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DEFICIT AND INTERGENERATIONAL WELFARE IN OPEN ECONOMIES

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Abstract

This paper deals with public debt in open economies, extending Diamond's overlapping generations model to deal with a small open economy as well as an international equilibrium of two large economies. It focuses on the intergenerational welfare redistributions caused by an increase in the public debt triggered by a period of government budget deficit, and shows that these effects are markedly different in open and closed economies. The interplay between the deficits in the government budget and the current account is also analyzed. Here, it is shown how a single period with a deficit in the government budget can be followed by a sequence of periods with a deficit in the current account.

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1. Introduction

This paper deals with public debt in open economies. The question of how public debt issue affects the well-being of future generations, sometimes referred to as the "burden of the public debt", has a long tradition in economics going back as far as Ricardo. Not surprisingly, the discussion seems to have been particularly active after periods with substantial government budget deficits. Indeed, the sizeable and growing budget deficits in many countries during recent years is a strong empirical motive for looking further at this issue today. The present close international integration of goods and capital markets, as well as the observation that deficits in the government budget tend to go hand in hand with deficits in the current account, makes it interesting to analyze the international aspects of the problem.

One intensive round in the debate, initiated by Buchanan (1958), took place in the late fifties and early sixties; for a summary of the heated, and sometimes confused, debate, see Ferguson (1964). Much of the confusion was resolved with the pathbreaking work of Diamond (1965). Diamond's analysis, drawing on an ingenious construction of Samuelson (1958), was particularly useful in two respects: First, by treating an (infinite) number of overlapping generations, it allowed for a discussion of intergenerational welfare redistributions in a relatively simple way. Second, by relying on an explicit general equilibirum framework, it made it possible to pose the central question about the burden of national debt in terms of lifetime utilities of welfare-maximizing consumers.

Diamond indeed included external debt in his analysis. However, he chose a formulation where only the government but not the private sector can borrow abroad. While sufficient to bring out certain differences between internal and external debt, this is not very plausible today, from an empirical point of view. Moreover, it makes the interesting interplay between the deficits in the government budget and the current account very trivial.

In this paper Diamond's analysis is extended to open economies where all agents, private and public, have access to perfectly integrated world markets. We look at the short and long-run effects of a period with government deficits, which manifest themselves in a permanent increase in the public debt. The analysis is carried out first in the context of a small open economy, then in a full world equilibrium of two large economies.

There already exist some open-economy versions of the Diamond-Samuelson overlapping generations model in the literature. In particular, there are two recent studies by Buiter (1981) and Dornbusch (1982). Buiter's model does only include private borrowing and lending and thus cannot be used to address the questions pursued here. The work by Dornbusch does include public debt, but the process whereby this debt is generated -- government deficit spending, that is -- is not explicitly modelled and only the long run effects of debt issue are analyzed. In addition, production is left exogenous in the analysis, and there is neither capital nor investment.

The paper proceeds as follows. Section 2 presents the Diamond model of a closed economy and we look at the short and long run consequences for factor rewards and welfare of public debt within this framework. This section covers material most of which now can be found in textbooks; see for example Atkinson and Stiglitz (1980). It is included here for the sake of completeness and as a background to the subsequent analysis, however, and can be skimmed through by readers who are already familiar with the standard overlapping generations model.

Section 3 extends the analysis to a small open economy facing perfect world goods and capital markets. We look at the consequences of public debt issue for current and future generations' welfare and indicate the differences to the closed economy results. The effects on the economy's external debt in the short and the long run, and the interrelation between the deficits in the budget and the current account, are also discussed.

A full world equilibrium with two (large) trading economies is set up in Section 4, and we analyze the national as well as the international adjustment in response to a deficit period in one of the economies.

An obvious and important qualification to the analysis, namely the consequences of introducing private intergenerational transfers à la Barro (1974), is taken up in Section 5. This section also summarizes the main points in the paper and includes some suggestions for further research.

2. The Diamond Model with Public Debt

Since growth is not esential for the problem treated here, we assume that the economy has a stationary population. All people live for two periods, so at each point in time there is a young and an old generation living side by side. Young people in period t have a fixed labor supply. They work at wage $\tilde{w}_t$ and pay a lum-sum tax t_t to the government. They consume part of the resulting income and save the remainder for the second period of their life. Old people, who are retired, earn principal and interest on their savings. They pay no taxes.

