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International Aspects of Budget Deficits with Distortionary Taxes

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Abstract

Much of the recent research of the international economic consequences of budget deficit has been conducted under the assumption that taxes are lump sum. It has thus abstracted from important issues that arise in the context of distortionary tax systems. Our analysis deals with the international effects of budget deficits under alternative tax systems. The key result of the analysis is that the consequences of tax policies and the characteristics of the international transmission mechanism depend critically on the precise composition of taxes. Specifically, under a value-added tax system a budget deficit lowers the world rate of interest while under an income-tax system the same deficit raises the world rate of interest.

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Contents

Summary

Much of the recent research in macroeconomics and public finance has been conducted in a closed-economy framework and has emphasized the intertemporal dimensions of tax policies and their effects on saving, investment, labor supply, and growth. The analysis in this paper extends the closed-economy framework to a two-country model of the world economy in which capital markets are fully integrated. The analysis shows that open-economy considerations lead to significant modifications of propositions derived previously in closed-economy models.

This paper concludes that the international and domestic consequences of a budget deficit of a given size differ sharply according to which taxes (on consumption, on income, or on international borrowing) are reduced to generate the deficit. Specifically, a domestic budget deficit arising from a cut in consumption taxes (value-added taxes) raises the world rate of interest and, thereby, crowds out domestic and foreign investment. It also worsens the trade balance of the domestic economy. On the other hand, if the budget deficit arises from a cut in income taxes, it lowers world rates of interest and crowds out domestic investment, but crowds in investment from abroad. In that case the domestic economy's trade balance improves.

I. Introduction

This paper deals with the international effects of budget deficits arising from tax and transfer policies. In order to focus on issues of public finance, we assume that the path of government spending is given and we examine the implications of alternative time profiles of taxes and of public-debt issue. To conduct a meaningful analysis of budget deficits, we depart from the pure Ricardian model (in which the timing of taxes does not matter) by allowing for distortionary taxes, and examine the effects of budget deficits arising from tax policies under alternative tax systems. We consider deficit policies involving taxes of different types: consumption taxes, taxes on income from domestic investment, taxes on income from foreign lending, and taxes on labor income.

Throughout we assume that capital markets in the world economy are fully integrated and, therefore, that individuals and governments of different countries face the same world rate of interest. This feature provides the key channel through which the effects of policies undertaken in one country are transmitted to the rest of the world.

Much of the recent research in macroeconomics and public finance has been conducted in a closed-economy framework and has emphasized the intertemporal dimensions of tax policies and their effects of saving, investment, labor supply, and growth. In this context, special attention has been given to the implications of budget deficits. 1/ Ouranalysis extends the closed-economy framework to a two-country model of the world economy. This extension permits the treatment of questions that could not have been dealt with in a closed-economy framework. Furthermore, we show that open-economy considerations lead to modifications of propositions derived previously in a closed-economy model. 2/

The key result of this paper is that the consequences of tax policies and the characteristics of the international transmission mechanism depend critically on the precise composition of taxes.

1/ Representative research emphasizing intertemporal considerations in a closed-economy framework is found in Barro (1974, 1979), Feldstein (1974, 1977), King (1983) and Judd (1987). For recent surveys and integrations of the various issues see Aschauer and Greenwood (1985) and Auerbach and Kotlikoff (1987).

2/ Examples of previous analyses of the effects of distortionary taxes in the context of a small open economy are found in Aschauer and Greenwood (1985), Greenwood and Kimbrough (1985) and Razin and Svensson (1983). By adopting a two-country model we deal with the interdependencies within the world economy, an issue that could not be addressed in the small-country framework. Some aspects of the interdependencies are examined in van Wijnbergen (1986).

Specifically, the international effects of a budget deficit of a given size differ sharply according to the types of taxes used to generate the deficit. 1/

In Section II we develop a simple analytical framework with inelastic labor supply suitable for the analysis of distortionary taxes. This framework is applied in the subsequent three sections to an examination of the international effects of budget deficits arising from cuts in consumption taxes, income taxes, and taxes on international borrowing. The analytical framework is extended in Section V to incorporate variable labor supply and to allow for the endogenous response of labor to income taxes. This framework is used in Section VI where we examine the effects of budget deficits arising from a cut in income taxes. The paper concludes in Section VII with an integrated summary of the main results.

In what follows we examine the effects of budget deficits under alternative assumptions concerning which taxes reduced. We consider consumption taxes, taxes on income from foreign lending, taxes on income from domestic investment, and taxes on labor income. The analysis extends the closed-economy framework developed by Barro (1979) and exposited in Aschauer and Greenwood (1985). The extension to the open economy is based on Frenkel and Razin (1986b). A related approach is found in van Wijnbergen (1986).

