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Fiscal Strategies, Foreign Indebtedness, and Overlapping Generations

Michael Schmid*)

1. Introduction

Problems surrounding the growth of public debt have been studied anew during the debt-ridden 1980s. The survey by *Buiter* (1985) and the CEPS paper by *Blanchard — Buiter — Dornbusch* (1985) offer a wide and balanced view of public deficits and debt. The present paper is confined to what these authors have dubbed "old-fashioned classical crowding out" or "full-employment capital accumulation". The new twist given to the old debate in this article is gained from the assumption of overlapping generations engaged in an "economic war of ages"(1) and an explicit consideration of national governments competing in a completely integrated international capital market by issuance of public bonds(2). Secondly, by looking at real capital formation and real government debt simultaneously, I try to avoid a dichotomy frequently found in the literature. There the sustainability of fiscal rules is analysed in a book-keeping manner, i. e., neglecting the effect of fiscal rules on the behaviour of the private economy. The simple method of coping with this important interrelatedness between public credit and private capital formation is a thorough application of dynamic system analysis, i. e., specifically phase-diagram techniques.

Relying on previous work in *Schmid* (1987) Section 1 introduces a two-country world economy with different national government behaviour. As building blocs I first present private consumer behaviour under lifetime taxation and private production and investment which is, by assumption, not affected by fiscal instruments. Government behaviour is summarized by a dynamic government budget constraint. A basic distinction is made between government induced private behaviour which may cause external indebtedness(3) and the direct placement of public debt at an integrated world capital market. Consequently, Section 2 takes up balanced budget strategies, like tax-financed public consumption or pay-as-you-go social security. Section 3 probes into the possibility of the existence of government PONZI schemes in a world economy and the stabilization of government debt in an open economy. From what has been said so far it is obvious that the paper does not address among other important problems monetization of public debt or public debt and deficits in an unemployed economy.

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1. Fiscal activity in a world economy

This section provides the consumption-saving decision and the investment decision as building blocs of a world credit market.

1.1 Private behaviour: Consumption and investment

Intertemporal household behaviour is subject to lump-sum taxation in a way well known from *Atkinson — Stiglitz* (1980). The representative consumer of generation t evaluates his lifetime consumption according to(4)

$$(1) \quad u(c_t^1, c_t^2) = \gamma \ln c_t^1 + \delta \ln c_t^2 \qquad \gamma + \delta = 1.$$

He solves the following problem:

$$max\, \gamma \ln c_t^1 + \delta \ln c_t^2$$

with respect to

$$(2) \quad c_t^1 = w_t - \tau^1 - s_t ,$$

$$(3) \quad c_t^2 = (1 + r_{t+1})\, s_t - \tau^2 .$$

Alternatively, these budget constraints per period can be summarized by the lifetime budget constraint:

$$(4) \quad c_t^1 + \frac{c_t^2}{1 + r_{t+1}} = w_t - \tau^1 - \frac{\tau^2}{1 + r_{t+1}} \equiv \hat{w}_t .$$

Given wage income, w_t, the lump-sum tax parameters, τ^1, τ^2, and the interest rate for savings of the working period, r_{t+1}, the agent chooses an optimal amount of savings to maximize lifetime utility. The solution of this problem gives optimal consumption demand and optimal savings:

$$(5) \quad c_t^1 = (1 - \delta)\, \hat{w}_t ,$$

$$(6) \quad c_t^2 = (1 + r_{t+1})\, \delta\, \hat{w}_t ,$$

$$(7) \quad s_t = \delta\, \hat{w}_t + \frac{\tau^2}{1 + r_{t+1}}$$

or

$$s_t = s(w_t, \tau^1, \tau^2).$$

From *(6)* and *(7)* it is obvious that interest and principal of working period savings cover tax payments and consumption during retirement(5):

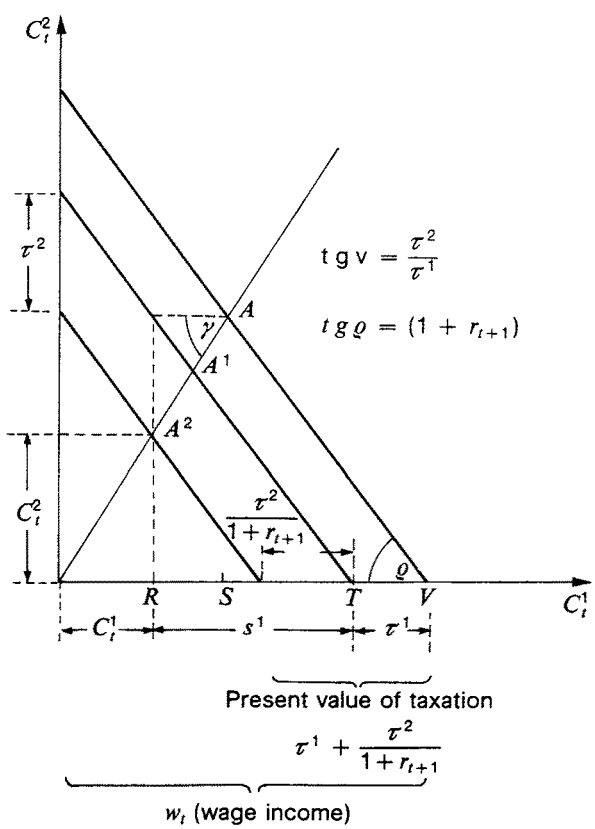
$$(8)\quad c_t^2 + \tau^2 = (1 + r_{t+1}) \left(\delta \hat{w}_t + \frac{\tau^2}{1 + r_{t+1}} \right) = (1 + r_{t+1})\, s_t \,.$$

The intertemporal maximization can be visualized in Figure 1. Three results follow:

1. Taxation of young consumers' labour income, τ^1, reduces their consumption and savings during the working period. Thus, as shown in A^1, the burden of present taxation is shifted somewhat to the future by lowering retirement consumption as well.