Each young person's consumption in period t is denoted by c_t, while d_t denotes consumption by each old. The decision problem for young people born at t is to maximize $U(c_t, d_{t+1})$ subject to

$$c_t + \frac{1}{1 + r_{t+1}} d_{t+1} = \tilde{w}_t - t_t,$$

where $U(\cdot)$ is a well-behaved utility function and r_{t+1} is the return on assets held over to period t+1. The solution gives consumption demand as a function of the after-tax wage $w_t \equiv \tilde{w}_t - t_t$ and the interest rate; $c_t = C(w_t, r_{t+1})$. Savings are given accordingly by $w_t - c_t$. It is useful to introduce a variable a_t, which expresses private wealth per worker in the beginning of period t. Because there are no bequests and all generations have equal size a_{t+1} will identically coincide with savings of the young at t, that is

$$a_{t+1} = w_t - c_t. \tag{1}$$

Since the savings decision is already bygone, old people have a trivial decision problem when retired. Each old person simply consumes all his income, or

$$d_t = (1 + r_t)(w_{t-1} - c_{t-1}) = (1 + r_t)a_t.$$

For future reference we note that the welfare of a member of the t^{th} generation may be expressed either by the direct utility function above, or by the indirect utility function

$$v_t = V(w_t, r_{t+1}), \tag{2}$$

increasing in both its arguments.

There are two factors of production, (non-depreciating) capital and labor; because the economy has only one sector, capital is simply non-consumed output. Production in the t^{th} period, X_t, is carried out according to a well-behaved, linearly homogenous, neo-classical production function $X_t = F(L, K_t)$, where L is the (constant) labor force and K_t is capital carried over from period t-1. Production per worker can thus be expressed by

$$x_t = f(k_t), \tag{3}$$

where k_t is capital per head. Profit maximizing behavior ensures that investment in period t, or rather the gross amount of capital held over to period t+1, is implicitly given by

$$f_k(k_{t+1}) = r_{t+1}. \tag{4}$$

Given constant returns to scale, the two factor returns are related by

$$\tilde{w}_t = f(k_t) - k_t f_k(k_t), \tag{5}$$

which by (4) gives rise to the standard factor price frontier.

The government may enter the economy in several ways, taking part both in consumption and production. To keep the analysis as simple as possible, we shall assume that its consumption and production are both zero, and that its only expenditure is interest payments on the public debt. In each period the government collects lump-sum taxes t_t from each worker. Any deficit in the government budget has to be covered by an increase in debt. The government's debt instruments are one period bonds that pay the current interest rate and principal in the next period. Denoting the amount of debt outstanding in the beginning of period t by G_t, the government's deficit is hence

$$G_{t+1} - G_t = r_t G_t - t_t L.$$

It will be convenient to express this per worker in what follows. Dividing through by L, we have

$$g_{t+1} - g_t = r_t g_t - t_t. \tag{6}$$

We see that if t_t is set to $r_t g_t$, net debt per worker is kept constant. We shall assume that r is strictly positive throughout, which makes taxes positive in this case.[1]

In each period a temporary, or perhaps better a momentary, equilibrium is established. That equilibrium is recursive in the following sense. Last period's investment and the labor endowment in period t fixed the economy's capital-labor ratio and the (past) real interest rate (the present return on capital) by (4). Then the before-tax real wage is also determined via the factor price frontier.

Given k_t, r_t and $\tilde{w}_t$, the individual consumption, savings and investment plans of young and old consumers, firms, and the government must be made consistent in the goods and the capital markets. As usual one of the clearing conditions is redundant, so it suffices to state the requirement for equilibrium in the capital market. This is, of course, that total savings is equal to investment

$$(a_{t+1}-a_t) - (g_{t+1}-g_t) = k_{t+1}-k_t, \tag{7}$$

which is here expressed on per capita form. However, in a closed economy a_t must always equal $(g_t + k_t)$ <u>ex post</u> and (7) can therefore be restated as

$$a_{t+1} = k_{t+1} + g_{t+1}. \tag{8}$$

Equation (8) states that savings by the young must be sufficient to absorb the total amount of capital and government debt carried over to the next period. Both a_t and k_{t+1} are functions of next period's real interest rate; so this condition uniquely determines r_{t+1}. This gives next period's capital-labor ratio, a new momentary equilibrium is established, and so on.