II. The Analytical Framework

To incorporate the effects of taxes, consider a one-good stylised model. The private sector's periodic budget constraints are:

$$(1) \quad (1+\tau_{c0})C_0 = (1-\tau_{y0})(\bar{Y}_0 - I_0) + (1-\tau_{b0})B^P_0 - (1+r_{-1}-\tau_{b0})B^P_{-1}$$

$$(2) \quad (1+\tau_{c1})C_1 = (1-\tau_{y1})(\bar{Y}_1 + F(I_0)) - (1+r_0-\tau_{b1})B^P_0$$

where τ_{ct}, τ_{yt}, and $\tau_{bt}(t=0,1)$ denote, respectively, the ad-valorem tax rates in period t on consumption, income, and new borrowing. In equation (1), the coefficient of C_0 indicates that the unit cost of

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1/ Elsewhere we analyzed in detail the effects of government spending on the equilibrium in the world economy and on the international transmission mechanism; see Frenkel and Razin (1985, 1986b). In Frenkel and Razin (1987) we analyzed the international effects of revenue-neutral tax reforms.

consumption is one plus the corresponding ad-valorem tax. The coefficient of the level of income $(\bar{Y}_0 - I_0)$ is one minus the corresponding ad-valorem tax, reflecting taxes on income from existing capital and inelastic labor supply $(\bar{Y}_0)$ and a tax rebate on negative income from current investment (I_0). This tax is a cash-flow capital income tax (with full expensing of investment, I_0). Our formulation of the tax on international borrowing assumes that the tax applies to new net private-sector borrowing--$(B_0^P - B_1^P)$. This can be verified by noting that the last two terms on the right hand side of equation (1) could also be written as $(1-\tau_{b0})(B_0^P - B_{-1}^P) - r_{-1}B_{-1}^P$. In this formulation, debt service is exempt from the tax. An analogous interpretation applies to the second budget constraint in equation (2). We note that in the second period there is negative new net borrowing (since past debt is repaid and no new debt is issued); therefore, the term $\tau_{b1}B_0^P$ corresponds to a tax rebate. As is evident from the formulation of equations (1) and (2), the three taxes are linked through an equivalence relation. This equivalence implies that the effect on the real equilibrium of any combination of the three taxes can be duplicated by a policy consisting of any two of them. Our formulation reveals that the celebrated equivalence between consumption and income taxes developed in the closed-economy context (see Auerbach and Kotlikoff (1987)) does not carry over to the open-economy context. 1/ In what follows, we use the equivalence property to suppress the tax on international borrowing. Thus, we set $\tau_{b0} = \tau_{b1} = 0$.

With consumption and income taxes, the periodic budget constraints of the government are:

$$(3) \quad G_0 = B_0^g + \tau_{c0}C_0 + \tau_{y0}(\bar{Y}_0 - I_0) = (1+r_{-1})B_{-1}^g \ ,$$

$$(4) \quad G_1 = \tau_{c1}C_1 + \tau_{y1}(\bar{Y}_1 + F(1_0)) - (1+r_0)B_0^g \ .$$

1/ In a recent tax-reform proposal, Hall and Rabushka (1983) advocate the adoption of a consumption-tax system *à la* Fisher (1939). In specifying the implementation of the consumption tax and its virtues over the conventional income tax they use the closed-economy equivalence relation between a consumption tax and a cash-flow income tax (capital-income tax with expensing plus a labor-income tax). Being confined to a closed-economy framework, they abstract from the role that taxes on international borrowing play in this tax-equivalence relation. For a comprehensive discussion of the closed-economy tax-equivalence proposition see Auerbach and Kotlikoff (1987).

The private-sector periodic budget constraints can be combined in order to yield the consolidated life-time budget constraint. 1/ Adding equation (2), multiplied by α_1, to equation (1) and dividing the resulting equation by $(1+\tau_{c0})$ yields

$$(5) \quad C_0 + \alpha_{\tau 1} C_1 = \frac{(1-\tau_{y0})}{(1+\tau_{c0})} \bar{Y}_0 + \frac{(1-\tau_{y1})}{(1+\tau_{c0})} \alpha_1 \bar{Y}_1$$

$$+ \frac{(1-\tau_{y0})}{(1+\tau_{c0})} [\alpha_{I1} F(I_0) - I_0] - \frac{(1+r_{-1})}{(1+\tau_{c0})} B^P_{-1}$$

where $\alpha_{\tau 1} = \frac{(1+\tau_{c1})}{(1+t_{c0})} \alpha_1$, $\alpha_{I1} = \frac{(1-\tau_{y1})}{(1-\tau_{y0})} \alpha_1$. For subsequent use we recall that the world discount factor is denoted by $\alpha_1 = \frac{1}{1+r_0}$.

Equation (5) is the private-sector consolidated budget constraint which incorporates the role of taxes. The key point to emphasize is

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1/ Our specification in equations (1)-(4) did not allow for government bond selling to the domestic private sector. This simplifying assumption was made for convenience only without affecting the analysis. To see this point let $-B^P$ denote foreign bonds purchased by the domestic government, A^g denote domestic government bonds purchased by the domestic private sector, and $-B^g$ denote foreign bonds purchased by the domestic private sector. In the presence of a tax on international borrowing arbitrage between government bonds and foreign bonds implies

$$\frac{1 + r_o - \tau_{b1}}{1-\tau_{bo}} = 1 + r^g_o, \quad \frac{1 + r_{-1} - \tau_{bo}}{1 - \tau_{b,-1}} = 1 + r^g_{-1}$$

where r^g is the market rate of interest on government bonds sold to the domestic private sector. Accordingly we can subtract $[A^g_o - (1+r^g_{-1})A^g_{-1}]$ from the right hand side of equation (1) and add $[(1+r^g_0)A^g_0]$ to the right hand side of equation (2). Correspondingly, we can add the term $[A^g_0 - (1+r^g_{-1})A^g_{-1}]$ to the right hand side of equation (3) and subtract $[(1+r^g)A^g]$ from the right hand side of equation (4). The reader can verify that these changes do not affect the results and, for simplicity, we henceforth set $A^g_{-1} = A^g_0 = 0$.

that the discount factors applicable to future period quantities are the tax-inclusive discount factors. These are the effective discount factors relevant for private-sector decisions. Accordingly, $\alpha_{\tau 1}$ measures the effective intertemporal price of C_1 in terms of C_0. This price reflects the prevailing tax structure. It is governed by the time profiles of the consumption tax (reflected by the ratio $(1+\tau_{c1})/(1+\tau_{c0})$).

