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Spending, Taxes and Real Exchange Rates

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Abstract

This paper develops a rigorous analytical framework suitable for the analysis of the effects of spending and tax policies on the world economy. It modifies the conventional conclusions according to which a budget deficit or a temporary current rise in government spending typically tend to raise interest rates. It is shown that by incorporating nontradable goods and distortionary taxes the direction of the effects of fiscal policies on interest rates and real exchange rates depend upon the timing and composition of government spending and on whether the budget deficit is financed through income or value added taxes.

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Summary

In the absence of nontradeable goods, the effects of government spending on the world rate of interest are clear cut: a current transitory rise in government spending raises the rate of interest, whereas an expected future transitory rise in spending lowers this rate. Further, in the absence of distortionary taxes, a budget deficit tends to raise the rate of interest.

This paper modifies the standard analysis by incorporating nontradable goods and by allowing for distortionary taxes, such as consumption and income taxes. The analysis of the effects of fiscal policies on the interdependent world economy reveals that the key factors determining the effects of fiscal policies on interest rates, the real exchange rates, real wages, debt accumulation, and other important macroeconomic variables are the composition of government spending between tradable and nontradable goods and its intertemporal allocations on the one hand, and the characteristics of the tax system, including the timing of taxes and types of taxes used to finance the budget, on the other hand. These results illustrate the critical role that open-economy considerations must play in a proper analysis of fiscal policies.

I. Introduction

This paper deals with the effects of government spending and tax policies on the evolution of real exchange rates and real rates of interest in the interdependent world economy. We construct an analytical framework suitable for a detailed examination of the various channels through which the effects of these policies are transmitted internationally.

Our analysis is motivated by developments occurring in the world economy during most of the 1980s. During this period changes in national fiscal policies were unsynchronized, real rates of interest were high and volatile and real exchange rates exhibited diverging trends and were subject to large fluctuations. The course of fiscal policies undertaken by the major industrial countries affected the rest of the world through the integrated goods and capital markets and resulted in increased concern in each country over policy measures taken in the rest of the world. Our analysis provides a framework useful for interpreting such developments.

As is well known, in the absence of nontradable goods the effects of government spending on the world rate of interest are clear cut: a current transitory rise in government spending raises the rate of interest, whereas an expected future transitory rise in spending lowers this rate. Further, in the absence of distortionary taxes a budget deficit tends to raise the rate of interest. This paper modifies the standard analysis by incorporating nontradable goods and by allowing for distortionary taxes, such as consumption and income taxes. The analysis of the effects of fiscal policies on the interdependent world economy reveals that, the key factors determining the effects of fiscal policies on interest rates, the real exchange rates, real wages, debt accumulation and other important macroeconomic variables are the composition of government spending between tradable and nontradable goods and its intertemporal allocations on the one hand, and the characteristics of the tax system, including the timing of taxes and types of taxes used to finance the budget, on the other hand. These results illustrate the critical role that open-economy considerations must play in a proper analysis of fiscal policies.

The analytical framework employs a general equilibrium inter-temporal approach for a two-country model of the world economy. We extend the analysis of Frenkel and Razin (1985) in two important dimensions. First, we allow for production and consumption (private and public) of nontradable goods and second, we allow for two alternative tax systems--consumption and income taxes.

The paper is divided into two main sections. Section II contains an analysis of the effects of government spending. In this context we develop the analytical framework for the two-country model of the world economy. Section III deals with the effects of budget deficits induced by tax policies. In this context we consider budget deficits arising from cuts in consumption taxes and income taxes. Section IV concludes the paper with a summary of the key results.

II. Government Spending Policies

In this section we analyze the effects of government spending on the real exchange rate. To focus on the unique role played by the temporal and the intertemporal allocations of government expenditures, we specify the model so as to ensure that the details of government finance, particularly the timing of taxes and borrowing, are immaterial. Accordingly, we abstract from monetary considerations and we assume in this section that all taxes are lump-sum.