There are two different stability conditions for this economy and we will assume that both of them are fulfilled. First, we have the condition for what might be termed (static) Walrasian stability, namely

$$\frac{1}{f_{kk}^{-1} + C_r} < 0. \tag{9}$$

When (9) is fulfilled, excess demand in the capital market leads to an increase in the interest rate. Second, we have the condition which ensures that the economy's development over time ends up in a stationary state,[2] _viz._

$$-1 < -(k + g)\frac{(1 - C_w)}{f_{kk}^{-1} + C_r} < 1 \tag{10}$$

Given that (9) holds (and goods are normal so $C_w < 1$), the sign of the expression between inequalities is always positive so joint fulfillment of (9) and (10) guarantees asymptotic (as opposed to oscillatory) convergence.

In a stationary state all variables are constant. Such an equilibrium is described by

$$\tilde{w} = f(k) - kf_k(k) \tag{11}$$

$$r = f_k(k) \tag{12}$$

$$w = \tilde{w} - t \tag{13}$$

$$t = rg \tag{14}$$

$$a = w - C(w,r) \tag{15}$$

$$a = k + g \tag{16}$$

$$v = V(w,r) \tag{17}$$

Let us turn to the effects of increased public debt. We assume that the government chooses to finance a transfer to the _young_ generation born at date t by running a deficit rather than by increasing taxes. (The analysis of debt rather than tax financing of either a transfer to the _old_ generation or increased government consumption or investment in the t^{th} period would be slightly more complicated but yield qualitatively similar results.) With tax finance net taxes paid by the young are unchanged and there are no effects either in the long or in the short run. Therefore, the difference between the two policies can be found by looking at debt finance only.

What we consider is thus a one-shot decrease in taxes in period t, $dt_t < 0$, and a corresponding increase in debt, which from the government budget constraint (6), satisfies $dg_{t+1} = -dt_t$. Furthermore, we assume that from period t+1 and onwards taxes are set so as to keep the public debt per capita constant. Hence, the increase in debt remains for all future periods and we may use the simplified notation $dg_{t+1} = dg_{t+2} \cdots = dg$.

The impact effects are easily determined. Since k_t is already given by history, so are r_t and $\tilde{w}_t$, and the adjustment to the increased government borrowing shows up in a change in r_{t+1}. Differentiating the capital market equilibrium condition (8) for dg and $dt_t = -dg$, we get

$$dr_{t+1} = -\frac{C_w}{f_{kk}^{-1} + C_r} dg. \tag{18}$$

The increase in government borrowing creates an excess demand of $-C_w dg$ in the capital market which has to be absorbed by the private sector. An increase in the interest rate reduces private investment, since $f_{kk} < 0$, and may stimulate or reduce private savings, since $C_r \gtrless 0$. Our assumption of Walrasian stability guarantees that the net effect is to decrease private excess demand (that is, the denominator in (18) is negative), however, which means that the interest rate rises.

Since the generation born at date t experiences an increase both in its net wage and the interest rate, the change in each member's welfare from (2)

$$dv_t = V_w dw_t + V_r dr_{t+1}$$

is clearly positive.

As for the effects in the next period, we already know that the capital-labor ratio is lower due to the rise in r_{t+1}. This in turn decreases gross wages, along the factor price frontier, by

$$d\tilde{w}_{t+1} = -k_{t+1} dr_{t+1}.$$

Taxes increase due to the greater government debt and due to the higher interest rate. Formally,

$$dt_{t+1} = r_{t+1}\, dg + g_{t+1} dr_{t+1},$$

and, the total effect on net wages is

$$dw_{t+1} = -(k_{t+1} + g_{t+1}) dr_{t+1} - r_{t+1} dg,$$

which is bound to be negative. Differentiating (8) once again, using the above results one obtains

$$dr_{t+2} = - \frac{1 - (1-C_w)(\partial w_{t+1}/\partial g)}{f_{kk}^{-1} + C_r}\, dg,$$

which is clearly positive and greater than dr_{t+1}. This is easy to understand since the young generation at t + 1 has a lower income than the young at t but nevertheless has to absorb the same amount of government debt.