Analogously, the effective discount factor applicable for investment decisions is α_{I1}. This effective discount factor is governed by the time profiles of the taxes on income. It does not depend on the time profile of the tax on consumption.

This dependence of the effective discount factors on the time profiles of the various taxes reflects the non-Ricardian feature of the model. A budget deficit arising from a current tax cut must be followed by a future tax hike in order to assure government solvency. This change in the time profile of taxes alters the effective discount factors. This provides for the principal channel through which budget deficits affect the intertemporal allocation of consumption and investment.

Finally, we note that if the time profile of any given tax is flat (so that $\tau_{c0}=\tau_{c1}$ or $\tau_{y0}=\tau_{y1}$), then this tax is nondistortionary and its impact is similar to that of a lump-sum tax. This property underlies our choice of a cash-flow formulation of the income tax.

III. Deficits with Consumption Taxes

Consider the effects of a budget deficit induced by a cut in the tax on consumption. We note in passing that this consumption tax is equivalent to a value-added tax system (VAT) under which investment and exports are exempt. In order to isolate the effect of this tax cut, we assume that all other taxes are zero. We also assume that the paths of foreign taxes are flat (so that the foreign tax system does not introduce a distortion) and that the foreign government runs a balanced budget (so that changes in the world rate of interest do not impact on the foreign government's solvency).

The initial equilibrium is described in Figure 1 by point A. The downward sloping schedules portray the desired ratio of current-period to future-period consumption. We assume that the utility functions are homothetic and therefore the desired consumption ratios depend only on the rate of interest. The world relative demand is denoted by D^W where $D^W = C_0^W/C_1^W = (C_0 + C_0^*)/(C_1 + C_1^*)$. This quantity is a weighted average of the two countries' relative demands, $D = C_0/C_1$ and $D^* = C_0^*/C_1^*$.

Accordingly

$$D^W = \mu_d D + (1-\mu_d)D^*$$

where the domestic country's weight is

$$\mu_d = \frac{C_1}{c_1 + C_1^*} .$$

The upward sloping S^W schedule is the world relative supply of (current to future-period) output net of investment and government spending. Its positive slope reflects the fact that investment falls when the rate of interest rises. In this figure, the vertical axis measures the (tax free) world rate of interest which is initially r_0. The schedules pertaining to the initial equilibrium (D, D^*, D^W, and S^W) are drawn for the given initial configuration of taxes. A reduction in the current tax on consumption from τ_{c0} to τ'_{c0} and a corresponding rise in the future tax from τ_{c1} to τ_{c1}' (necessary to restore government solvency) raises the effective discount factor applicable to consumption, $\alpha_{\tau 1}$ (that is, lowers the effective rate of interest) and induces a substitution towards current consumption. Thus, for each and every value of the world rate of interest, the domestic (relative) demand schedule shifts to the right from D to D'. The proportional vertical displacement of the schedule equals the proportional rise in the effective discount factor. This proportion is $[(1+\tau_{c1})/(1+\tau_{c1})][(1+\tau_{c0})/(1+\tau_{c0})]$. Associated with the new domestic relative demand, the new world relative demand also shifts to the right from D^W to $D^{W'}$. Being a weighted average of the domestic and foreign relative demands, the vertical displacement of D^W is smaller than that of D.

A rise in the effective discount factor applicable to consumption decisions, from $\alpha_{\tau 1}$ to $\alpha_{\tau 1}$, does not effect the effective discount factor applicable to investment decisions. Therefore, the relative supply schedule in Figure 1 remains intact. Hence, the equilibrium world rate of interest rises from r_0 to r_0. This higher world rate of interest discourages domestic investment as well as investment in the foreign country and therefore results in a positive cross-country correlation of investment.

To determine the incidence of this change in the time-profile of taxes on the domestic effective rate of interest, we recall that the percentage vertical displacement of the D schedule equals the tax-induced percentage change in the effective disount factor. This change is represented by the distance BC in Figure 1. Accordingly, in order to determine the new equilibrium value of the domestic effective rate of