1. The analytical framework

Throughout we assume that there are two composite goods: an internationally tradable good, denoted by x, and a nontradable good, denoted by n. To allow for intertemporal considerations we assume for simplicity a two-period model, period 0 and period 1. 1/ The relative price of the nontradable good (the inverse of the real exchange rate) in period t is denoted by P_{nt}, the exogenously given output of that good is $\bar{Y}_{nt}$, government purchases of the nontradable good are G_{nt}, and private-sector demand is c_{nt} $(t = 0,1)$.

The private sector life-time budget constraint is

$$(1) \qquad (C_{x0}+p_{n0}c_{n0}) + \alpha_{x1}(c_{x1}+p_{n1}c_{n1}) = (\bar{Y}_{x0}+p_{n0}\bar{Y}_{n0}) + \alpha_{x1}(\bar{Y}_{x1}+p_{n1}\bar{Y}_{n1}) - (T_0+\alpha_{x1}T_1) - (1+r_{x,-1})B^p_{-1} = W_0.$$

where $\alpha_{x1} = 1/(1+r_{x0})$ denotes the discount factor and where T_t, c_{xt} and $\bar{Y}_{xt}$ denote, respectively, the levels of lump-sum taxes, consumption and the exogenously given level of production of tradable goods, in period t, $(t = 0,1)$, W_0 denotes wealth, r_{xt} $(t = -1,0)$ denotes the world rate of interest and B^p_t denotes private-sector debt in period t $(t = -1,0)$. The values of taxes, wealth, debt, and the rates of interest are measured in terms of tradable goods.

In addition to the private sector life-time budget constraint the economy's overall constraint incorporates the government budget constraint.

1/ The two-country analysis in this section draws on Frenkel and Razin (1986c and 1987). A related analysis of fiscal policies and the real exchange rate within a small-country model is contained in Buiter (1986). For an extension of the small-country model to the analysis of the effects of terms-of-trade shocks on the real exchange rate see Edwards (1987) and Ostry (1987).

Accordingly, the government present-value intertemporal budget constraint is

$$(2) \qquad (G_{x0}+p_{n0}G_{n0}) + \alpha_{x1}(G_{x1}+p_{n1}G_{n1}) = T_0 + \alpha_{x1}T_1 - (1+r_{x,-1})B^g_{-1}$$

where G_{xt} and G_{nt} denote, respectively, government purchases of tradable and nontradable goods, and where B^g_t denotes government debt in period t. Consolidating the private sector life-time constraint (1) with that of the government (2) and imposing equality between consumption and production of nontradable goods in each period, yields the economy's consolidated constraint:

$$(3) \qquad c_{x0} + \alpha_{x1}c_{x1} = (\bar{Y}_{x0}-G_{x0}) + \alpha_{x1}(\bar{Y}_{x1}-G_{x1}) - (1+r_{x,-1})B_{-1}$$

where $B_t = B^p_t + B^g_t$ denotes the economy's external debt in period t.

The individual maximizes life-time utility subject to the lifetime budget constraint (1). We assume that the life-time utility function can be expressed as a function of two linearly homogeneous sub-utility functions $C_0(c_{x0},c_{n0})$ and $C_1(c_{x1},c_{n1})$. Hence, life-time utility is $U(C_0,C_1)$. The maximization of this utility function subject to the life-time constraint (1) is carried out in two stages where the first stage optimizes the composition of spending within each period and the second stage optimizes the intertemporal allocation of spending between periods.