Figure 1

Intertemporal maximization with lump-sum lifetime taxation
Cobb-Douglas case



2. Adding future taxation, τ^2, i. e., taxation during the retirement period, generates an increase in savings. Thus the anticipated future tax burden is shifted to the present by lowering present consumption as well (see point A^2).

3. These two conflicting reactions on savings of the young can be combined to obtain a neutrality result: Given a specific amount of the present value of total lifetime taxation, it is always possible to define a tax-burden ratio $\frac{\tau^2}{\tau^1}$ such that savings of young people, s, are invariant under lifetime taxation. In Figure 1, I indicate this burden ratio as $t\,g\,v = \frac{\tau^2}{\tau^1}$. Simple geometric reasoning shows that $SV = RT$.

The members of consecutive generations, L_t, are growing with a constant rate n.

$$L_t = (1 + n)\, L_{t-1}$$

or

$$L_t = L_0\,(1 + n)^t.$$

Therefore, it is useful to introduce the wealth variable a_t denoting private wealth per worker, i. e., currently young people(6), at the beginning of period t. Without gifts or bequests, savings of the young members of generation t must equal wealth of the economy at the beginning of period $t+1$, a_{t+1}:

$$(9) \quad L_t\, s_t = A_{t+1}$$

or

$$s_t = (1 + n)\, a_{t+1}.$$

Making use of the wealth variable, it is possible to express consumption of generation $t-1$ during period t, i. e., consumption of currently old people(7):

$$(10) \quad \frac{L_{t-1}}{L_t}\, c^2_{t-1} = \frac{1}{1 + n}\, c^2_{t-1} = (1 + r_t)\, a_t - \frac{\tau^2}{1 + n}.$$

Obviously, in period t, old people live and pay taxes by spending principal and interest of their working period savings.

In an economy with overlapping generations, old people dissave their wealth, a_t, while young people save. Consolidated savings of the household sector, $\tilde{s}$, equals aggregate national savings (see Section 5.2 for a derivation of important properties of the national saving rate in an OLG model):

(11) $\tilde{s}_t = s_t - a_t = (1 + n)\, a_{t+1} - a_t$.

Only in a growing economy, net savings are positive and can be used to finance investment, government deficits or a current account surplus.

Labour and a (non-depreciating) real capital stock — carried over from period $t-1$ — are combined within the production sector of the economy to produce output of period t. There is a well-behaved neoclassical production technology, thus output per capita, x_t , is a function of the capital-labour ratio, k_t :

$$x_t = f(k_t).$$

The allocation of factors is perfectly competitive, hence the usual conditions for factor rewards hold:

(12) $w_t = f(k_t) - k_t f_k(k_t)$

and

$$r_t = f_k(k_t).$$

From these conditions, we obtain more information for further use.

(13) $\frac{d w_t}{d k_t} = -k_t f_{kk} > 0 \qquad \frac{d r_t}{d k_t} = f_{kk} < 0 \qquad \frac{d w_t}{d r_t} = -k_t < 0.$

Investment in period t is carried out by firms whose managers maximize the net value of the firm by choosing the optimal capital stock, k_{t+1}, given the current stock, k_t . They operate with a two-period planning horizon: During the (first) period t, the financing of k_{t+1} is obtained by offering securities to the young generation which will have to be redeemed during the second period when the members of this generation t will have grown old and will then be wishing to dissave. Assuming that some cash-flow is paid, the firms' optimization problem is

$$\max_{k_{t+1}} \left(-k_{t+1} + \frac{x_{t+1} - w_{t+1}}{1 + r_{t+1}} + \frac{k_{t+1}}{1 + r_{t+1}} \right)$$

with respect to

$$x_{t+1} = f(k_{t+1}).$$

From this optimization follows that the optimal capital stock, k_{t+1}, carried over to the next period, has been attained when the interest rate equals the marginal productivity of the future capital stock.

(14) $r_{t+1} = f_k(k_{t+1})$.

By definition, per-capita investment, $i_t = \frac{K_{t+1} - K_t}{L_t}$, can be written

$$i_t = (1 + n)\, k_{t+1} - k_t .$$

Hence, investment is a declining function of the interest rate. Note that securities backing up the real capital stock are a store of value in this economy. By redeeming securities from the old generation and reissuing them to the young generation at the same point in time a transfer of ownership of the immortal physical capital stock between generations can be achieved.