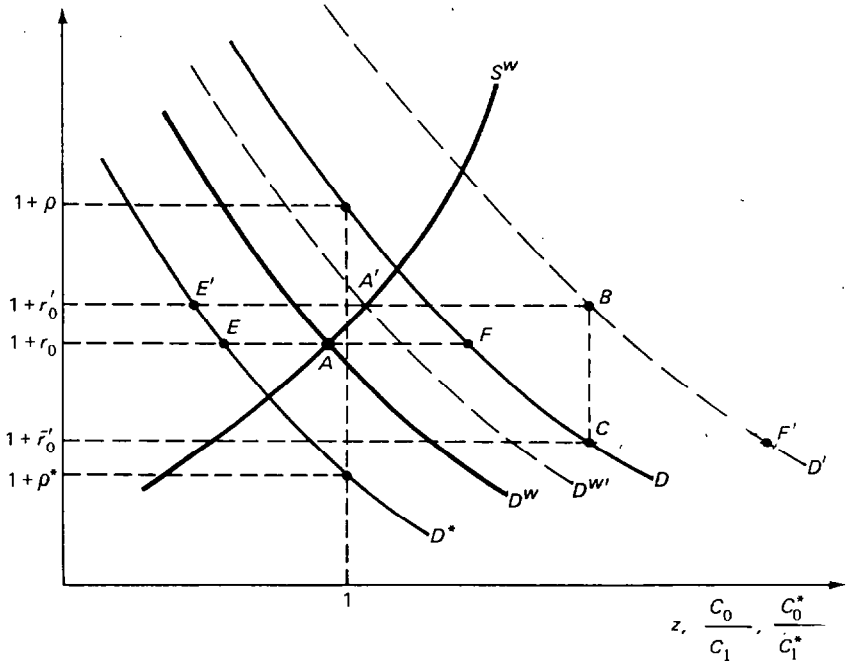

Figure 1: The Effects of a Budget Deficit Arising from a Cut in Consumption Taxes.

interest, we subtract from $1+r_0'$ the distance BC. This yields $1+\tilde{r}_0'$ in Figure 1. Evidently, the new equilibrium effective rate of interest $\tilde{r}_0'$ is lower than the initial rate r_0 since the vertical displacement of D^w is smaller than BC, and since the percentage fall in the world discount factor is even smaller than the vertical displacement of D^w.

Since in the new equilibrium world rate of interest rises, it induces intertemporal substitution in foreign consumption towards the future and thereby results in a higher growth rate of foreign consumption (represented by the move from point E to point E' in Figure 1). By similar reasoning, the fall in the domestic effective rate of interest induces intertemporal substitution of domestic consumption toward the current period and hence lowers the growth rate of domestic consumption (represented by the move from point F to point B in Figure 1). Finally, we note that even though the growth rate of foreign consumption rises, the growth rate of world consumption falls (as represented by the move from point A to point A' in Figure 1). This decline reflects the fall in world investment.

By influencing the world rate of interest, the domestic budget deficit is transmitted internationally. In general, due to possible conflicts between income and substitution effects induced by the tax policy and by the interest rate changes, the effects of the budget deficit on the levels of consumption and the trade balance are not clear cut. However, if the foreign economy has a flat tax profile then, ruling out a backward-bending saving function, the rise in the world rate of interest operates to reduce current foreign consumption. In this case, since world investment falls while output is unchanged, the market-clearing condition for world output implies that domestic consumption rises. We conclude that if the intertemporal elasticities of substitution between current and future consumption are relatively low, then the correlation between changes in domestic and foreign consumption consequent on the budget deficit may be positive or negative. On the other hand, if the elasticities of substitution are relatively high, then the budget deficit results in a negative correlation between domestic and foreign levels of consumption.

Finally, in the case for which the foreign saving function does not bend backwards, foreign absorption (consumption plus investment) falls and therefore the foreign economy's trade account improves. The counterpart of this improvement is a corresponding deterioration in the domestic balance of trade.

IV. Deficits with Income Taxes

We now consider the effects of a deficit arising from a current cut in taxes on income. Assuming that all other taxes are zero, this tax cut must be accompanied by a corresponding rise in future taxes.

Accordingly, suppose that the time profile of taxes is changed from (τ_{y0}, τ_{y1}) to a steeper profile (τ'_{y0}, τ'_{y1}). The initial equilibrium is described by point A in Figure 2. Since the taxes τ_{y0} and τ_{y1} do not influence the effective discount factor applicable to consumption decisions, α_{I1}, changes in the time profile of this tax do not alter the desired ratio of intertemporal consumption. Therefore, the relative demand schedules in Figure 2 remain intact.

Turning to the supply side, we note that, in analogy with the construction of the world relative-demand schedule, the world relative-supply schedule is also a weighted average of the two countries' schedules, S and S*. Accordingly, $S^W = \mu_s S + (1-\mu_s)S^*$ where the domestic country weight is

$$\mu_s = \frac{\bar{Y}_1 + F(I_0) - G_1}{\bar{Y}_1 + F(I_0) - G_1 + \bar{Y}^*_1 + F^*(I^*_0) - G^*_1} = \frac{\bar{Y}_1 + F(I_0) - G_1}{C_1 + C^*_1} \quad .$$

By lowering the effective discount factor relevant for investment decisions, α_{I1}, the budget deficit displaces the domestic relative supply schedule downwards from S to S'. The proportional displacement is equal to $(1-\tau'_{y1})(1-\tau_{y0})/(1-\tau_{y1})(1-\tau'_{y0})$ which measures the percentage change in α_{I1}. The proportional downward displacement of the world relative supply schedule is smaller than this quantity since the weight μ_s is less than unity.