The $(t+1)^{th}$ generations' welfare may either rise or fall because

$$dv_{t+1} = V_w dw_{t+1} + V_r dr_{t+2}$$

has an ambiguous sign due to the opposite influences of the falling net wage and the rising interest rate. In other words, it is not clear whether in fact there is a burden on that generation.

From the earlier discussion about stability we know that the increase in interest rates and associated decrease in capital-labor ratios will continue in subsequent periods as the economy approaches its stationary state. The long-run effects on factor prices are easily found from equations (10) to (14), as

$$dw = -(k + g)dr - rdg < 0, \tag{19}$$

and

$$dv = -\frac{1 - (1-C_w)}{f_{kk}^{-1} + C_r + (1-C_w)(k + g)}\,dg > 0. \tag{20}$$

The change in stationary-state welfare, using (19), is

$$dr = V_w dw + V_r dr = [-V_w r - V_w(k + g)\frac{\partial r}{\partial g} + V_r \frac{\partial r}{\partial g}]dg$$

But by Roy's identity we know that $V_r = V_w d/(1+r)^2$, and since $d = (w - c)(1 + r)$, we may thus rewrite the above expression as

$$dv = V_w[-r - (k + g)\frac{\partial r}{\partial g} + \frac{w-c}{1+r}\frac{\partial r}{\partial g}]dg. \tag{21}$$

Each of the terms within brackets has a clear interpretation. The first is the direct negative welfare effect of increased taxes to service the higher government debt. The second, which is also negative, is the combined effect on net wages of the changes in gross wages and taxes, because of the rise in the interest rate brought about by the rise in g. The third effect, finally, is positive and measures the gain of a rise in the real interest rate (all young people are net lenders).

The net outcome would then seem to be ambiguous, but we may reformulate (21) by help of (15) and (16) to

$$dv = V_w[-r - a\frac{r}{1+r}\frac{\partial r}{\partial g}]dg. \quad (22)$$

The sum of the last two terms in (21) is thus negative and the net effect is an unambiguous fall in stationary state welfare. To understand this result we note that the economy underaccumulates capital relative to its golden rule capital-labor ratio given by $f_k(k) = 0$, already in its initial position. The increase in the interest rate reduces k further, accentuating this underaccumulation.[3] The resulting welfare loss must be added to the negative effect of higher taxes.

Summarizing, we have thus shown that with an increase in the government debt to finance a transfer payment to the currently young generation, this generation gains, its nearest descendants may either gain or lose, while all generations must necessarily lose when the economy has converged to its new stationary state. Which generation that starts to experience a fall in welfare is thus an open question.

3. Deficits and Intergenerational Welfare in a Small Open Economy

Let us take a look at the same economy in an open economy context. All agents act in the same way as before, but they now have access to a perfect world capital market with a given rate of interest, denoted by r*, as well as a perfect world market for its single good.

In autarchy private wealth per worker in each period a_t must be identically equal to the capital stock k_t plus government debt g_t. With international capital mobility, this would happen only if countries were identical in all respects, however, and we would generally expect a non-zero foreign debt (per worker) e_t, given by

$$e_t = (k_t + g_t) - a_t \quad (23)$$

We may then readily define the current account deficit for period t, q_t say, as the increase in foreign debt during that period

$$q_t = e_{t+1} - e_t. \tag{24}$$

Using (23), the current account deficit may be expressed as either the sum of the private sector's and the government's accumulation of financial debt, or, equivalently as

$$q_t = (k_{t+1} - k_t) - [(a_{t+1} - a_t) - (g_{t+1} - g_t)];$$

total investment minus the sum of the two sectors' savings. If desired, the economy's trade balance deficit b_t is easily found. Since the difference between q_t and b_t is interest payments abroad, we have

$$b_t = q_t - r_t e_t = e_{t+1} - (1 + r_t)e_t. \tag{25}$$

The equations describing a momentary equilibrium in the small open economy are restated here for convenience

$$\tilde{w}_t = f(k_t) - k_t f_k(k_t) \tag{5}$$

$$r_{t+1} = f_k(k_{t+1}) \tag{4}$$

$$r_t = r^*_t \tag{26}$$

$$w_t = \tilde{w}_t - t_t \tag{27}$$

$$a_{t+1} = w_t - C(w_t, r_{t+1}) \tag{1}$$

$$e_t = (k_t + g_t) - a_t \tag{23}$$

$$q_t = e_{t+1} - e_t \tag{24}$$

$$v_t = V(w_t, r_{t+1}) \tag{2}$$

Except for the issues we have just discussed, there is yet a new feature in this setting. With the given interest rate (and constant returns to scale), the economy's capital-labor ratio is in fact determined independently of domestic conditions and hence is also the gross wage.