1.2 Government

The other store of value consists of government bonds, B_t, which are assumed perfect substitutes for ownership titles on the private capital stock, i. e., they are one-period bonds paying the same rate of return. The government is considered an immortal agent. In period t, taxes are collected from young and old people, interest and principal, $(1 + r_t)\, b_t$, are paid to the holders of government debt, i. e., to the members of the old generation, and a new emission of government bonds, B_{t+1}, is sold to members of the young generation who carry them over to period $t+1$. The government also finances public consumption, G_t. The role of the government is summarized by the following dynamic government budget constraint:

(15) $B_{t+1} = (1 + r_t)\, B_t + G_t - L_t\, \tau_t^1 - L_{t-1}\, \tau_t^2$.

Defining $g_t = \frac{G_t}{L_t}$ and $b_t = \frac{B_t}{L_t}$ allows *(15)* to be rewritten in per-capita terms:

(16) $(1 + n)\, b_{t+1} - b_t = r_t\, b_t + g - \tau^1 - \frac{1}{1 + n}\, \tau^2$.

Government deficit (new emission of government debt) — Interest payment — Primary government deficit

Note, a primary government deficit (surplus) implies a new emission of government debt larger (smaller) than debt service on government bonds. Note further that the primary deficit or surplus will be considered most of the time as permanent; hence I shall omit the time subscript.

1.3 The world economy

In the world economy there is an integrated capital market, i. e., $r_t = r_t^*$. The size of national labour forces and national labour growth rates are assumed identical, i. e., $n = n^*$ and $L_t = L_t^*$. With respect to intertemporal taste, technology and government behaviour, there may be differences in both countries. If tastes and technologies are identical across countries(8) I speak of identical (private) economies; to treat a meaningful and not too complicated case in what follows later I shall assume therefore identical economies but non-identical governments, i. e., primary government budgets. The only tax instruments are a lump-sum taxation of domestic and foreign young people; hence there is neither taxation of production or investment nor taxation of any border-crossing economic activities. Also, a discussion of, e. g., economic aid by intergovernmental transfers is excluded.

Extending the presentation in *Schmid* (1987), I define net wealth for the domestic and foreign economy:

$$(17) \quad a_t = k_t + b_t + z_t \qquad a_t^* = k_t^* + b_t^* - z_t \,.$$

$z_t \gtrless 0$ denotes the net foreign asset position of the domestic country. If the domestic country is a creditor country domestic national income, y, exceeds the value of the domestic product by the interest payments due to government debt and foreign investment:

$$(18) \quad y_t = f(k_t) + r_t\,(b_t + z_t) \qquad y_t^* = f^*(k_t^*) + r_t\,(b_t^* - z_t),$$

$$y_t = w_t + r_t\,a_t \qquad y_t^* = w_t^* + r_t\,a_t^*.$$

Domestic or foreign government bonds and ownership titles to domestic or foreign firms are perfect substitutes. Hence, z_t must not be specified explicitly as a bond issued by the foreign government or an investment in foreign firms. Only the net asset position matters. From the world goods market constraint

$$\left[f(k_t) - c_t - \frac{1}{1+n}\,c_{t-1} - i_t - g_t\right] + \left[f^*(k_t^*) - c_t^{*\,1} - \frac{1}{1+n}\,c_{t-1}^{*\,2} - i_t^* - g_t^*\right] = 0.$$

I can derive a well-known saving-investment statement modified by government deficits:

$$(19) \quad \{[(s_t - a_t) - i_t] - [g + r_t\,b_t - \tau^1]\} + \{[(s_t^* - a_t^*) - i_t^*] - [g + r_t\,b_t^* - \tau^{*1}]\} = 0.$$

Obviously, the terms in { } brackets denote the national current accounts which must sum up to zero. The equilibrium condition for the world credit market *(21)* is a consequence of *(19)* taking into account the two national government budget constraints:

(20) $(1 + n)\, b_{t+1} - b_t = r_t\, b_t + g - \tau^1,$

$(1 + n)\, b^*_{t+1} - b^*_t = r_t\, b^*_t + g^* - \tau^{*1},$

and the wealth definitions *(17)*

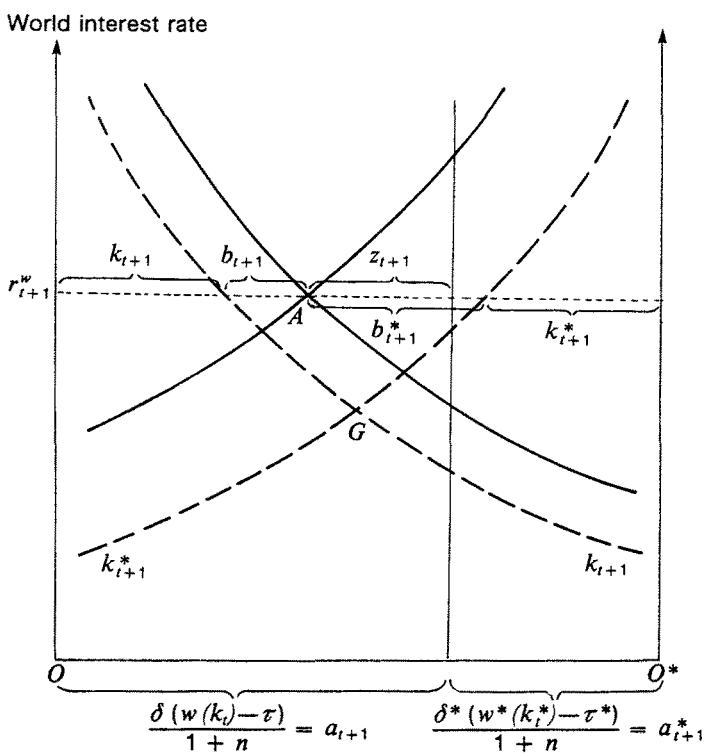
(21) $s_t + s^*_t = (1 + n)\,[k_{t+1} + b_{t+1} + k^*_{t+1} + b^*_{t+1}],$