The new equilibrium obtains at the intersection of the (unchanged) world relative demand schedule, D^W, and the new world relative-supply schedule, $S^{W'}$. This equilibrium is indicated by point A' at which the world rate of interest falls, from r_0 to r'_0, and (one plus) the effective interest rate applicable to domestic investment rises by the proportion $(1+\tilde{r}'_0)/(1+r'_0)$. This rise is indicated by the distance BC corresponding to the vertical displacement of the domestic relative-supply schedule. In the new equilibrium the rates of growth of domestic and foreign consumption fall. This is indicated by the respective moves from point F to point F' and from point E to point E'. As a result, the rate of growth of world consumption must also fall. In view of the fall in the world rate of interest from r_0 to r'_0, foreign investment rises and, in view of the rise in the effective domestic rate of interest from r_0 to $\tilde{r}'_0$, domestic investment falls. Thus, a deficit arising from a cut in taxes on income crowds-out domestic investment and crowds-in foreign investment. These changes result in a negative correlation between domestic and foreign rates of growth of consumption.

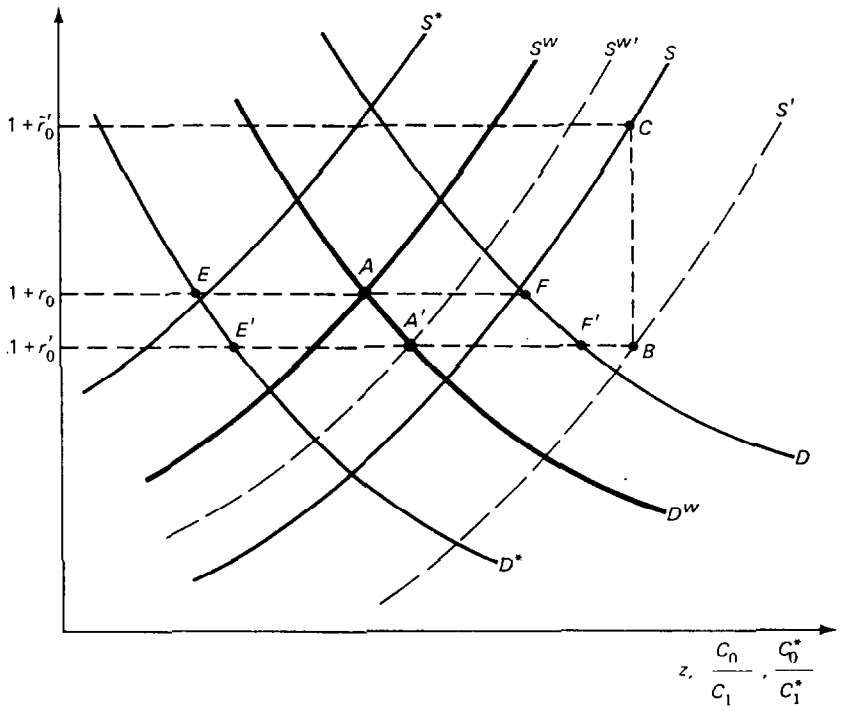

Figure 2: The Effects of a Budget Deficit Arising from a Cut in Income Tax: Inelastic Labor Supply.

The effects of this cut in taxes on the level of domestic consumption are unambiguous if the initial equilibrium is undistorted (i.e., the initial tax profile is flat). The reason is that the fall in the world rate of interest raises current consumption by increasing wealth (through the increased value of the discounted sum of GDPs) and by inducing intertemporal substitution of consumption toward the current period. Similarly, if the time profile of foreign taxes is also flat, the fall in the world rate of interest raises foreign consumption for the same reasons. It follows that under these circumstances the domestic budget deficit crowds in both domestic and foreign private-sector consumption and results in a positive cross-country correlation between the levels of consumption.

It is also noteworthy that, in contrast to the effects of a cut in consumption taxes, the reduction in taxes on income improves the domestic country trade balance. This improvement of the domestic balance of trade is the counterpart to the deterioration in the foreign trade account consequent on the rise in foreign absorption (consumption plus investment).

The foregoing analysis demonstrated that consumption-tax policies influence the equilibrium in the world economy by altering the relative-demand schedules whereas capital-income tax policies influence the equilibrium by altering the relative-supply schedules. With fixed labor supply, a tax on international borrowing is equivalent to a combination of consumption and income taxes (as can be seen from the budget constraints, equations (1) and (2)). It follows that such a tax policy influences the equilibrium by altering both the relative-demand and the relative-supply schedules. The effects of a deficit arising from a cut in taxes on international borrowing are, therefore, a combination of the effects of cuts in both consumption and income taxes. Without going through the detailed derivations, we summarize the results in Table 1.

V. Variable Labor Supply: The Analytical Framework

In this section we extend the stylized model to allow for a variable labor supply and focus on income taxes. We consider the effects of a budget deficit arising from a cut in current taxes on income. In order to focus on this effect, we abstract from other taxes. Further, in order to allow for endogenous labor supply and variable output we modify the utility function and the production function.

Normalizing total endowment of time in each period t to unity, let the fraction of time spent on labor be l_t. Correspondingly, the fraction of time left for leisure is $1-l_t$. We assume that life-time utility is a function of four "goods": ordinary consumption, (C_0,C_1), and leisure consumption $(1-l_0,1-l_1)$. In order to facilitate the exposition suppose that the utility function is separable between ordinary consumption and leisure, and let each sub-utility be

homothetic. These assumptions imply that the utility-maximizing ratio of consumption in the two consecutive periods depends only on the rate of interest; likewise, the utility-maximizing ratio of leisure in the two consecutive periods depends only on the ratio of wages (net of tax).

