, J_2$  and  $J_3$  (corresponding to the three roots) to determine.<sup>11</sup>

The solution can be written as:

$$\begin{aligned} c_t - \tilde{c} &= (\rho + \theta)J_1 e^{-(\rho + \theta - r_0)t} - \theta J_3 e^{(r_0 + \theta)t} \\ b_t - \tilde{b} &= J_1 e^{-(\rho + \theta - r_0)t} + J_2 e^{r_0 t} + J_3 e^{(r_0 + \theta)t} \quad \dots\dots \text{Equations 28-30} \\ m_t - \tilde{m} &= \beta J_1 e^{-(\rho + \theta - r_0)t} - J_2 e^{r_0 t} + \beta J_3 e^{(r_0 + \theta)t} \end{aligned}$$

$$\tilde{c} = \gamma(y_0 - \tau_0) = c_0$$

where  $\tilde{b} = ((\gamma - 1)/r_0)(y_0 - \tau_0) = b_0 \quad \dots\dots \text{Equations 31-33}$

$$\tilde{m} = (\beta\gamma/r_0)(y_0 - \tau_0) = m_0$$

To determine the  $J$ s, we use the following three boundary conditions:

**I.** Perfect foresight implies that consumption is continuous at  $T$ , i.e.

$c_{T-}$  (from regime  $0 < t < T$ ) =  $c_{T+}$  (from regime  $t \geq T$ ), so that:

$$\tilde{c} + (\rho + \theta)J_1 e^{-(\rho + \theta - r_0)T} - \theta J_3 e^{(r_0 + \theta)T} = \bar{c} + (\rho + \theta)(b_T - \bar{b}) \quad \dots\dots (i),$$

where  $b_T - \bar{b}$  can be obtained by noting that  $\dot{c}_{T+} = \dot{c}_{T-}$ , and that from 27:

$$\dot{b}_T = \left( \frac{1}{\rho + \theta} \right) \dot{c}_{T+} [= \dot{c}_{T-}] \text{ and } \dot{b}_T = -(\rho + \theta - r_0)(b_T - \bar{b}). \text{ Now since,}$$

$$\dot{c}_{T-} = -(\rho + \theta - r_0)(\rho + \theta)J_1 e^{-(\rho + \theta - r_0)T} - \theta(r_0 + \theta)J_3 e^{(r_0 + \theta)T}, \text{ we have:}$$

$$b_T - \bar{b} = J_1 e^{-(\rho + \theta - r_0)T} - \frac{\theta(r_0 + \theta)}{(\rho + \theta)(\rho + \theta - r_0)} J_3 e^{(r_0 + \theta)T}, \text{ which plugged into (i) gives } J_3.$$

**II.** Perfect foresight implies that real balances are continuous at  $T$ , that is:

$$m_{T-} = m_{T+}, \text{ so that:}$$

<sup>11</sup> Under the earlier saddle-point assumption in  $t \geq T$ , jumps in  $c$  and  $m$  had ensured that the “destabilising constants” were set to zero.

$\tilde{m} + \beta J_1 e^{-(\rho+\theta-r_0)T} - J_2 e^{r_0 T} + \beta J_3 e^{(r_0+\theta)T} = \bar{m} + \beta(b_T - \bar{b}) \dots (ii)$ . Having already used the  $b_T - \bar{b}$  expression obtained from the inter-relationship of  $b$ ,  $m$  and  $c$  at  $T+$ , we now need a second expression for  $b_T - \bar{b}$ . We can do this by evaluating  $b_t$  at  $T-$  in the system for  $0 < t < T$ :  $b_T - \bar{b} = \tilde{b} - \bar{b} + J_1 e^{-(\rho+\theta-r_0)T} + J_2 e^{r_0 T} + J_3 e^{(r_0+\theta)T}$ , noting that while  $\dot{b}_{T+}$  might differ from  $\dot{b}_{T-}$ , the “levels” of  $b_T$  should be the same “around”  $T$  ( $b$  is backward looking). Plugging into (ii) gives  $J_2$ .

**III.** We can finally utilise an end-point condition on  $b$ , i.e. evaluate  $b_t$  in the  $0 < t < T$  system at  $t=0$ . We get:  $b_0 - \tilde{b} = J_1 + J_2 + J_3$ , which, yields  $-\frac{\gamma-1}{r_0}(\tau_0 - \tau_1) = J_1 + J_2 + J_3$ .