The optimization of the intertemporal allocation of the (consumption-based) real spending yields the demand functions for each period real spending $C_t = C_t(\alpha_{c1},W_{c0})$ where α_{c1} is the (consumption-based) real wealth. Expressed in terms of tradable goods, the level of spending in each period is P_tC_t where P_t is the consumption-based price index (the "true" price deflator). Thus, $\alpha_{c1} = \alpha_{x1} P_1/P_0$ and $W_{c0} = W_0/P_0$. Obviously, the price index in each period depends on the temporal relative price p_{nt} with an elasticity that equals the relative share of expenditure on nontradable goods, β_{nt}. Within each period the (sub)utility-maximizing allocation of spending between goods depends on the relative price p_{nt}. 1/

The market for nontradable goods must clear in each country during each period. Accordingly,

$$(4) \qquad c_{n0}(p_{n0},P_0C_0(\alpha_{x1},W_{c0})) = \bar{Y}_{n0}-G_{n0}$$

$$(5) \qquad c_{n1}(p_{n1},P_1C_1(\alpha_{c1},W_{c0})) = \bar{Y}_{n1}-G_{n1}$$

1/ A similar procedure is developed in Svensson and Razin (1983).

where the left-hand sides of these equilibrium conditions show the demand functions and the right-hand sides show the supply net of government purchases. As seen, the demand functions depend on the relative price, p_{nt}, and on spending, $P_t C_t$, where P_t is the (consumption-based) price index, and C_t is the (consumption-based) real spending. Real spending depends on the (consumption-based) real discount factor, α_{cl}. We assume that the utility function is homothetic so that the elasticity of consumption demand with respect to spending as well as the elasticity of spending with respect to wealth are unity.

In what follows we use the market clearing conditions in order to analyze the international transmission of fiscal policies. In the present case, since the only tradable good is a single composite commodity, the international price which affects the transmission mechanism is the world rate of interest. The analysis proceeds in two stages. In the first, we determine the effects of fiscal policies on the time paths of the real exchange rate and of private consumption of tradable goods under the assumption that the world rate of interest is given. Similarly, we also determine the effects of changes in the world rate of interest on the paths of the real exchange rate and of private consumption of tradable goods under the assumption that fiscal policies are given. In the second stage we use a two-country framework and combine these partial results in order to determine the equilibrium relations between fiscal policies, the world rate of interest, and the time paths of domestic and foreign real exchange rates.

2. Spending policies

In analyzing the effects of government spending, we first note that the equilibrium value of wealth W_0, is obtained by substituting the government present-value budget constraint (2) into the corresponding private-sector budget constraint. Accordingly,

$$(6) \qquad W_0 = [p_{n0}(\bar{Y}_{n0}-G_{n0}) + (\bar{Y}_{x0}-G_{x0})] + \alpha_{x1}[\bar{Y}_{n1}-G_{n1} + (\bar{Y}_{x1}-G_{x1})] - (1+r_{x,-1})B_{-1}$$

Starting from a zero level of initial government spending, consider a rise in the discounted sum of government spending by dG. This change in aggregate government spending falls in part on nontradable goods. For a given value of the world rate of interest (measured in terms of tradable goods) the effect of the rise in government spending on the time path of the real exchange rate p_{n0}/p_{n1}, is found by differentiating equations (4) and (5) around G = 0, subtracting the resulting equations from each other and using the Slutsky decomposition. If the expenditure shares of the

private and public sectors do not vary over time, this yields 1/

$$(7)\quad \frac{d \log (p_{n0}/p_{n1})}{dG} = \frac{\phi_{n0}(1-\gamma_s)}{\beta_n\sigma+(1-\beta_n)\sigma_{nx}}\left[\frac{\beta^g_{n0}(1-\gamma^g_s)}{\beta_n(1-\gamma_s)} - \frac{\beta^g_{n1}\,\gamma^g_s}{\beta_n\gamma_s}\right]$$

where ϕ_{nt} denotes the inverse of the value of private consumption of nontradable goods in period t, that is, $\phi_{nt} = 1/p_{nt}c_{nt}$ $(t = 0,1)$. The intertemporal and the temporal allocations of government spending are governed by the government saving propensity, γ^g_s, defined as the ratio of future government spending (in present value terms) to the discounted sum of spending, and by the relative share of government spending on nontradables in total government spending in period t, β^g_{nt}. Finally, σ and σ_{nx} denote the intertemporal and the temporal elasticities of substitution, and where γ_s, defined as the ratio of private sector future consumption (in present-value terms) to the discounted sum of private-sector spending, denotes the private-sector saving propensity.