As in the previous sections, the individual who has access to the world capital market maximizes life-time utility subject to the consolidated life-time budget constraint. With variable labor supply it is convenient to include in the definition of life-time spending the imputed spending on leisure. Correspondingly, the definition of wealth includes the imputed value of labor endowment. Thus, the life-time budget constraints is

$$(6)\quad C_0 + (1-\tau_{y0})(1-l_0)w_{10} + \alpha_1\left(C_1+(1-\tau_{y1})(1-l_1)w_{11}\right)$$

$$= (1-\tau_{y0})(w_{10}+r_{k0}K_0 - I_0) + \alpha_1(1-\tau_{y1})\left(w_{11}+r_{k1}(K_0+K(I_0))\right)$$

$$- (1 + r_{-1})B^p_{-1} = W_0$$

where τ_{yt}, w_{1t}, and r_{kt} denote, respectively, the tax rates on income, the wage rate and the rental rate on capital in period t (t=0,1), and where K_0 denotes the initial endowment of capital. As indicated in equation (6) the individual life-time (full) income, that is the individual wealth (W_0), is the discounted sum of the value of time endowment and capital income (net of taxes and the initial debt commitment). Capital income in the current period is the rental on existing capital, $r_{k0}K_0$, minus investment, I_0; correspondingly, the stock of capital in the subsequent period is $K_0 + K(I_0)$.

Maximization of the utility function subject to the life-time budget constraint yields the demand functions for ordinary consumption and for leisure in each period. These demand functions depend on the three relative prices (net wages in each of the two periods and the discount factor), and on wealth. Accordingly, the labor supply functions (which are inversely related to the leisure demand functions) can be written as:

$$(7)\quad l_0 = l_0\left((1-\tau_{y0})w_{10},\ \alpha_1,\ \alpha_1(1-\tau_{y1})w_{11};\ W_0\right),$$

$$(8)\quad l_1 = l_1\left((1-\tau_{y0})w_{10},\ \alpha_1,\alpha_1(1-\tau_{y1});\ W_0\right) .$$

The assumption that leisure is not a Giffen good implies that a rise in the current period net wage raises l_0 and a rise in the (discounted value of) future net wage raises l_1. Assuming that the amounts of leisure consumed in two consecutive periods are gross-substitutes implies that for a given level of wealth a current tax cut lowers future labor supply while a future tax cut lowers current labor supply. This

specification will be useful in the subsequent analysis of the effects of changes in the time-profile of taxes on labor income.

In each period the level of outputs Y_0 and Y_1, depends on labor and capital inputs. In order to simplify the exposition we assume linear production functions. Thus, let

$$(9) \qquad Y_0 = a_0 l_0 + b_0 K_0$$

$$(10) \qquad Y_1 = a_1 l_1 + b_1 \left(K_0 + K(I_0)\right)$$

The assumption that factor markets are competitive, implies that in equilibrium the wage rates and the rental rates equal the corresponding marginal productivities of labor and capital, respectively. Thus,

$$(11) \qquad w_{l0} = a_0, \; w_{l1} = a_1, \; r_{k0} = b_0, \; r_{k1} = b_1.$$

As usual, profit-maximizing investment implies equality between the marginal cost of capital, $(1+r_0)$ and the marginal return on the investment, which is the product of the marginal product of investment in capital formation and the discounted sum of the rental rates on capital. Hence, in the present two-period model, profit maximization requires that

$$(12) \qquad r_{k1} K'(I_0) = 1 + r_0.$$

In order to close the model we note that the present-value budget constraint of the government is

$$(13) \quad G_0 + \alpha_1 G_1 = \tau_{y0}\left(w_{l0} l_0 + r_{k0}(K_0 - I_0) + \alpha_1 \tau_{y1}\left(w_{l1} l_1 + r_{k1}(K_0 + K(I_0))\right) - (1+r_{-1}) B^g_{-1}.$$

Combining the private sector life-time constraint (6), with the government present-value constraint (13), and making use of the supply-side equations (8) - (10) yields the economy's consolidated budget constraint in which the discounted sum of consumption equals V_0, where

$$(14) \qquad C_0 + \alpha_1 C_1 = \left(a_0 l_0 + b_0 K_0 - G_0 - I_0\right)$$

$$+ \alpha_1 \left(a_1 l_1 + b_1 (K_0 + K(I_0)) - G_1\right) - (1+r_{-1}) B_{-1} = V_0$$

The right-hand-side of equation (14) measures the value of the constraint, V_0, relevant for the economy as a whole. As with the previous case a key property of the specification of this constraint is that it is evaluated by using undistorted prices. Thus, in comparison with the private-sector constraint (6) the wages used in (14) for evaluating leisure and income are the tax-free wages and similarly with capital income. Obviously, the wages which appear as arguments in the consumption and leisure demand (labor supply) functions, C_0, C_1, l_0, and l_1 are the after-tax wages.