Using the expressions for  $J_2$  and  $J_3$  above, we can solve for  $J_1$  and for  $b_T - \bar{b}$

$$J_1 = -\left[ \frac{(\gamma-1)(1+\beta) + n_2 + \beta(1-n_3)}{r_0(1+\beta)} + \frac{\gamma n_1(\rho+\theta-r_0)}{\theta(\rho+2\theta)} e^{-\theta T} \right] (\tau_0 - \tau_1), \quad J_2 = \left[ \frac{n_2 + \beta(1-n_3)}{r_0(1+\beta)} \right] (\tau_0 - \tau_1),$$

$$J_3 = \left[ \frac{\gamma n_1(\rho+\theta-r_0)}{\theta(\rho+2\theta)} e^{-\theta T} \right] (\tau_0 - \tau_1),$$

$$b_T - \bar{b} = \left[ \frac{n_1(\gamma + \beta\gamma - 1) - (\gamma + \beta\gamma - 1 + n_2 - \beta n_3) e^{-(\rho+\theta)T}}{r_0(1+\beta)} + \frac{\gamma n_1(\rho+\theta-r_0)}{\theta(\rho+2\theta)} (1 - e^{-(\rho+2\theta)T}) \right] (\tau_0 - \tau_1)$$

## **2c: General solutions:**

Combining the solutions for the two regimes, the general solution for the aid-augmented model can be written as:<sup>12</sup>

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<sup>12</sup> The general solution can also be expressed as a linear combination of three terms: the first term is  $n_1$  times the  $n_1=1$  solution, the second term is  $n_2$  times the  $n_2=1$  solution, and the last term is  $n_3$  times the  $n_3=1$  solution. Thus,  $c_t = n_1 * (c_t |_{n_1=1}) + n_2 * (c_t |_{n_2=1}) + n_3 * (c_t |_{n_3=1})$ .

$$\begin{aligned}
c_t &= \begin{cases} \tilde{c} + (\rho + \theta)J_1 e^{-(\rho+\theta-r_0)t} - \theta J_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{c} + (\rho + \theta)(b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
b_t &= \begin{cases} \tilde{b} + J_1 e^{-(\rho+\theta-r_0)t} + J_2 e^{r_0 T} + J_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{b} + (b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
m_t &= \begin{cases} \tilde{m} + \beta J_1 e^{-(\rho+\theta-r_0)t} - J_2 e^{r_0 T} + \beta J_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{m} + \beta(b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
z_t &= \begin{cases} z_0 + \frac{\tau_0 - \tau_1}{r_0}(e^{r_0 t} - 1), & \text{for } 0 < t < T \\ z_0 + \frac{\tau_0 - \tau_1}{r_0}(e^{r_0 T} - 1), & \text{for } t \geq T \end{cases} \\
b_t - z_t &= \begin{cases} \tilde{b} - (z_0 - \frac{\tau_0 - \tau_1}{r_0}) + J_1 e^{-(\rho+\theta-r_0)t} + (J_2 - \frac{\tau_0 - \tau_1}{r_0})e^{r_0 t} + J_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ \bar{b} - \{z_0 + \frac{\tau_0 - \tau_1}{r_0}(e^{r_0 T} - 1)\} + (b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases} \\
x_t = \dot{b}_t - \dot{z}_t &= \begin{cases} -(\rho + \theta - r_0)J_1 e^{-(\rho+\theta-r_0)t} + r_0(J_2 - \frac{\tau_0 - \tau_1}{r_0})e^{r_0 t} + (r_0 + \theta)J_3 e^{(r_0+\theta)t}, & \text{for } 0 < t < T \\ -(\rho + \theta - r_0)(b_T - \bar{b})e^{-(\rho+\theta-r_0)(t-T)}, & \text{for } t \geq T \end{cases}
\end{aligned}$$

### **3a: Initial Jumps**

The forward-looking variables,  $c$ ,  $m$ , and  $x$ , can jump at time zero and these expressions can be obtained by putting  $t=0$  in the  $0 < t < T$  solution for these variables and subtracting the initial steady state values therefrom.

$$c_{0+} - c_0 = \tilde{c} - c_0 + (\rho + \theta)J_1 - \theta J_2 = (\rho + \theta)J_1 - \theta J_2$$

$$m_{0+} - m_0 = \tilde{m} - m_0 + \beta J_1 - J_2 + \beta J_3 = \beta J_1 - J_2 + \beta J_3, \text{ noting that } x_0 \text{ is zero.}$$

$$x_{0+} = -(\rho + \theta - r_0)J_1 + r_0(J_2 - \frac{\tau_0 - \tau_1}{r_0}) + (r_0 + \theta)J_3$$

### **3b: Adjustment paths**

These are quite complicated for the general case and so are discussed in the context of the special case of  $n_3=0$  in the next section.

## **C: SOLUTION FOR THE CASE OF FULL GRANT FINANCE ( $n_3=1$ )**

When the deficit is expected to be fully closed (after  $t = T$ ) by an inflow of foreign grants (i.e.  $n_3=1$ ),  $J_2=J_3=0$ , and therefore the solution simplifies significantly. Recalling that  $J_2$  and  $J_3$  were the constants associated with the unstable roots, we can infer that the system in  $c$ ,  $b$  and  $m$  will now be stable throughout, even for the backward looking variable  $b$ .

We can solve sequentially for the initial jumps, the final steady states and the full adjustment paths to develop an understanding of the economy's response to the temporary fiscal impetus.