Equation (7) reveals that the direction of the change in the path of the real exchange rate depends on the temporal and the intertemporal allocations of government demand for nontradable goods relative to the corresponding allocations of private sector demand. If the ratio of the relative share of government spending on nontradable goods in the current period, $\beta^g_{n0}(1-\gamma^g_s)$, to the private-sector share, $\beta_n(1-\gamma_s)$, exceeds the corresponding ratio in the future period, $\beta^g_{n1}\gamma^g_s/\beta_n\gamma_s$, then a rise in government spending raises the percentage rate of change of the real exchange rate and vice versa.

This result can be interpreted in terms of a "transfer-problem" criterion relating the temporal and the intertemporal spending patterns of the government and the domestic private sector. Accordingly, the rise in government spending raises the current price of nontradable goods relative to its future price, if the pattern of government spending is biased toward current nontradable goods in comparison with the pattern of private-sector spending.

We turn next to determine the effects of government spending on the path of private-sector consumption of tradable goods. Analogously to the previous specification, the demand function for tradable goods in period t is

$$(8)\quad c_{xt} = c_{xt}(p_{nt},\ P_tC_t(\alpha_{c1},\ W_{c0})), \qquad t = 0,1.$$

1/ Derivations of this and other formulae used in this paper are contained in Frenkel and Razin (1986c).

Obviously, in contrast to the markets for nontradable goods, the consumption of tradable goods in any given period is not limited by the available domestic supply. In determining the percentage change in the ratio c_{x0}/c_{x1} we differentiate equation (8) and use the Slutsky decomposition. Accordingly,

$$(9) \qquad \frac{d \log (c_{x0}/c_{x1})}{d \log (p_{n0}/p_{n1})} = \beta_n(\sigma_{nx} - \sigma).$$

Equation (9) shows that the qualitative effects of a rise in the price ratio p_{n0}/p_{n1} on the tradable-goods consumption ratio, c_{x0}/x_{x1}, depends only on whether the temporal elasticity of substitution, σ_{nx}, exceeds or falls short of the intertemporal elasticity of substitution, σ. A rise in the relative price of nontradable goods, p_{nt}, induces substitution of consumption of tradable goods for nontradable goods within the period. The magnitude of this temporal substitution is indicated by σ_{nx}. Further, if p_{n0} rises by more than p_{n1} (so that the ratio p_{n0}/p_{n1}, rises) then the extent of the temporal substitution within the current period exceeds the corresponding substitution within the future period. As a result the ratio of current to future consumption of tradable goods rises. This is reflected by the positive term $\beta_n\sigma_{nx}$ in equation (9). The same rise in the intertemporal price ratio p_{n0}/p_{n1} raises the (consumption-based) real rate of interest (and lowers the corresponding real discount factor, α_{c1}). This rise in the real rate of interest induces substitution of spending between periods: from the present to the future period. The magnitude of this intertemporal substitution is indicated by the negative term $-\beta_n\sigma$ in equation (9). Finally, we note that the change in the intertemporal consumption ratio does not depend on private wealth. This reflects the homotheticity assumption which implies that the tax-induced fall in wealth lowers current and future demand for tradable goods by the same proportion.

Combining equations (7) with (9) yields

$$(10) \qquad \frac{d \log (c_{x0}/c_{x1})}{dG} = \frac{\beta_n^2\phi_{n0}(1-\gamma_s)(\sigma_{nx}-\sigma)}{\beta_n\sigma+(1-\beta_n)\sigma_{nx}} \frac{\beta_n^g}{\beta_n} \left[\frac{(1-\gamma_s^g)}{(1-\gamma_s)} - \frac{\gamma_s^g}{\gamma_s}\right]$$

where we assume that $\beta_{nt}^g = \beta_n^g(t=0,1)$.