In order to analyze the equilibrium of the system we assume that the foreign economy has a similar structure of production, consumption and taxes. The initial equilibrium of the system is described by point A in Figure 3. As before, the downward sloping schedules D and D* denote the domestic and foreign relative demands for (ordinary goods) consumption in the two periods, and the schedule D^W is the weighted average of the domestic and foreign relative demands. The negative slopes of the schedules reflect the intertemporal substitution arising from changes in the rate of interest. The positively sloped schedule, S^W, reflects the response of z to the rate of interest, where, as before, z measures the ratio of world GDP net of investment and government spending in the two consecutive periods. That is,

$$(15) \qquad z = \frac{(a_0 l_0 + b_0 K_0 - I_0 - G_0) + (a_0^* l_0^* + b_0^* K_0^* - I_0^* - *_0)}{[a_1 l_1 + b_1 (K_0 + K(I_0)) - G_1] + [a_1^* l_1^* + b_1^* (K_0^* + K^*(I_0^*)) - G_1^*]}$$

The S^W schedule is drawn with a positive slope for convenience. In fact changes in the rate of interest affect the intertemporal prices of leisure and of ordinary goods as well as wealth. These changes may alter the supply of labor in a way that more than offsets the effect of the induced changes in investment on z. In that case the S^W schedule is negatively sloped but, as long as it is steeper than the world relative demand schedule, our subsequent analysis remains intact.

VI. Deficits with Variable Labor Supply

Consider the effect of a budget deficit arising from a current reduction in the tax (τ_{y0}) on labor income (accompanied by a future rise in the tax, τ_{y1}). The assumption that the homothetic utility functions are separable between leisure and ordinary consumption implies that for a given rate of interest the change in the time-profile of wages (net of taxes) does not alter the desired ratios of ordinary consumption in the two consecutive periods. Thus, the budget deficit does not alter the position of the relative demand schedules in Figure 3.

On the other hand, the assumption that the amounts of leisure consumed in the two periods are gross substitutes, ensures that the rise in the current net wage and the fall in the future net wage raises the current labor supply, l_0, and lowers the future labor supply, l_1. As a result of this and the negative effect on investment, the domestic relative-supply schedule (not drawn) shifts to the right. Therefore, as seen from equation (15), this change in the time-profile of taxes raises the value of z for any given rate of interest. This is shown by the rightward shift of the world relative supply schedule from S^W to $S^{W'}$ in Figure 3.

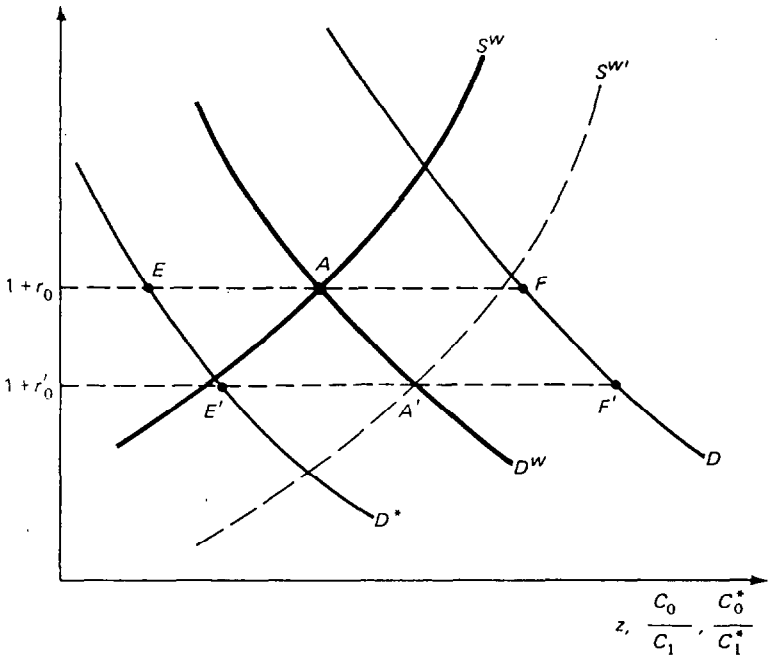

Figure 3: The Effect of a Budget Deficit Arising from a Cut in Taxes on Income: Variable Labor Supply.

The new equilibrium shifts from point A to point A', the world rate of interest falls from r_0 to r_0' and, the rates of growth of domestic, foreign and world consumption fall. The lower rate of interest induces a positive correlation between growth rates of consumption. It also stimulates investment in both countries and, therefore, induces a positive correlation between domestic and foreign rates of investment.

The budget deficit arising from the change in the time-profile of taxes on labor income also alters the levels of consumption in both countries. In the domestic economy the changes in the level of consumption reflect the combination of the induced changes in labor supply, the wealth and substitution effects induced by changes in the world rate of interest, and the response of investment. The fall in the world rate of interest raises the discounted sum of foreign GDP (provided that the foreign labor supply is not greatly reduced by the fall in the rate of interest). In addition (ruling out a backward bending saving function) the fall in the rate of interest induces substitution of current consumption for future consumption. Hence, in this case, foreign consumption rises.

Finally, in the present framework the budget deficit may cause an improvement in the balance of trade. For example, if the foreign labor supply does not respond appreciably (positively) to the fall in the rate of interest, and, correspondingly if the foreign GDP (net of government spending) does not rise much, then the rise in foreign absorption (consumption plus investment) worsens the foreign trade balance and, correspondingly, improves the domestic balance of trade. Thus, in this case, the budget deficit causes an improvement in the trade account. This improvement reflects the rise in current period output induced by the stimulative policy of the lower taxes on labor income.