If the foreign interest rate is constant, the economy will converge to a stationary state, the conditions for which are also stated here

$$\tilde{w} = f(k) - kf_k(k) \tag{11}$$

$$r = f_k(k) \tag{12}$$

$$r = r^* \tag{28}$$

$$w = \tilde{w} - t \tag{13}$$

$$t = rg \tag{14}$$

$$a = w - C(w,r) \tag{15}$$

$$e = (k + g) - a \tag{29}$$

$$q = 0 \tag{30}$$

$$v = V(w,r) \tag{17}$$

Thus the current account is zero in stationary state. The trade balance is not zero, however. From (25) it is clear that the economy runs a surplus (deficit) on its trade account to service its external debt (spend the interest income from its external assets) in the stationary state.[4]

We are now prepared to look at expansion of the public debt. As before, we consider a government deficit in period t; $dg_{t+1} = -dt_t > 0$, and set $dg_{t+1} = dg_{t+2} \cdots = dg$ in later periods. To simplify matters, we assume a horizontal path for the foreign interest rate; $r^*_t = r^*$, for all t.

On impact this results in an increased current account deficit. From (23), (24) and (27):

$$dq_t = de_{t+1} = C_w dg > 0. \tag{31}$$

The young generation which faces an increase in their net wage will absorb some but not all of the new government debt by increasing its savings. This results in an aggregate excess demand for credit of $C_w dg$, which, instead of driving up the interest rate as in the closed economy (cf. equation (18)), can be satisfied via increased foreign borrowing at the given world interest rate (whether it is the government or the private sector that actually borrows abroad is, of course unimportant). It is obvious that the young generation's welfare increases, although not as much as in the closed economy, since there is no magnifying effect from a rise in the interest rate.

In the period after the government deficit, workers face increased taxes to service the higher government debt, but no change in their gross wage. We find the effect on the current account as

$$dq_{t+1} = de_{t+2} - de_{t+1} = [1 + (1-C_w)r^* - C_w]dg, \tag{32}$$

which is clearly positive and greater in value than dq_t. Young people in this period save less because their income is lower, and old people dissave more because they saved more when young in period t. Both these reasons make total private savings in t+1 lower than in the period before. This results in a larger (increase in the) current account deficit than in the period when the public debt was increased. Unlike in the closed economy, it is now clear that the young generation born in t+1 has a lower welfare, since $dw_{t+1} < 0$.

As for the long-run effects, the increase in the foreign debt, from (13), (14), (15) and (29), satisfies

$$de = dg - da = [1 + (1-C_w)r^*]dg. \tag{33}$$

The derivative de/dg thus exceeds unity. This is explained by the private sector not only being unwilling to hold the higher public debt in the long run, but also saving less since the taxes have been increased to cover a higher debt service in the stationary state. (The expression on the RHS of (33) is the analogue to the numerator in (20).)

If we solve for de_{t+2} in (37), we find that $de_{t+1} + de_{t+2} = de$. In other words, the whole adjustment to the higher foreign debt is accomplished by the current account deficits we have already investigated, and the economy has reached its new stationary state only two periods after the initial deficit episode. We may note in passing that the economy has a larger trade surplus (smaller deficit) in the new stationary state since it now has larger interest payments abroad (smaller interest income from abroad).

Since there are no effects on gross factor returns, the sole welfare effect is the burden of higher taxes, <u>viz</u>.

$$dv = -V_w r^* dg < 0;$$

equivalent to the first negative term of the bracketed expression in (22) giving the welfare loss in a closed economy. The second negative term in (22) does not appear here, of course, since the capital-labor ratio stays constant.

Summarizing the comparison of the intergenerational redistribution of welfare, we have thus been able to show two differences between a closed and a small open economy (or more precisely between an economy without and with capital mobility). First, there is no ambiguity about gainers and losers in the small open economy; the young generation in the deficit period being the only one to gain and all future generations having to bear the burden of the higher public debt. Second, because there were no effects on gross factor rewards, both the welfare gain of the first generation and the long run welfare losses are smaller than in the closed economy. The opportunity of intertemporal trade at a given interest rate thus eliminates the downward adjustment of the economy's capital-labor ratio that was necessary in autarchy and was seen to constitute part of the burden on future generations of an increased public debt.