***i) Initial Jumps:***

Using the expressions in 3a, and substituting out for  $J_1|_{n_3=1}$ , we get:

$$c_{0+} - c_0 = (\tau_0 - \tau_1) \left[ \frac{-\gamma(\rho + \theta - r_0) + \rho + \theta}{r_0} \right]$$

$$m_{0+} - m_0 = \frac{\beta}{r_0} (\tau_0 - \tau_1)$$

$$x_{0+} - x_0 = -(\tau_0 - \tau_1) \left[ \frac{-\gamma(\rho + \theta - r_0) + \rho + \theta}{r_0} \right]$$

Interesting results arise for the jumps in consumption and the current account. The jump in consumption at time 0 in response to the tax cut is unambiguously positive, as one would expect. Importantly however, the size of the jump depends on the  $[\cdot]$  term, which is greater than 1 when  $\gamma < 1$ , and less than 1 when  $\gamma > 1$ .<sup>13</sup> With  $\gamma < 1$ , consumption will jump more than the initial fiscal impetus, and vice versa. From equation 17, we can see that  $\gamma > 1$  is simply the condition that initial bond-holdings are positive, while  $\gamma < 1$  implies that agents are net debtors at time zero. Also, given that:  $\gamma = \frac{\theta(\rho + \theta)}{(1 + \beta)(\rho + \theta - r_0)(r_0 + \theta)}$ , a sufficient condition for  $\gamma < 1$  is  $\rho > r_0$ .<sup>14</sup>

Given  $y_0$ ,  $g_0$  an inherited (backward-looking) stock of net external assets  $b_0 - z_0$ , and fixed interest payments thereon of  $r_0(b_0 - z_0)$ , a jump in consumption translates into a jump of equal magnitude in the current account ( $x$ ), but in the opposite direction. Thus, if  $\gamma < 1$ , the current account will jump “down” by more than  $\tau_0 - \tau_1$ .

***ii) Final steady states:***

Before looking at the dynamic adjustment paths, it is instructive to recall the final steady states and their relation to the initial steady states, the size of the fiscal impetus, and the jumps at  $t=0$ . When  $n_3=1$ , a little rearrangement permits us to write the final steady states as:

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<sup>13</sup> The jump in real balances is unambiguously positive and its size depends on  $\beta$  and  $r_0$ , not  $\gamma$ .

<sup>14</sup> The condition can be written as  $(1 + \beta)(1 - \frac{r_0}{\rho + \theta})(1 + \frac{r_0}{\theta}) > 1$  which must be true when  $(1 - \frac{r_0}{\rho + \theta})(1 + \frac{r_0}{\theta}) > 1$

The latter simplifies to  $\rho > r_0$ .



$$\bar{c} = c_0 + \gamma(\tau_0 - \tau_1)$$

$$\bar{m} = m_0 + \frac{\beta\gamma}{r_0}(\tau_0 - \tau_1)$$

$$\bar{b} = b_0 + \frac{(\gamma-1)}{r_0}(\tau_0 - \tau_1)$$

Thus, when  $\gamma < 1$  (initial jump in consumption bigger than  $\tau_0 - \tau_1$ ), steady state consumption is actually lower than  $c_0 + (\tau_0 - \tau_1)$ . The reverse is true when the initial jump is smaller ( $\gamma > 1$ ) so that the final steady state is higher than  $c_0 + (\tau_0 - \tau_1)$ . Again, this has important implications for the extent to which the impact of a fiscal impact on consumption levels is sustained. It is clear that when consumers are relatively impatient ( $\gamma < 1$  or  $\rho > r_0$ ), the benefits of the tax cut are not fully sustained in the long run, despite full grant financing in the future.