VII. Budget Deficits: Overview

The important role attached to the intertemporal substitution effects suggests that the various distortionary taxes can be usefully divided according to whether they induce excess demand for current goods or for future goods or, equivalently, whether they stimulate current external borrowing (national dissaving) or lending (national saving). Tax policy that induces an excess demand for current goods by raising current consumption or investment or by lowering current GDP relative to future GDP is classified as a pro-borrowing policy, and tax policy that creates an excess supply of current goods by discouraging current consumption or investment, or by raising current GDP relative to future GDP is classified as a pro-lending policy. Alternatively, the various tax policies associated with the budget deficit can be classified into expansionary supply-shift policies and expansionary demand-shift policies. Accordingly, a deficit arising from a cut in taxes on income reflects supply-shift policies, whereas a deficit arising from a cut in the consumption tax (value-added tax) reflects demand-shift policy. The former is a pro-lending policy while the latter is a pro-borrowing

policy. From this classification we note that a budget deficit arising from a cut in taxes on international borrowing contains elements of both supply and demand-shift policies. It can be shown, however, that the demand-shift component dominates, so that a cut in the tax on international borrowing is a pro-borrowing policy. 1/

The results of the analysis are summarized in Table 1. It is seen that the effects of the budget deficit on the world rate of interest, r_0, depend on whether the deficit arises from a pro-borrowing or a pro-lending tax cut. A cut in current taxes on consumption and on international borrowing is a pro-borrowing tax policy that raises the world rate of interest. On the other hand a cut in current taxes on capital income and on labor income is a pro-lending tax policy that lowers the world rate of interest.

The Table also shows that in the case of consumption and income taxes domestic investment falls while in the case of taxes on international borrowing investment rises.

The results reported in the Table show that independent of whether the tax cut is pro-borrowing or pro-lending, the budget deficit always lowers the growth rate of domestic consumption, $g_c = (C_1/C_0)-1$. On the other hand, the international transmission of the effects of the deficit depends on whether the deficit arises from a pro-borrowing or pro-lending tax policy. If the tax policy is a pro-borrowing policy, then the growth rate of foreign consumption rises and foreign investment falls, and conversely if the tax policy is a pro-lending policy.

Table 1 also reports the changes in the growth rates of world consumption $g_c^w = (1/z)-1$ (which is equal to the growth rate of world GDP net of investment and government spending). As seen the direction of the change in the growth rate of world consumption depends on the characteristics of the taxes that are changed. Since the various taxes influence the levels of current and future consumption, investment and GDP, the net effect reflects the interactions among these changes. Accordingly, the growth rate of world consumption rises if the (second-period) domestic trade account is in a surplus and the budget deficit arises from a cut in taxes on international borrowing. On the other hand the growth rate of world consumption falls if the tax cut on international borrowing occurs in the presence of a (second-period) domestic trade-account deficit, or if the budget deficit stems from a cut in the other taxes.

1/ For open-economy analyses emphasizing the pure wealth effects of lump-sum non-distortionary tax policies see Blanchard (1985), Buiter (1986), Frenkel and Razin (1986a) and Persson (1985). In these models the pure wealth effects of budget deficits arise from differences between the time horizon of individuals and of the economy at large.

Expressed in terms of correlations, Table 1 reveals that a budget deficit arising from a pro-borrowing tax policy results in negative cross-country correlations between growth rates of consumption. On the other hand a budget deficit arising from a pro-lending tax policy results in positive cross-country correlations between the growth rates of consumption. As for the cross-country correlations between levels of investment, Table 1 shows that this correlation is positive if the deficit arises from a cut in taxes on consumption or labor income, and the correlation is negative if the budget deficit stems from a cut in taxes on international borrowing and capital income.

The effects of the budget deficit on the levels of domestic and foreign consumption and on the balance of trade depend in general on the shape of the initial time-profile of taxes, on the initial borrowing needs of the country (being positive or negative) and on the size of the intertemporal elasticity of substitution. The signs of the effects indicated in the last three columns in Table 1 are based on the assumption that the initial tax profile is flat and that the saving functions are not backward bending. With these assumptions a budget deficit arising from a pro-borrowing tax policy lowers foreign consumption and worsens the domestic balance of trade, while a budget deficit arising from a pro-lending tax policy raises foreign consumption and improves the domestic balance of trade.

Table 1. The Effects of Domestic Budget Deficits Arising from a Cut in Taxes on International Borrowing, Capital Income, and Labor Income

Tax Cut on	g_c^w	r_0	$\tilde{r}_0$	g_c	g_c^*	I_0	I_0^*	C_0	C_0^*	$(TA)_0$
Consumption	−	+	−	−	+	−	−	+	−	−
International Borrowing	+ if $\mu_s > \mu_d$									
	−	+	−	−	+	+	−	?	−	−
	if $\mu_s < \mu_d$									
Income	−	−	+	−	−	−	+	?	+	+

Note: g_c^w, g_c and g_c^* denote, respectively, the world, the domestic and the foreign growth rates of consumption. $\tilde{r}_0$ denotes the effective domestic rate of interest applicable to consumption. This effective rate also governs domestic investment decisions (except for the case of consumption taxes for which domestic investment depends on the world rate of interest r_0). If $\mu_s > \mu_d$, then the (second-period) domestic trade account is in a surplus and vice versa. The ambiguities in the effects of taxes on domestic consumption reflect conflicting substitution and wealth effects. Domestic consumption rises if the substitution effect dominates the wealth effect. The latter depends on the initial borrowing needs position. The assumption underlying the direction of the changes in the levels of consumption and the trade account in the absence of backward bending saving functions.

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