4. World Equilibrium and Public Debt

We now turn to a full international equilibrium which marries together two countries of comparable size. Differences in size are not of prime interest for the problems addressed here, so we simplify matters by assuming that the two countries are identical in the size of their labor endowment. With respect to technology, tastes, and government behavior, we allow for any differences, however. The two countries are referred to as the home and foreign country, and the same notation as before is adopted, but with a *-superscript on foreign variables.

In a momentary equilibrium, the home country still obeys equations (1), (2), (4) through (6), (23), (24), and (27), and there are analogous expressions for the foreign country; (1*), ..., etc. With perfect financial capital mobility there must be one signle interest rate in the two countries, $r_t = r^*_t$, and we denote this common rate by r_t. Finally, market clearing requires world savings equal to world investment, that is

$$q_t + q^*_t = 0;$$

the sum of the two current accounts must equal zero. Since e_t and $-e^*_t$ are equal, by definition, and already predetermined in period t, we can also express the equilibrium condition for the world capital market as

$$e_{t+1} + e^*_{t+1} = 0. \tag{34}$$

We assume that the two economies would both be stable in autarchy. That is, (9) and (10), and analogous conditions for the foreign country, (9*) and (10*), continue to hold. Then the world economy will asymptotically converge to a stationary state.[5] A long-run equilibrium is defined by equations (11) through (14), (16), (17), and (28) through (30) (with and without *), and by the condition

$$e + e^* = 0. \tag{35}$$

When discussing the comparative statics, it is useful to recall that the world economy is, of course, a large closed economy. Therefore we should expect the adjustment to be an intermediate case between that in the single, closed economy and that in the small open economy. Indeed, this conjecture is verified below in the sense that we find effects on factor prices smaller than in the closed economy case, and effects on external debts and current accounts smaller than in the small economy case.

Consider then as before an issue of public debt cum tax cut in the home country; $dg = - dt_t$. To find the effect on the world interest rate, we differentiate (34) for this change, taking the responses by savers and investors into account. This yields

$$dr_{t+1} = - \frac{C_w}{(f_{kk} + f^*_{kk})^{-1} + (C_r + C^*_r)} dg,$$

which is positive (by (9) and (9*)) and less than in the closed economy; cf. (18).

As in the closed economy, the public borrowing creates excess demand in the capital market, which drives up the interest rate and crowds out private investment, but now in both countries. This does not affect gross wages of the currently young generations at home and abroad, however, who both gain from a higher interest rate. Consequently the young generation abroad, whose net wage is constant, as well as the young generation at home, who pays lower taxes, experience a higher welfare level.

To find the impact on the current accounts it is easiest to look first at the foreign country. From (24*), we have

$$dq_t^* = de_{t+1}^* = [(f_{kk}^{*-1} + C_r^*) \frac{\partial r_{t+1}}{\partial g}]dg;$$

so it follows that there is an improvement in the foreign country's current account. The corresponding deterioration in the current account of the home country is given by

$$dq_t = de_{t+1} = [C_w + (f_{kk}^{-1} + C_r)\frac{\partial r_{t+1}}{\partial g}]dg.$$

Comparing this to (31), we indeed find that the effect is less than in the small country case, in the sense that the derivative dq_t/dg is smaller. This is because here the rise in the interest rate increases home savings and decreases investment.

The home country will suffer a deterioration in its current account also in the next period. In that period gross as well as net wages will fall in both countries, because of the higher interest rate on the now retired generations' savings in capital and government securities. The generations born t+1 are compensated somewhat, since the interest rate continues to rise. Furthermore, one can show that the welfare for this generation, both at home and abroad, can either rise or fall in the same way as in the closed economy. Instead of developing the rather messy expressions involved, we go to the long run effects, however.