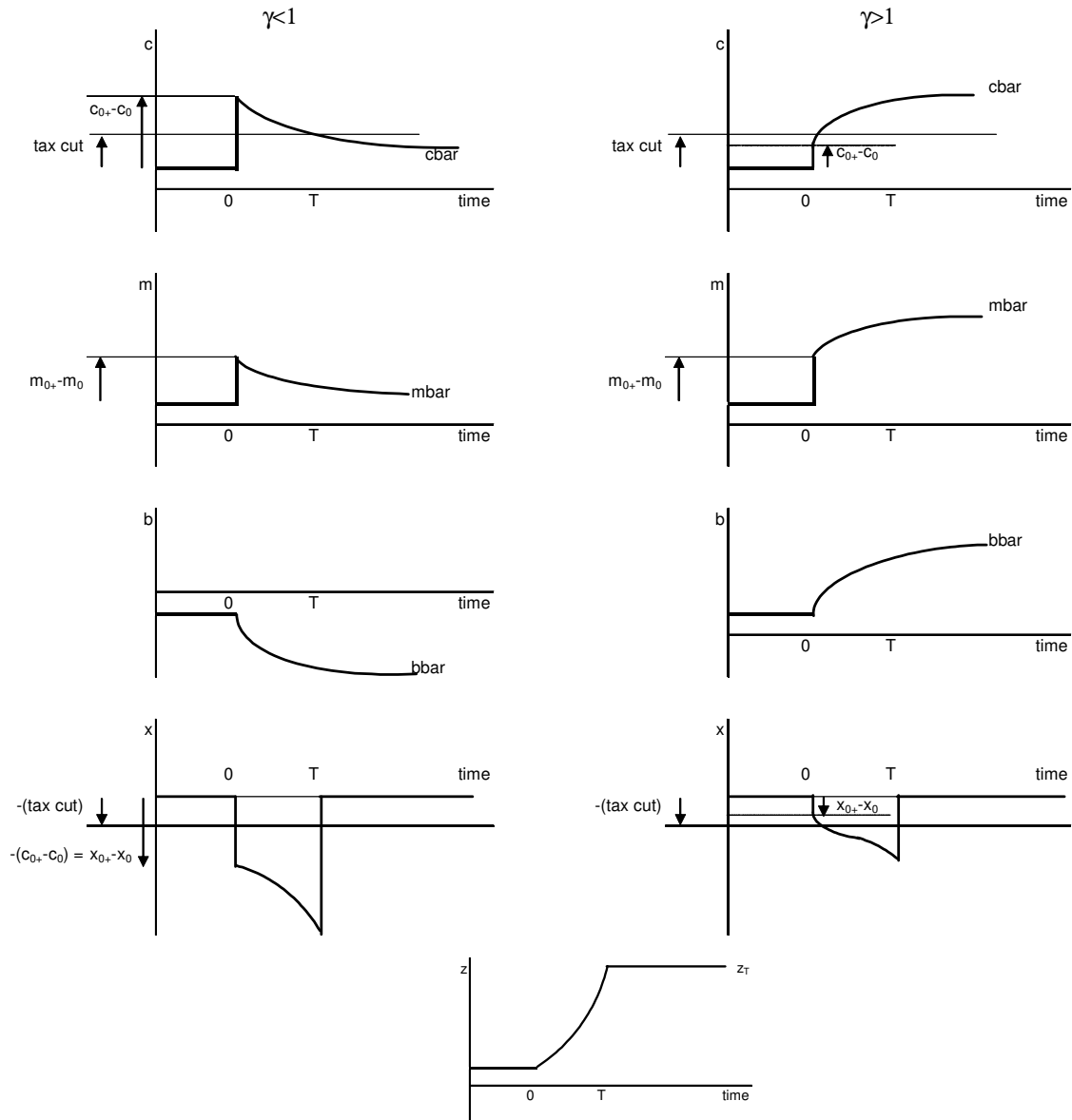
Similar results hold for  $m$  and  $b$  as well. For  $b$  (bond-holdings), the final steady state level is higher than  $b_0$ , whereas when  $\gamma < 1$ , agents end up being more indebted, i.e.  $\bar{b} < b_0$ .

### **iii) Dynamic adjustment paths:**

The paths of  $c$ ,  $b$ ,  $m$  and  $x$  can be derived directly from the general solutions, imposing  $n_3=1$  therein, differentiating with respect to time and observing the sign of the gradients and whether the latter are become steeper or flatter (by evaluating the second derivatives w.r.t.  $t$ ). The relevant time derivatives of  $c$ ,  $m$  and  $b$  are given below for both  $0 < t < T$  and  $t \geq T$ :

$$\begin{aligned} \dot{c} &= (\rho + \theta - r_0)(\rho + \theta)(\tau_0 - \tau_1) \left[ \frac{\gamma-1}{r_0} \right] e^{-(\rho+\theta-r_0)t}, \quad \ddot{c} = -(\rho + \theta - r_0)^2(\rho + \theta)(\tau_0 - \tau_1) \left[ \frac{\gamma-1}{r_0} \right] e^{-(\rho+\theta-r_0)t} \\ \dot{m} &= \beta(\rho + \theta - r_0)(\tau_0 - \tau_1) \left[ \frac{\gamma-1}{r_0} \right] e^{-(\rho+\theta-r_0)t}, \quad \ddot{m} = -\beta(\rho + \theta - r_0)^2(\tau_0 - \tau_1) \left[ \frac{\gamma-1}{r_0} \right] e^{-(\rho+\theta-r_0)t} \\ \dot{b} &= (\rho + \theta - r_0)(\tau_0 - \tau_1) \left[ \frac{\gamma-1}{r_0} \right] e^{-(\rho+\theta-r_0)t}, \quad \ddot{b} = -(\rho + \theta - r_0)^2(\tau_0 - \tau_1) \left[ \frac{\gamma-1}{r_0} \right] e^{-(\rho+\theta-r_0)t} \\ \dot{x} &= -e^{r_0 t}(\tau_0 - \tau_1) \left[ \frac{(\rho + \theta - r_0)^2(\gamma-1)}{r_0} e^{-(\rho+\theta)t} + r_0 \right], \quad \ddot{x} = e^{r_0 t}(\tau_0 - \tau_1) \left[ \frac{(\rho + \theta - r_0)^3(\gamma-1)}{r_0} e^{-(\rho+\theta)t} + r_0^2 \right] \end{aligned}$$

Expectedly, given results on initial jumps and final steady states, the adjustment paths depend crucially on whether  $\gamma$  is  $>$  or  $<$  1. The paths are given below, followed by a discussion.