Equation (10) shows that the direction of the effect of a rise in government spending on the path of tradable-goods consumption, c_{x0}/c_{x1}, depends on the product of two factors. First, the government-induced temporal-intertemporal

bias in demand relative to the private sector (indicated by the term in the squared brackets in (10)), and second, the temporal-intertemporal substitution bias in private-sector demand (indicated by $\sigma_{nx}-\sigma$). The first determines the effect of the rise in G on the price ratio and the second translates the change in the price ratio into changes in the consumption ratio.

We turn next to determine the effects of changes in the world rate of interest (or equivalently the world discount factor) under the assumption that government spending remains intact. Using equations (4)-(5) it can be shown that the percentage change in p_{n0}/p_{n1} (indicating the reciprocal of the rate of change over time in the price of nontradable goods) arising from a given percentage change in the world discount factor is

$$(11) \qquad \frac{d \log (p_{n0}/p_{n1})}{d \log \alpha_{x1}} = \frac{\sigma}{\beta_n \sigma+(1-\beta_n)\sigma_{nx}} \ .$$

Equation (11) indicates that changes in the world rate of interest influence the path of the real exchange rate only through the intertemporal substitution effect. Accordingly, a rise in the world rate of interest (a fall in α_{x1}) induces intertemporal substitution of spending toward the future and, thereby, lowers the current price of nontradable goods relative to the future price (that is, it decelerates the rate of increase of the real exchange rate from period zero to period one). Due to the homotheticity assumption the wealth-induced proportional change in the current demand and, thereby, in the current price of nontradable goods, p_{n0}, equals the corresponding changes in the future demand and price, p_{n1}. Therefore, these wealth effects do not influence the price ratio p_{n0}/p_{n1}.

Using equations (9) and (11), the intertemporal-consumption ratio of tradable goods, c_{x0}/c_{x1}, depends on the world discount factor according to

$$(12) \qquad \frac{d \log (c_{x0}/c_{x1})}{d \log \alpha_{x1}} = \frac{\sigma_{nx}\ \sigma}{\beta_n \sigma+(1-\beta_n)\sigma_{nx}}$$

Equation (12) shows that the only factors governing the change in this intertemporal-consumption ratio are pure temporal and intertemporal

substitution effects. As before the wealth effects do not influence this ratio. 1/

Equations (10) and (12) summarize the results of the first stage of the analysis. They provide the ingredients for the second stage in which we determine the equilibrium relation between the world rate of interest and the level of government spending. In order to determine the equilibrium in the world economy we need to consider the factors governing world demand and world supply of tradable goods. The foreign economy is assumed to be characterized by a structure of demand and supply similar to that of the domestic economy. Thus, the relative world supply of tradable goods net of government purchases, z, is

$$(13) \qquad z = \frac{(\bar{Y}_{x0}-G_{x0}) + (\bar{Y}^*_{x0}-G^*_{x0})}{(\bar{Y}_{x1}-G_{x1}) + (\bar{Y}^*_{x1}-G^*_{x1})}$$

The analysis of the equilibrium in the world economy is carried out with the aid of Figure 1. Panel I of Figure 1 shows the relative intertemporal world supply, S, and the relative intertemporal domestic, D, foreign, D^*, and world, D^W, demands for tradable goods. The world relative demand is a weighted average of the domestic and foreign relative demands. That is,

$$D^W = \frac{c_{x0}+c^*_{x0}}{c_{x1}+c^*_{x1}} = \mu_d \frac{c_{x0}}{c_{x1}} + (1-\mu_d)\frac{c^*_{x0}}{c^*_{x1}} \quad \text{where } \mu_d = c_{x1}/(c_{x1}+c^*_{x1}).$$