$s_t = s_t\,(w(k_t) - \tau^1),$

$s^*_t = s^*_t\,(w^*(k^*_t) - \tau^{*1}).$

Figure 2

The world credit market



The world capital market equilibrium *(21)* is illustrated in Figure 2 where national excess demands for credit are equalized at an equilibrium interest rate, r^w_{t+1}. Note that, given historic values for k_t, k_t^*, b_t, b_t^*, and the permanent fiscal parameters τ^1, τ^2, g, g^*, the credit market determines the foreign asset position, z_{t+1}, and real capital stocks, k_{t+1}, k^*_{t+1}, given government bonds issuance, b_{t+1}, b^*_{t+1}(9).

It has been shown in *Buiter* (1981) and *Schmid* (1987) that without fiscal activity the dynamic adjustment of the world economy is determined by the difference equation *(21)* only. Modelling government behaviour yields two more difference equations in *(20)*. Thus the dynamics would be governed by a system of three non-linear difference equations with time-constant disturbance terms. These are the primary government budgets. Here I am not interested in further analysis of the system dynamics, I rather look more deeply into the problem of the existence of steady states and their comparative statics.

A steady state of the world economy is given by the following set of equations (see *Schmid — Großmann,* 1986, and *Schmid,* 1987, for an analysis without fiscal activity):

(22a) $[a - b - k] + [a^* - b^* - k^*] = 0,$

(22b) $s\,(w\,(k) - \tau^1) = (1 + n)\,a,$

$s^*\,(w^*\,(k^*) - \tau^{*1}) = (1 + n)\,a^*,$

(22c) $r = f_k\,(k) \qquad r^* = f^*_k\,(k^*),$

$w = f(k) - f_k\,(k)\,k \qquad w^* = f^*\,(k^*) - f^*_k\,(k^*)\,k^*.$

Perfect international capital mobility yields

(22d) $r = r^*.$

The government budget constraints are (b, $b^* > 0$ public debt)

(22e) $(n - r)\,b = g - \tau^1 \qquad (n - r)\,b^* = g^* - \tau^{*1}.$

The (net) foreign asset positions are ($z > 0$ domestic creditor position)

(22f) $z = a - b - k \qquad z^* = -z = a^* - b^* - k^*.$

The current account is ($q > 0$ domestic surplus)

(22g) $q = n\,[a - k - b] = n\,z$

and the trade account is ($h > 0$ domestic trade surplus)

$$(22h) \qquad h = q - rz = (n - r)\, z.$$

2. Foreign debt by fiscal strategies without public debt

The steady-state version *(22)* of the dynamic system *(20), (21)* is rather general, but fortunately it can be stripped down for further analysis. Employing the assumptions of identical private economic behaviour and Cobb-Douglas forms for taste and technology, yields

identical technology:

$$(23) \quad f(k) = f^*(k^*) \qquad w^* = w = \beta f(k) \qquad r = \alpha f(k),$$

identical savings before tax:

$$s(.) = \delta\,[\beta f(k) - \tau^1] \qquad s^*(.) = \delta\,[\beta f(k) - \tau^{*1}].$$

This is useful because now the net foreign asset position is not a reflex of national differences in private tastes and technology as in *Schmid* (1987). On the contrary, external debt must be completely dependent on fiscal activity, i. e., the imbalance of the government budget, and the private reaction to income taxation. This way, I am able to separate conveniently fiscally related foreign debt from external indebtedness caused by private economic behaviour. Obviously, if worldwide government behaviour would be completely harmonized, i. e., identical governments, there would be no fiscally related foreign indebtedness. Therefore, I need asymmetric government behaviour. In the rest of the paper, I will study balanced budget strategies first and government debt in open economies later.

2.1 Balanced budget with public consumption

A balanced budget is implemented by setting $b = b^* = 0$ and

$$(24) \quad g = \tau^1 \qquad g^* = \tau^{*1}.$$

Note that the size of the balanced budget may differ across countries. Using *(24)* and *(23)* in *(22a)*, a very simple condition for credit market equilibrium appears:

$$(25) \quad \underbrace{\left\{\frac{\delta\,[\beta f(k) - g]}{1+n} - k\right\}}_{z_{bb}} + \underbrace{\left\{\frac{\delta\,[\beta f(k) - g^*]}{1+n} - k\right\}}_{z^*_{bb}} = 0.$$

The steady-state equilibrium *(25)* can be illustrated in Figure 3 where I use a geometric apparatus developed for a world economy without government activity in *Schmid — Großmann* (1986) and *Schmid* (1987). Setting $g = g^* = 0$ in *(25)*, the two terms in { } brackets represent free of government national excess supply for credit, i. e., the net foreign asset position, $z = z(k)$ and $z^* = z^*(k)$. The $z(k)$ and $z^*(k)$ functions are shown as the $z\,z$ and $z^*\,z^*$ loci in Figure 3(10). It follows from the assumption of the world economy's private sectors being perfect replicas that the intersection point of the $z\,z$ and $z^*\,z^*$ locus, i. e., the international steady state, is located right on the k axis. Adding a government sector with a balanced budget yields the $z\,z_{b\,b}$ and $z^*\,z^*_{b\,b}$ lines. This contraction is an expression of the