As can be seen, the dynamic adjustment of the four variables is quite different from what obtains when either tax or money finance is anticipated (the Kawai and Maccini (1995) results are reproduced in the Appendix at the end to facilitate comparison).

Let us begin by understanding the impact of future grant inflows on the exchange rate. The latter should appreciate, or prices should fall, given a fixed  $M$ . Moreover, the deflationary expectations should be “imported” into the present through perfect foresight. At the same time, the tax cut induces a current jump in consumption, which is inflationary. When the jump is big ( $\gamma < 1$ ), this inflationary impact is large and hence the overall fall in prices smaller. By contrast, when  $\gamma > 1$ , the consumption jump and the associated inflation is smaller, and hence the overall fall in prices larger. Given  $m_t = \beta c_t / (r_0 + \pi_t)$ , the jump in  $m$  in both cases turns out to be of the same size and sign:  $(\beta/r_0)(\tau_0 - \tau_1)$ .

As for the current account, it deteriorates in both cases, i.e. when  $\gamma < 1$  and  $\gamma > 1$ . The jump and subsequent deterioration in the former case is very sharp even though consumption has begun to fall. This is primarily due to the sharper fall in bond-holdings. Note from the time

derivatives that from  $t=0+$ ,  $b$  falls faster than  $c$ , given that  $\rho+\theta$  is likely a small fraction. When  $\gamma > 1$ , the current account still deteriorates after a smaller initial downward jump, but not as steeply. The reason is rising bond-holdings which offset the effects of rising public external debt. However, since consumption rises after  $t=0+$ , the combined effect of this with a rising  $z$  dominates the rise in  $b$  causing  $\dot{x}$  to eventually turn negative and thus drive an exponential worsening of the current account deficit.<sup>15</sup>

The possible policy conclusion that can be derived from the foregoing are consolidated in Section E. Before we stab into that, let us enrich the above analysis by a further policy experiment.

#### D. EFFECTS OF A CHANGE IN ANTICIPATED FINANCING METHODS

Returning to the general solution framework characterised by a mixed tax-money-grant closure rule, let us address the following question: given a certain known anticipated mix of financing methods, what happens when news arrives of a change in the future financing mix that the government will employ to close the deficit in  $t \geq T$ ? For example, suppose the country suddenly receives news that donors will put in more grant financing. How will this impact final steady states and initial jumps?

We first look at *steady state (SS) comparative statics*, recalling Equations 20-23.

$$\begin{aligned}\bar{c} &= \gamma(y_0 - \tau_0) - \gamma n_1 \bar{d} \\ \bar{m} &= \frac{\beta\gamma}{r_0}(y_0 - \tau_0) - \frac{\beta\gamma n_1 + n_2}{r_0} \bar{d} \\ \bar{b} &= (1/r_0)\{(\gamma-1)(y_0 - \tau_0) - (\gamma n_1 - (1-n_3))\bar{d}\} \\ \bar{d} &= r_0 z_T + g_0 - \tau_1 = (\tau_0 - \tau_1)e^{r_0 T}\end{aligned}$$

Using these, we can derive the following marginal effects table.<sup>16</sup> [ $\sim$  denotes no change].

	<i>Aid</i>	<i>Money</i>	<i>Taxes</i>	Impact on		
				$\bar{c}$	$\bar{b}$	$\bar{m}$
Aid goes Up	$n_3 +$	$n_2 \sim$	$n_1 -$	+	-, if $\gamma < 1$	+
	$n_3 +$	$n_2 -$	$n_1 \sim$	$\sim$	-	+
Money finance up	$n_3 -$	$n_2 +$	$n_1 \sim$	$\sim$	+	-
	$n_3 \sim$	$n_2 +$	$n_1 -$	+	+	-, if $\beta\gamma < 1$
Lump-sum taxes up	$n_3 -$	$n_2 \sim$	$n_1 +$	-	+, if $\gamma < 1$	-
	$n_3 \sim$	$n_2 -$	$N_1 +$	-	-	+, if $\beta\gamma < 1$

As can be seen, an increase in grant aid that is expected to replace tax financing raises SS consumption and money balances, while the impact on bonds depends on whether initial

<sup>15</sup> Note that that when  $\gamma > 1$ ,  $m$  rises, implying that prices must be falling (exchange rate appreciation), while with  $\gamma < 1$ ,  $m$  falls, implying that prices must be rising (exchange rate depreciation). Since the current account deteriorates in both cases, the results of the model reinforce the weak empirical association of current accounts with exchange rate movements documented in literature (see Agenor and Montiel, 1999).

<sup>16</sup> Since the  $n_1$ ,  $n_2$  and  $n_3$  are shares, marginal effects must be defined and interpreted with care.

bond-holding is positive or negative ( $\gamma > 1$  or  $< 1$ ). When it is negative, aid expectations cause agents' long-run indebtedness to increase. The latter result holds unambiguously (i.e. independent of the value of  $\gamma$ ) when aid is expected to eat into money finance. Again, this reinforces the earlier argument that grant aid is a pro-borrowing policy.