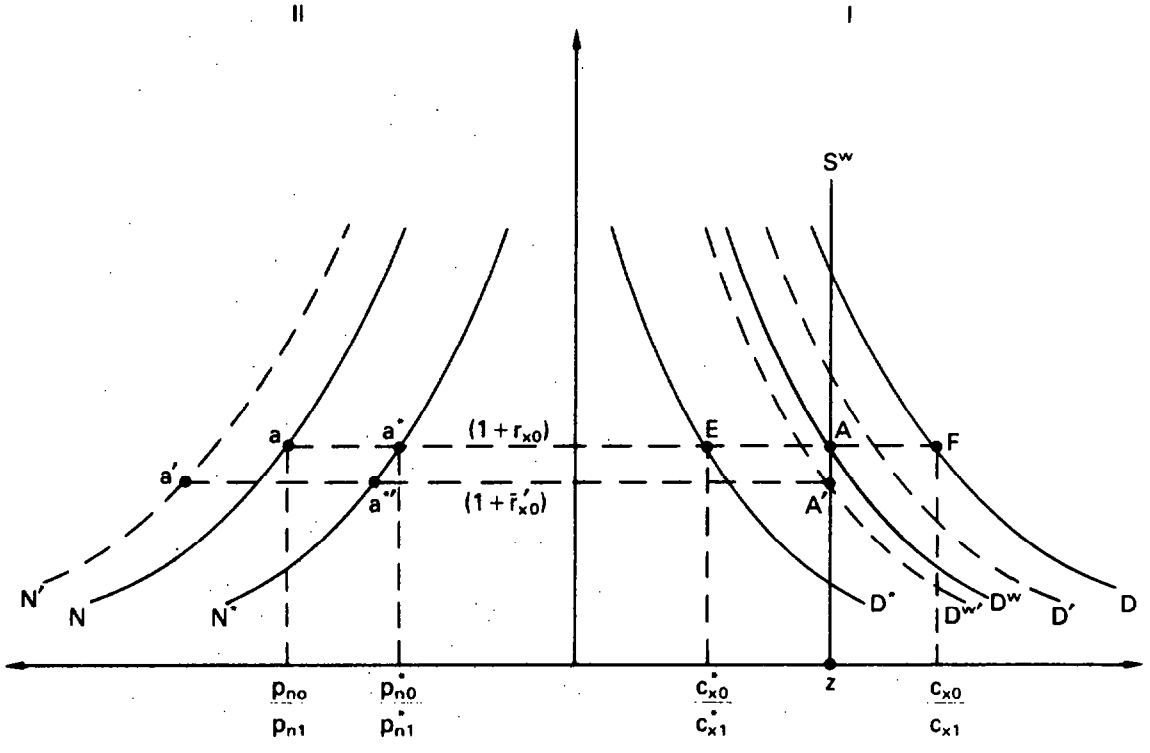
1/ In this case, however (and in contrast with the effects of the rise in government spending analyzed in equation (10)), both the temporal and the intertemporal elasticities of substitution operate in the same direction. This is evident by noting from the definition of the (consumption-based) real discount factor and from equation (11) that

$$\frac{d \log \alpha_{c1}}{d \log \alpha_{x1}} = 1-\beta_n \frac{d \log (p_{n0}/p_{n1})}{d \log \alpha_{x1}} = \frac{(1-\beta_n)\sigma_{nx}}{\beta_n\sigma+(1-\beta_n)\sigma_{nx}}$$

Thus, a rise in the world discount factor raises the (consumption-based) real discount factor (but by a smaller proportion in view of the rise in p_{n0}/p_{n1}). This rise induces intertemporal substitution of spending toward the present and raises the consumption ratio c_{x0}/c_{x1}. Further, a rise in the price of nontradable goods induces within each period substitution in consumption toward tradable goods. Since the rise in the discount factor raises p_{n0}/p_{n1}, the temporal substitution in consumption is stronger in the current period and, therefore, also operates to raise the ratio c_{x0}/c_{x1}.

Figure 1:

The Effects of Government Spending on the World Rate of Interest and on the Paths of the Real Exchange Rates.