Figure 3

Balanced budget: $b = b^* = 0$
Tax financed public consumption

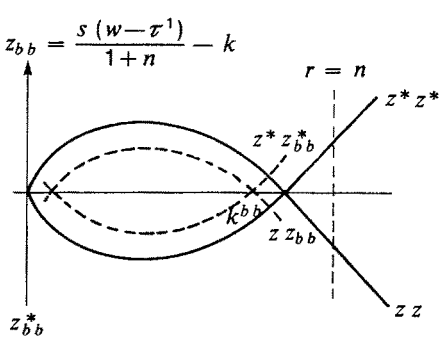


Figure 3A: Case: $\sigma < \alpha$

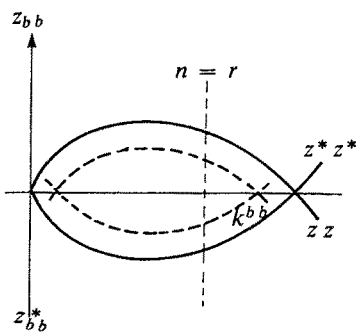


Figure 3B: Case: $\sigma > \alpha$

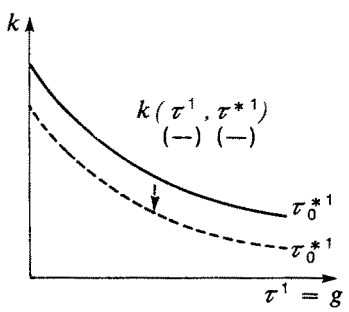


Figure 3C

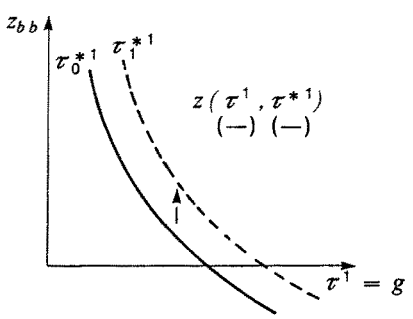


Figure 3D

fiscal drag on private savings of young people. If both nations run a balanced budget of the same size, $g = g^* > 0$, the new steady-state $k_{b\,b}$ must show a lower capital-labour ratio and there is no external indebtedness. If the balanced budget size differs across nations the government will cause external debt. The dependence of k and z on the fiscal instruments, $\tau^1 = g$ and $\tau^{*1} = g^*$, is summarized in Figures 3C and 3D proving the following

Theorem 1: Two identical nations with different balanced budget sizes will always have external indebtedness for the country affording the larger balanced budget size.

2.2 Social security: Pay-as-you-go

Another interesting balanced budget strategy is the case of a pay-as-you-go social security system(11). To demonstrate the balanced budget nature of a pay-as-you-go social security system recall the general government budget constraint *(16)* for the special case of a steady state without public debt and public consumption. The following constraint must hold:

$$(26) \quad \tau^2 = -(1 + n)\,\tau^1 \qquad \tau^1 > 0.$$

The pay-as-you-go social security system asks the young population to contribute $L_t\,\tau^1$ during their working period and pays this amount in benefits to the currently old population, i. e., $L_t\,\tau^1 = -L_{t+1}\,\tau^2$. Note that the social security tax amounts to $\tau^1 > 0$ and the benefits are to be considered a negative tax, $\tau^2 < 0$, i. e., a transfer. Using *(26)* in *(7)*, yields

$$-\frac{\delta\,(1 + r) + (1 - \delta)\,(1 + n)}{1 + r}\,\tau^1 < 0.$$

From the logic of the intertemporal maximization, it is clear that any social security tax reduces the savings of currently young people, and the expected transfer during retirement reduces the propensity to save even further(12). Thus, savings of young people shrink unambiguously and decisively. The case of social security in an open economy therefore is very similar to the case of pure tax finance of public consumption. The $z\,z$ locus contracts towards the k axis and I can formulate the following

Theorem 2: Assume two identical nations with pay-as-you-go social security systems. Then the country asking the bigger social security tax must show external indebtedness.

3. Public debt and external indebtedness

As experienced recently by Latin America debtor countries a substantial rise in fiscal deficits and debt may lead simultaneously to a critical amount of foreign indebtedness. This section explores the sustainability of permanently maintained primary fiscal deficits in an open economy. The following statement was proofed in *Carlberg* (1983) for a closed economy Solow growth model:

> *Theorem* (*Carlberg,* 1983): A permanently maintained primary (PMP) deficit is never sustainable in the long run if an empirically relevant national saving rate, $\sigma < \alpha$, (capital share in GNP) is assumed. If the saving rate is relatively high, $\sigma > \alpha$, and the primary deficit remains below a relatively low critical value primary deficits are sustainable. This, however, must be considered a purely theoretical possibility only.

In this section I investigate whether a PMP deficit is in general sustainable in an open economy with overlapping generations. Furthermore I ask, how the amount of foreign indebtedness is determined, given the size of public debt. A second problem would be the explanation of unsustainable debt profiles and stabilization of such a debt crisis(13). The next sub-section deals with the impact of transitory government deficits on external indebtedness.