Importantly, SS consumption remains unchanged when aid expects to replace or is expected to be replaced by money financing.

Let us now analyse the *impact of a change in financing methods on the size and, possibly, direction of the initial jumps in  $c$ ,  $m$  and  $x$* . A little algebra permits us to derive the jump expressions from the general solutions for these variables, as follows:

$$c_{0+} - c_0 = \gamma(\tau_0 - \tau_1) - (\tau_0 - \tau_1) \left[ \frac{(\rho + \theta)(\gamma - 1)(1 + \beta) + n_2 + \beta(1 - n_3)}{r_0} + \frac{\gamma n_1(\rho + \theta - r_0)}{\theta} e^{-\theta T} \right]$$

$$m_{0+} - m_0 = \frac{1}{r_0} [\beta \gamma(\tau_0 - \tau_1) - (\tau_0 - \tau_1) \{ \beta(\gamma - 1) + n_2 + \beta(1 - n_3) \}]$$

$$x_{0+} - x_0 = -\{(\tau_0 - \tau_1) - (\tau_0 - \tau_1) \left[ \frac{\gamma n_1(\rho + \theta - r_0)}{\theta} e^{-\theta T} + \frac{(\rho + \theta)(n_2 + \beta(1 - n_3))}{r_0(1 + \beta)} + \frac{\gamma - 1}{r_0}(\rho + \theta - r_0) \right]\}$$

The expressions are complicated and so are the associated partial derivatives with respect to  $n_1$ ,  $n_1$  and  $n_3$ , but some conclusions can still be drawn. When  $\gamma = 1$ , (i.e. agents are neither net debtors nor net creditors to start with) an increase in anticipated aid that is to replace tax finance increases the upward jump in consumption.

When  $\gamma \neq 1$ , it helps to write the expression for the “change in the consumption jump” in response to a rise, say  $\Delta$ , in  $n_3$  (matched by an fall  $\Delta$  in  $n_1$ ). The expression is:

$$\text{change in } [c_{0+} - c_0] = (\tau_0 - \tau_1) \Delta \left[ \frac{\beta}{r_0} - \frac{\gamma(\rho + \theta - r_0)}{\theta} e^{-\theta T} \right], \quad \text{which is positive when:}$$

$$\frac{\beta(1 + \beta)(\theta + r_0)}{r_0(\theta + \rho)} > e^{-\theta T}. \quad \text{When } \gamma < 1 \text{ (i.e. } r_0 < \rho), \text{ a necessary condition for this inequality to}$$

$$\text{hold is } \frac{\beta(1 + \beta)}{r_0} > e^{-\theta T}. \quad \text{Thus when the real interest rate is low, consumption is less}$$

important in the utility function relative to real balances, the probability of death is high (horizons are short) or the deficit regime is of longer duration, tax-replacing aid is likely to cause a larger upward jump in consumption. It can be shown that similar conditions also apply to the jump in the current account. That is, a larger initial current account deficit obtains the higher is  $\beta$ ,  $\theta$ ,  $T$  and the smaller is  $r_0$ .

## E: POLICY CONCLUSIONS AND WAY FORWARD

Given the limiting assumptions of the model, especially in relation to the free substitutability between foreign and domestic assets (which is unlikely to apply in post-HIPC Africa), any policy conclusions must be drawn and handled with caution. That said, there are some general and HIPC-specific insights than can be tentatively derived, and might usefully inform the policy debate. Below I summarise these in the order in which they arise.

1. We saw in Section C – full grant financing (see sub-section i) – that anticipated grant aid causes consumption and hence the current account to jump today by more than the fiscal impetus when agents are net bond-issuers to start with ( $\gamma < 1$ ), and to jump less than the initial fiscal impetus when agents are net bond-holders ( $\gamma > 1$ ). If one of these two had to be picked to describe African private agents today, it would probably be the former. With very little government domestic bond issuance and access to foreign bonds limited, African private agents are unlikely to be net holders of bonds.

Also, the underlying sufficient condition for  $\gamma < 1$ , i.e.  $\rho > r_0$  is more likely to be true when  $r_0$  falls below some fixed subjective discount rate. To the extent that world interest rates are low (as they are today), foreign debt is available at concessional interest rates (as to HIPC), and the monetary impact of large external financing inflows has caused domestic real interest rates to fall (as in some post-HIPC African countries), this sufficient condition for  $\gamma < 1$  might well hold in our current context. *It would be interesting to revisit these results after relaxing the perfect substitutability assumption between foreign and domestic bonds. As mentioned in the research proposal, I endeavour to do that in a subsequent paper.*

2. The analysis on C also tell us that the jump in the current account is *unambiguously negative*, which conflicts with the conclusion in Kawai and Maccini (1995) where a future money financing closure rule – perhaps a more realistic closure rule to anticipate in most HIPC, given their fiscal impotence – is associated with a *positive* jump in the current account. Moreover, the initial deterioration is seen to progressively worsen after the initial downward jump until the regime switch at time T (see analysis of C-iii), consistent with *ever-increasing injections of foreign financing* in the interim period.