In the new stationary state net wages fall both at home and abroad, viz.

$$dw = -(k + g)dr - rdg \tag{36}$$

and

$$dw^* = -(k^* + g^*)dr, \tag{36*}$$

and the interest rate rises

$$dr = - \frac{1 + (1-C_w)r}{(f_{kk} + f^*_{kk})^{-1} + (C_r + C^*_r) + (1-C_w)(k+g) + (1-C^*_w)(k^*+g^*)} dg.$$

From (17), (38) and the properties of V(•) we get the welfare change for future generations in the home country

$$dv = V_w[-r - (k + g)\frac{\partial r}{\partial g} + \frac{w - c}{1 + r}\frac{\partial r}{\partial g}]dg. \tag{21}$$

This is the same expression as in the closed economy case and the three terms have the same interpretation, capturing the increase in taxes due to the higher debt (at given r), the decrease in net wages due to lower gross wages and higher taxes, and the increase in the interest rate, respectively. In that case we could verify that the net effect was always negative implying a burden on future generations. Here, such an assertion can not be made, however. To see this, note that by (29), (21) can be reformulated as

$$dv = V_w[-r(1 + a\frac{1}{1 + r}\frac{\partial r}{\partial g}) - e\frac{\partial r}{\partial g}]dg, \tag{37}$$

where the first term, which corresponds to (22), is negative, but the second term is negative only if e is positive.

The economic significance of this is clear. A change in the interest rate redistributes income from workers/taxpayers to wealth holders. If e is positive, some of these are foreigners and hence the consumption possibilities for the economy as a whole are reduced. In this case the increase in debt unambiguously lays a burden on future generations at home. If the home country is a net creditor, on the other hand, this intertemporal terms-of-trade effect instead redistributes income in its favor which alleviates the burden of increased taxes and a lower capital-labor ratio on future generations. When $-e$ becomes sufficiently high, the net result is even a welfare gain.

The probability of the home country being a long-run creditor is higher, the lower the rate of time preference of consumers -- cf. Buiter (1981) -- the lower the initial government debt, and the worse the investment opportunities in the home country; all relative to the foreign country. Since the countries may very well differ on all these accounts, there is no reason to look upon a positive stationary-state welfare effect in the home country as a degenerate special case.

Similarly, we derive the long-run welfare effect in the foreign country

$$dv^* = V^*_w[-(k^* + g^*)\frac{\partial r}{\partial g} + \frac{w^* - c^*}{1 + r}\frac{\partial r}{\partial g}]dg, \qquad (38)$$

which is equivalent to that in the home country, except that the (direct) tax burden of higher debt is absent, of course. Rewriting (38) as

$$dv^* = V^*_w[-a^*\frac{r}{1 + r}\frac{\partial r}{\partial g} - e^*\frac{\partial r}{\partial g}]dg, \qquad (39)$$

we see that the outcome depends on the negative effect of the lower capital-labor ratio plus the ambiguous intertemporal terms of trade effect. Thus, the result is even more uncertain than for future generations in the home country.[6]

A final result is the effect on the countries' net debt positions in stationary state. For the foreign country we have

$$de^* = [f_{kk}^{-1} + C_r^* + (1 - C_w^*)(k^* + g^*)\frac{\partial r}{\partial g}]dg,$$

which is negative by our stability assumption (10*). Having said this, we know that the home country's net debt must increase. Comparing

$$de = [(1 + (1 - C_w)r) + (f_{kk}^{-1} + C_r + (1 - C_w)(k + g)\frac{\partial r}{\partial g})]dg$$

with (33), we find (recalling (10)) that the change is smaller than in the small economy case. In the same way as for the impact effect, the rise in the interest rate works as a cushion. When it comes to the dynamics there is a further difference between the present and the small economy case. In the same way as the factor rewards, e converges only asymptotically to its new equilibrium. Therefore, the adjustment process with deficits in the current account will be much longer than the small economy's two-period adjustment.

Let us conclude this section by summarizing our findings regarding the welfare redistributrions among generations in the two-country case and by comparing them to our previous results.

The currently young generations in both countries gain from a deficit in the home country. Like in the closed economy, but unlike in the small open economy, their immediate descendants in the home country may either gain or lose. The ambiguity extends to the foreign country. Both in the closed economy and the small open economy there was a definite burden on future generations in the stationary state. Here, however, this is no longer a necessary result. If the home country is a creditor, the rise in the interest rate may actually redistribute income in its favor to such an extent that future generations gain. Future generations in the foreign country may either gain or lose. However, it is clear from (37) and (39) that although welfare may well decline in the long run in both countries, a welfare improvement in both countries is not possible.[7]

5. Final Remarks

This paper studied the effects of public debt issue in open economies with overlapping generations.