3.1 Sustainability of fiscal PONZI games in a world economy

The steady-state conditions are now captured by a system of three equations with the variables k, b, b^*.

$$(27a)\quad \underbrace{\left\{\frac{\delta\,[\beta f(k) - \tau^1]}{1+n} - k - b\right\}}_{z_b} + \underbrace{\left\{\frac{\delta\,[\beta f(k) - \tau^{*1}]}{1+n} - k - b^*\right\}}_{z_b^*} = 0,$$

$$(27b)\quad (n - r)\, b = g - \tau^1,$$

$$(27c)\quad (n - r)\, b^* = g^* - \tau^{*1}.$$

Without loss of generality, I further assume that government behaviour in the foreign country is restricted to a balanced budget, i. e., $b^* = 0$ and $g^* = \tau^{*1}$, while the domestic government starting from a balanced budget of equal size is allowed to raise loans in the world credit market.

Before the domestic government issues bonds the steady state of the world economy is located at $k_{b\,b}$ in Figure 4. We know from Figure 3 that depending on the size of the (iden-

Figure 4

Government debt in an open economy

Figure 4A: Case: $\sigma > \alpha$

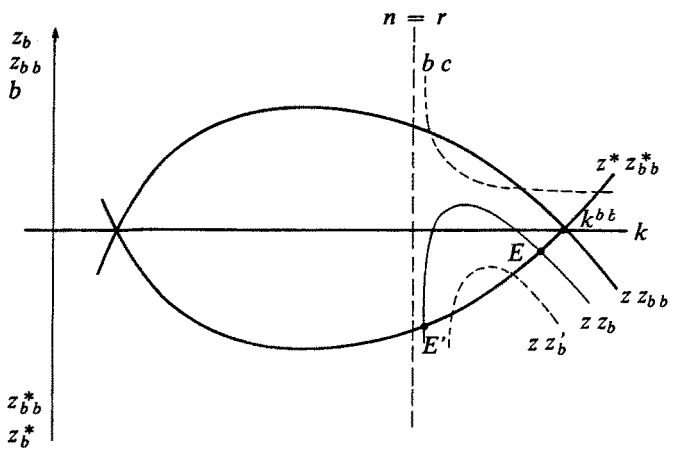
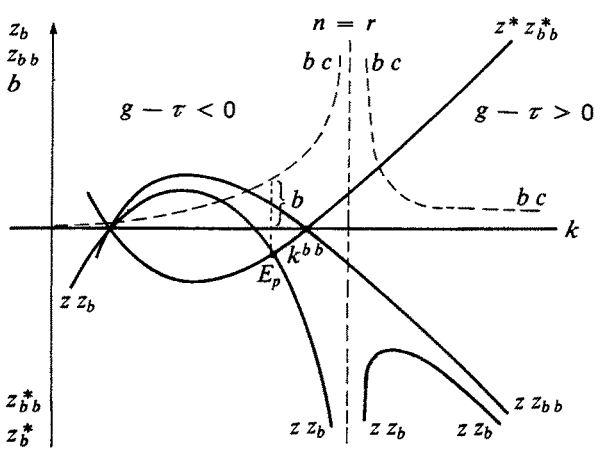


Figure 4B: Case: $\sigma < \alpha$



tical) national saving ratios k_{bb} may be situated to the right (see Figure 4A) or to the left (see Figure 4B) of the golden rule $\bar{k}$ (represented by the dashed $n = r$ vertical line). This vertical is an asymptote for the two branches of the $b\,c$ line, i. e., the graph of the domestic government budget constraint *(27b)*. Note that in the $n - r > 0$ region there exists a horizontal asymptote (not shown) for the downward sloping $b\,c$ locus. The distance of this

asymptote from the abszissa marks the size of the PMP deficit. Note further that in the $n-r<0$ region we must have a PMP surplus regime. An increase in the PMP surplus shifts the upward sloping $b\,c$ line in an upward direction. Now suppose the domestic government raises public consumption beyond the original balanced budget level and finances this increase by government bonds(14). The resulting primary government deficit appears as the dashed $b\,c$ locus in the $n-r>0$ region of Figure 4A. In an open economy, government bonds can be sold to foreigners and, in fact, are placed abroad whenever supply of public bonds exceeds the net demand of the private sector. On the other hand, the foreign asset position of a country must be positive if the private sector's (net) demand for bonds is larger than the public bonds supply. Thus in *(27a)*, we subtract b from $z_{b\,b}$ to obtain z_b. In Figure 4A, the $z\,z_b$ locus is obtained by subtracting the $b\,c$ locus from the $z\,z_{b\,b}$ locus. As a result, we observe (two) steady-state equilibria, E and E', where the domestic PMP deficit is financed (partly) by external debt. Concentrating on the stable equilibrium E, two conclusions can be drawn:

1. The steady-state capital-labour ratio is higher in a world economy than it would be in a closed economy due to the savings of young foreigners.

2. In a world economy, a single nation can finance PMP deficits of a much larger size than possible in a closed economy (see the $z\,z_b'$ locus in Figure 4A).