These results are not wholly inconsistent with what has been observed in recent years in HIPC past Completion Point. Indeed, according to IMF and World Bank (2003), 6 out of the 8 HIPC countries (which reached Completion Point by July 2003), had witnessed external account deteriorations. To the extent that this is partly a result of what agents might anticipate about a grant-led “donor-bailout” in the future, this paper’s *twin deficits* finding might be policy-relevant. *One must concede though that the current account deficit of any HIPC is the outcome of a complex process involving many factors (of which aid anticipation might be one), and that only by modelling some the other factors (such as the real exchange rate) can one really understand the relative contribution thereof. The Buiter (1988) model of a dependent economy with the traded/non-trade goods segregation seems to offer a natural starting-point for such an analysis.*

3. In C-ii, we saw that the *final steady state* consumption was also higher than the initial fiscal impetus when  $\gamma > 1$ , but less when  $\gamma < 1$ . The rather worrying implication of this is that aid worsens debtors’ indebtedness and is, as such, a “pro-borrowing policy”. In other words, the initial bond-holding is important not just for sustaining the long-run consumption-benefits of the fiscal impetus but also the final indebtedness of the economy – both important current concerns of HIPC managers.

The result also tends to reinforce Chalk and Hemming’s (2000) contention that *domestic savings* are the key to establishing joint public and external debt sustainability. *To the extent that this might be true, there is a case for re-investigating the impact on saving of a HIPC government’s domestic debt policy (given the latter’s role in driving local financial market development), and how this could inform the country’s external vs. domestic borrowing decision.*

4. The analysis of the effects of an anticipated change in the future financing mix (section D) also reveals some interesting and, possibly, policy-relevant results. For instance, steady state consumption remains unchanged when aid expects to replace or is expected to be replaced by money financing. In a world where very high future taxation does not immediately come to mind as the obvious policy choice, this result might be read in support of “aid neutrality” with respect to steady state consumption.

5. One of the experiments in section D revealed that *tax-replacing aid* is likely to cause a larger upward jump in consumption when the real interest rate is low, consumption less important in the utility function relative to real balances, the instantaneous probability of death higher, and the deficit regime of longer duration. [The same conditions apply for the current account as well but in the context of a downward jump]. In the current post-HIPC context, these are likely to be true. Money remains important for consumers relative to consumption due to a poorly developed transactions technology in most LICs, including HIPCs. The probability of death in HIPCs is high due to diseases like Malaria and, where present, AIDS. As a result agent horizons ( $1/\theta$ ) are short.  $T$ , the duration of debt-finance deficit regime is expected to be long since the fiscal deficits are essentially driven by larger social sector transfers, which would need to be sustained over a fairly long period of time given the long paybacks to social spending. Finally,  $r_0$  is low, which is very much the case at present. This would serve to reinforce earlier findings about aid being a pro-borrowing policy.

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As is clear from the introduction, the discussion of the assumptions and of the final results, the motivation of the author in writing this paper was clearly to study how a fiscal deficit anticipated to be closed by grant aid affects the intertemporal consumption decision of a small open economy in a perfect foresight setting, and use the results of this study to inform the ongoing debt sustainability debate on post-HIPC Africa. It is hoped that the paper has been able to at least partially address that motivation. However, given some of the restrictive assumptions of the model, which I hope to relax in future papers, it might well be that the paper reads better as an exercise in *intertemporal macroeconomics* than as one in *fiscal adjustment and the role of aid in HIPCs*. For this reason, the technical part of the paper was kept separate from the conclusions part. Further research on the author’s part and the comments of those who peruse this paper will help determine where the paper best belongs.