With regard to the intergenerational welfare distribution, we showed the following: In a small open economy with access to a perfect world capital market, the welfare effects are smaller than in a closed economy both in the short and the long run. But the direction of the redistribution; from future to the present generation is essentially the same. In an economy that is large enough to affect world market prices these results need no longer hold, however. Future generations in an economy that increases its public debt may then actually gain because of an intertemporal terms-of-trade effect that redistributes resources from the rest of the world.

We also discussed some interesting dynamics in the current account. The adjustment towards the higher external debt implied by a higher public debt was shown to involve an extended period of current account deficits following an initial government budget deficit. This adjustment period was longer in the large economy.

It should be pointed out that both these sets of results hinge crucially on the absence of operative private gifts between generations. The discussion in Barro (1974) showing how private, non-market, intergenerational transfers can compensate for government, non-market, intergenerational transfers and thereby leave the welfare of future generations unaffected applies equally well to open economies, of course. As is well known, such "dynastic" savings behavior turns the decision problem for each generation into that of infinitely-lived consumers, meaning that a substitution of debt for taxes would leave consumption unaffected. In an open economy context, this means that the current account would be unaffected by public debt-issue (for given government expenditures) -- cf. Sachs (1982).

However, as discussed for instance by Buiter (1980), for such private compensating transfers to occur, a number of quite restrictive assumptions have to be fulfilled. Given this, and the unclear empirical support for the dynastic savings hypothesis, an exploration of overlapping generations models with life-cycle savings behavior is by all means warranted.

An application of such models to problems in international trade and macro theory is of particular interest because they include maximizing agents with finite planning horizons that overlap with each other. This means that there are agents with marginal propensities to spend ranging from zero (the unborn) to one (the presently old) and with some in between (the presently young). As a result the adjustment of such economies to various shocks will be quite different from the adjustment of economies with agents that have infinite planning horizons. The effects of terms-of-trade changes on the current account is one example where the results in an overlapping generations framework -- see Persson and Svensson (1983) -- differ a great deal from those in an infinite horizon framework -- see Obstfeld (1982), and Svensson and Razin (1983).

Footnotes

1. The assumption that the interest rate is higher than the rate of growth (n) also rules out equilibria that are "dynamically inefficient" in the sense that k is above its golden rule value given by $f_k(k) = n = 0$.

2. Substituting the factor price frontier and the government budget constraint into (8) one gets a first-order difference equation in k, and (10) expresses the stability requirement $|dk_{t+1}/dk_t| < 1$.

3. This result might also be understood by viewing the rise in the interest rate and the associated fall in the wage as a movement along the after-tax factor price frontier, obtained by substituting (11), (12), and (14) into (13). The slope of this in (w,r) space is $-(k + g)$; cf. the second term in (21). However, since the indirect utility function is flatter than that -- its slope being $-V_r/V_w = -(w - c)/(1 + r)$; cf. the third term in (21) -- it follows that a rise in the interest rate must lower welfare.

4. If the rate of growth was n, we would have $q = ne$. The trade deficit would be $b = (n-r)e$. As long as the growth rate was positive and lower than the interest rate, the stationary-state trade and current account deficits would therefore have opposite signs.

5. The condition for monotonic convergence is

$$0 < \frac{(1 - C_w)(k + g) + (1 - C^*_w)(k^* + g^*)}{(f_{kk} + f^*_{kk})^{-1} + (C_r + C^*_r)},$$

which is satisfied if (9), (9*), (10) and (10*) hold.

6. In the two-country model of Dornbusch (1982) an increase in home country debt decreases home welfare and increases foreign welfare without ambiguity. This crucially depends on the assumption that all debt is in the

form of consols, meaning that debt service is coupon payments independent of the interest rate. Therefore a change in the interest rate cannot redistribute consumption possibilities across countries as it does here. This assumption and the fact that Dornbusch leaves production and capital exogenous also makes his results quantitatively different, since a change in the interest rate does not change the economies' capital-labor ratios.

7. An appropriate measure of the change in world welfare is the sum of the wealth equivalents of the two welfare changes. Hence, if we substitute from (37) and (39) into

$$dv/V_w(w,r) + dv^*/V^*_w(w^*,r),$$

we find that world welfare unambiguously declines.

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