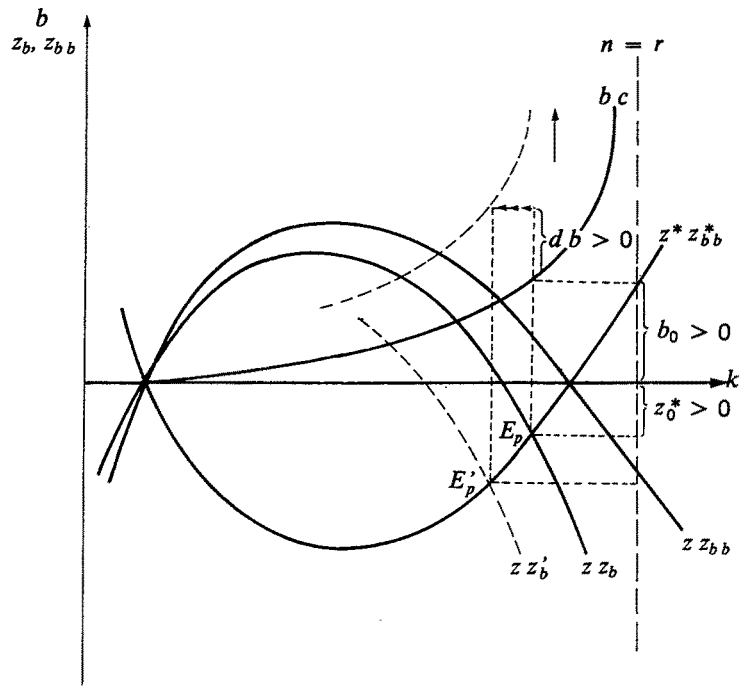
However, again there is a critical size of the PMP deficit, given the savings capacity of the foreign country, i. e., the $z^*\,z_b^*{}_b$ line. Furthermore, if the foreign government would run a PMP deficit, too, the existence of a steady state would be threatened very quickly. To summarize I state the following

> *Theorem 3:* Assuming the empirically not relevant high savings case, $\sigma>\alpha$, PMP deficits hardly are more likely to be possible in an open economy when more than one government run them. However, there seems to exist the possibility of one single (small) nation running a PMP deficit in a large world economy(15).

Recall that this statement is conditioned on an overcapitalized world economy and I have to analyse the more realistic case of an undercapitalized world economy. Figure 4B clearly demonstrates that now a steady state cannot exist in case of a domestic PMP deficit of any size. Interestingly enough, there exists an international steady state in case of a PMP surplus with positive government debt, $b>0$, and a positive external debt for the domestic country, $z<0$(16). The equilibrium E_p is shown within the realistic $n-r<0$ region in Figure 4B(17). Since public interest payments to serve the debt, b, held by domestic and foreign residents, exceed revenues of new bonds, a PMP surplus is necessary to balance the overall budget.

Figure 5

Transitory deficits in a world economy



3.2 Transitory government deficits

The debt from transitory deficits can be stabilized in an open economy as reported in *Persson* (1985). There exists an initial public debt b_0 in the $n-r<0$ domain of Figure 5. The steady-state E_p illustrates that this debt is held by foreigners, $z_0^*>0$, and domestic residents. Suppose the domestic government runs a (one-period) transitory deficit by lowering the tax necessary to maintain steady-state E_p. Suppose furthermore that $d\,b>0$ is the resulting increase in domestic debt which is to be stabilized from now on. Obviously, taxation must become endogenous because only a series of consecutive tax hikes guarantees a constant b while the economy decumulates real capital along the arrowed path in Figure 5. In the new steady-state E_p' external debt has risen since part of the additional domestic government debt was credited by foreigners. A larger domestic primary budget surplus is necessary to service the national debt at a higher world interest rate. Foreigners enjoy an increase in their foreign investment income while the domestic current account worsens.

By reversing the direction of this experiment, I demonstrate how the government could remove public debt from the economy in a silent way: A temporary increase of the primary

surplus, e. g., an initial period of higher taxation, can be used to repurchase part of the public debt. To stabilize the lower debt level a series of later tax reductions are possible while the economy vigorously increases the capital-labour ratio with interest rate and debt service declining. The current account would improve.

4. Conclusions

This paper offers a unifying dynamic system approach to real government debt and real capital formation in a world economy. The sustainability of permanently maintained primary fiscal deficits is investigated in an open economy. In particular if national governments compete in the issuance of debt at an international capital market sustainable debt profiles appear only as a theoretical (i. e., not empirically valid) curiosity. Within the more realistic regime of an undercapitalized world economy a nation can only run a permanently maintained primary surplus. Starting from a PMP surplus the paper also demonstrates the viability of temporary deficits implying an increase in taxation later to stabilize the fiscal debt. By reversing the argument this shows, the right way to reduce government debt in a non-traumatic manner is to run a higher temporary surplus via higher taxation. Using this extra-surplus to buy back fiscal debt the economy may reduce taxation later while enjoying vigorous capital accumulation towards a higher capital-labour ratio. Furthermore, the paper shows that ceteris paribus a relatively high social security load and a relatively high size of a balanced budget causes external indebtedness via consumption oriented current account deficits. It is left for further research to see what happens if government borrows for public investment instead of public consumption.

5. Appendix

5.1 List of symbols

All variables are per capita, starred variables refer to the foreign country.