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**APPENDIX:**  
**KAWAI AND MACCINI (1995) ADJUSTMENT PATHS**

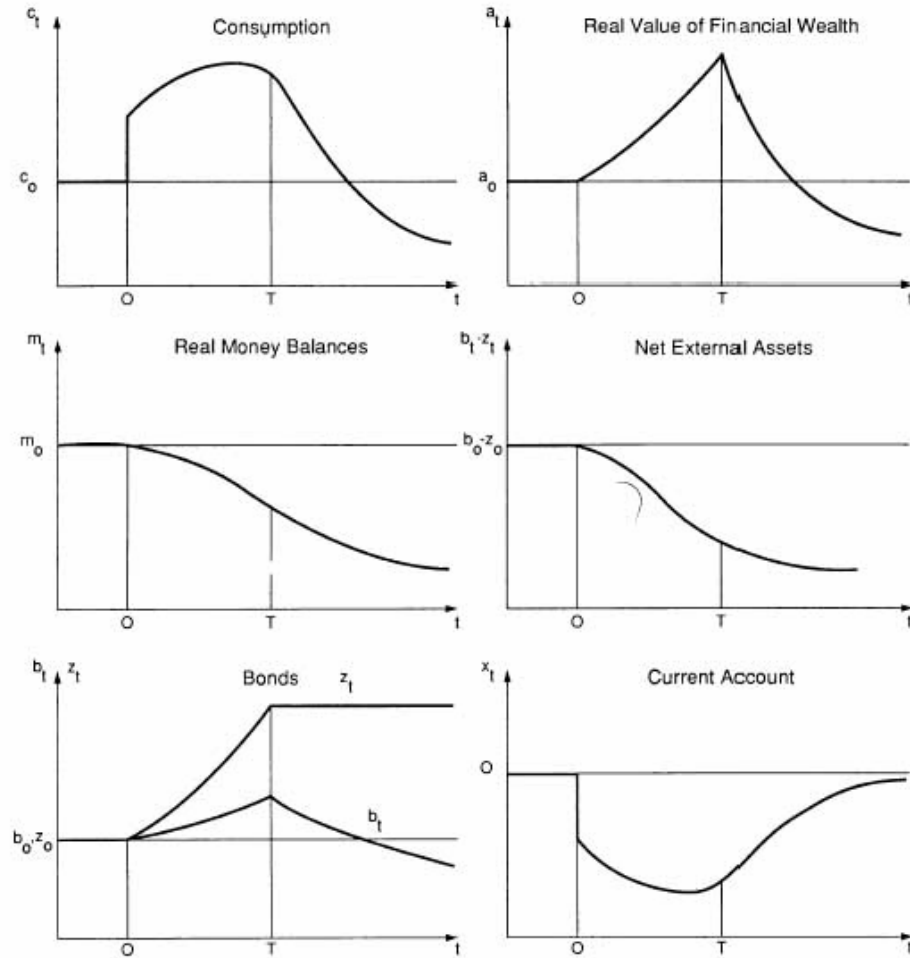


FIG. 1. The Case of Pure Tax Finance ( $\eta_1 = 1$ ) in the Future

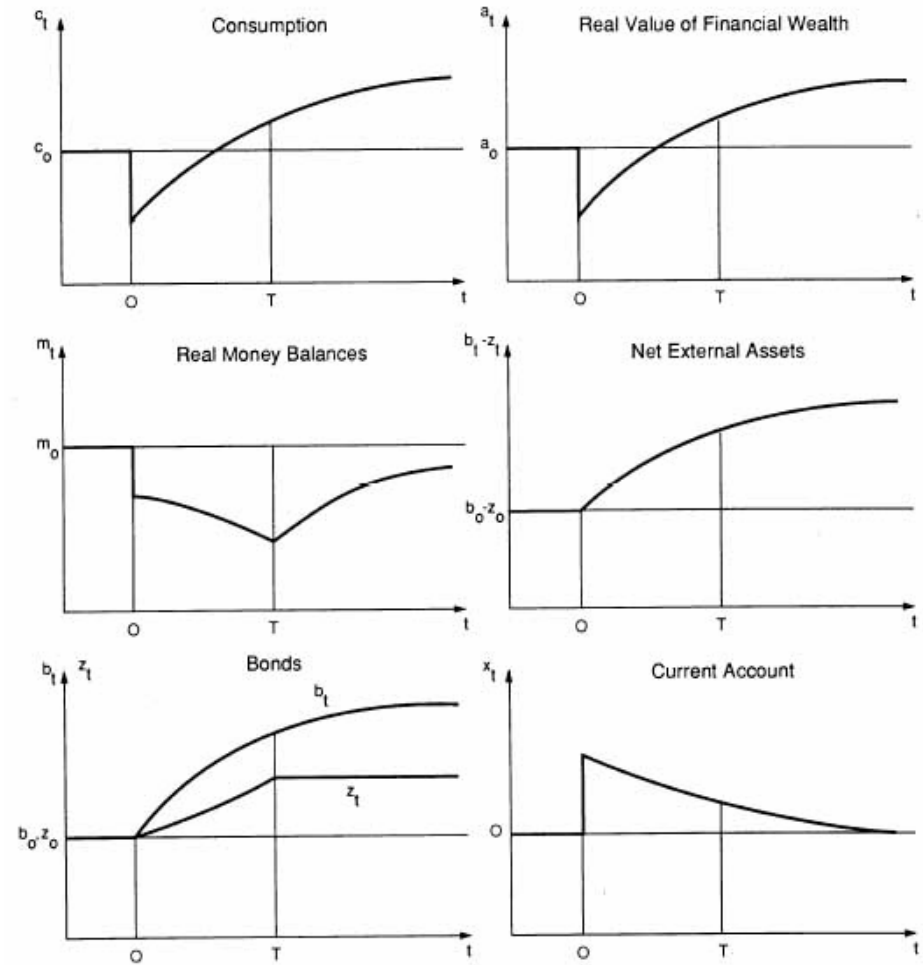


FIG. 2. The Case of Pure Money Finance ( $\eta_2 = 1$ ) in the Future