Variables

c_t^1	= working period consumption of a member of generation t,
c_t^2	= retirement period consumption of a member of generation t,
τ^1, τ^2	= lump-sum tax during working and retirement period,
r_{t+1}	= interest rate for savings during period t which are carried over to period $t+1$,

s_t = savings of young people,
$\tilde{s}_t$ = national savings,
w_t = wage income,
$\tilde{w}_t$ = present value of lifetime income net after taxes,
L_t = number of members, i. e., size, of generation t,
k_t = capital-labour ratio,
x_t = $f(k_t)$ = output-labour ratio ($f(.)$ = production function),
y_t = national income including interest on government debt and net foreign investment income,
i_t = $(1 + n)\, k_{t+1} - k_t$ = per-capita investment,
b_t = government bonds,
g = public consumption,
a_t = private wealth at the beginning of period t,
$(1 + n)\, b_{t+1} - b_t$ = current overall government deficit (secondary government deficit),
$[g - \tau^1 - \tau^2]$ = primary government deficit.

Parameters

α = capital income share,
β = labour income share,
δ = saving ratio of young people $\left(\frac{1-\delta}{\delta} = \text{time preference}\right)$,
σ = national saving ratio,
ν = tax-burden ratio,
n = growth rate of labour.

5.2 The national saving rate in an OLG model

Assume the technology is given by $f(k) = k^{\alpha}$ together with linear logarithmic utility *(1)*. α represents the share of capital income and $\beta = 1 - \alpha$ is the wage share of the economy. Now steady state is given by

$$\delta\, \beta\, f(k) = (1 + n)\, k.$$

This can be rewritten

$$\delta\, \beta\, r = (1 + n)\, \alpha.$$

From the definition of the national saving ratio, $\sigma = \frac{\tilde{s}}{f(k)}$, we obtain

$$f(k)\,\sigma = \frac{n}{1+n}\,s = \frac{n\,\delta\,w}{1+n}$$

or

$$\sigma = \frac{n\,\delta\,\beta}{1+n}.$$

Using the definition of σ in the above steady-state condition yields

$$\frac{n\,\delta\,\beta}{1+n}\,r = n\,\alpha$$

or

$$\sigma\,r = n\,\alpha.$$

$\sigma \leq \alpha$ implies $r \geq n$. Thus $\sigma < \alpha$ implies $k < \bar{k}$.

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7. Notes

(1) See "Time", February 22, 1988, and *Ihori* (1986), *Buiter* (1979), *Atkinson — Stiglitz* (1980) for a scientific analysis of public debt in a closed economy modelled along Samuelson-Diamond lines.

(2) Debt in open economies and in a world economy populated by overlapping generations is studied in *Buiter* (1981), *Persson* (1985), *Schmid — Großmann* (1986), *Schmid* (1987).

(3) See *Sinn* (1984) on the importance of investment incentives for international capital flows.

(4) The Cobb-Douglas functional form has been used by many analysts in the field of intertemporal optimization. It yields simple closed-form decision rules and the loss in generality is not important to the main subject of this paper. However, special effects of this functional form will be mentioned later on. Note further that publicly provided consumption, g_t, which will be introduced later, is not evaluated by the private sector. I am not dealing with optimal government in this paper.

(5) Assuming no gifts or bequests in this paper, the transfer of wealth between generations is contractual.

(6) Obviously, the model distinguishes L_t, the working population of period t, from $L_t + L_{t-1}$, the consuming population of period t. We will refer to the working population when we use per-capita notation.

(7) Apart from their size, different generations are populated by identical members.

(8) *Buiter* (1981) introduced the two-country case with identical technologies. *Schmid — Großmann* (1986) and *Schmid* (1987) analysed differences in taste and technologies, showing that Buiter's external debt criterion is neither necessary nor sufficient.

(9) The demand for credit of the government and the supply of credit of young people is assumed interest inelastic. The assumption of identical economies shifts the middle axis to point G if and only if national lump-sum taxes are equal $\tau^1 = \tau^{*1}$.

(10) Figures 3A and 3B show two possible cases. Assuming a relatively high (low) saving rate, σ, the international steady state must be located to the right (left) of the $n = r$ line, i. e., the overcapitalized (undercapitalized) region. For proof, see *Schmid — Großmann* (1986).

(11) See, e. g., *Auerbach — Kotlikoff* (1987, ch. 10) for a discussion of social security for a closed economy with overlapping generations.

(12) This effect is valid independently of the present value of the social security scheme, $pv = -\frac{n-r}{(1+r}\tau^1$, which is ambiguous.

(13) In the much longer original paper read at the CEEA Symposium March 2-4, 1988, in Vienna. I have dealt explicitly with a government debt crisis and how to stabilize a critical development.

(14) Note that a bonds-financed increase in public consumption is the simplest case since it leaves the $z_{b\,b}$ locus unchanged. A switch from tax to bonds finance would shift the $z_{b\,b}$ locus in an upward direction.

(15) Thus the theorem found in *Carlberg* (1983) is still valid in a world economy, but only in a much weaker form. To get a feeling for the critical parameters involved it would be useful to extend Carlberg's discriminant criterion to the world economy.

(16) This steady state is analysed in *Persson* (1985).

(17) The $z\,z_{b\,b}$ locus is obtained by subtracting the upward-sloping $b\,c$ line from $z\,z_{b\,b}$.

Correspondence:

Michael Schmid
Institut für Theoretische Ökonomie
Universität der Bundeswehr
Postfach 70 08 22
D-2000 Hamburg 70
Bundesrepublik Deutschland