Data: $\sigma > \sigma_{nx}$, $\gamma_s > \gamma^o_s$, $\beta^o_n = 1$

The relative demand schedules relate the desired consumption ratio of tradable goods to the rate of interest. Their slope reflects the negative relation embodied in equation (12). These demand schedules are drawn for a given level of government spending. The relative supply schedule is drawn with a zero interest elasticity since we abstract from investment. This schedule is also drawn for a given level of government spending.

The schedules N and N^* in Panel II of Figure 1 show the relation between the world rate of interest and the internal relative price structure (the path of the real exchange rate) in each country. The negative slope of these schedules reflects the relation embodied in equation (11).

The initial equilibrium is described in Panel I by point A in which the world rate of interest is r_{x0}. The domestic and foreign intertemporal consumption ratios are indicated by points F and E. The periodic percentage changes of the domestic and the foreign real exchange rates associated with the initial equilibrium are shown in Panel II by points a and a^*.

Consider the effects of a rise in the level of the domestic government spending. This change alters the domestic relative demand, the domestic country weight, μ_d (and, thereby, the world relative demand), as well as the world relative supply. As shown in equation (10), the direction of the change in the relative demand schedules depend on the government-induced bias in the intertemporal net supply of nontradable goods and on the temporal-intertemporal substitution bias in private-sector demand. A rise in the level of domestic government spending influences world relative demand in two ways: (1) through its effect on the domestic relative demand, and (2) through its effect on the domestic country weight, μ_d. The direction of the change in the world demand due to the induced change in the weight μ_d is equal to

$$(10a) \qquad \frac{d \log [(c_{x0}+c^*_{x0})/(c_{x1}+c^*_{x1})]}{dG} = \frac{1}{(c_{x0}+c^*_{x0})}(1-\mu_d)(1-\beta_n)\gamma_s \left[\frac{1-\gamma^*_s}{\gamma^*_s} - \frac{1-\gamma_s}{\gamma_s}\right]$$

while maintaining c_{x0}/c_{x1} constant; note that this effect vanishes if $\gamma_s=\gamma^*_s$. In order to determine the direction of the change in the relative supply schedule we differentiate equation (13) with respect to government spending. Accordingly,

$$(14) \qquad \frac{d \log z}{dG} = \lambda^g_{x1}(1-\beta^g_n)(1-\gamma^g_s)\left[\frac{\gamma^g_s}{1-\gamma^g_s} - \mu_d \frac{\gamma_s}{1-\gamma_s} - (1-\mu_d)\frac{\gamma^*_s}{1-\gamma^*_s}\right]$$

where λ^g_{xt} denotes the reciprocal of the world output of tradable goods net of government purchases of these goods in period t (t = 0,1). Thus, $\lambda^g_{xt} = 1/[(\bar{Y}_{xt}-G_{xt}) + (\bar{Y}^*_{xt}-G^*_{xt})]$. Equation (14) indicates that the direction

of the change in the relative supply reflects the bias in the intertemporal allocation of government spending on tradable goods. For example, a temporary current rise in government spending ($\gamma_s^g = 0$) induces a leftward shift of the relative supply schedule, whereas a temporary future rise in government spending ($\gamma_s^g = 1$) induces a rightward shift of the relative supply.

Since the direction of the shift of the world relative demand and supply depends on the assumed magnitude of the various parameters, we cannot determine on a priori grounds whether the rise in government spending raises or lowers the equilibrium world rate of interest. Similar considerations apply to the effects of government spending on the paths of the domestic and foreign real exchange rates. As indicated by equation (7), depending on the temporal and intertemporal pattern of government spending, the rise in government spending may induce a rightwards or leftwards shift of the N schedule in Panel II of Figure 1.

In order to illustrate the working of the model we consider in Figure 1 the effects of government spending for a benchmark case in which the intertemporal elasticity of substitution, σ, exceeds the temporal elasticity, σ_{nx}; the ratio of the shares of government spending to private spending in the current period, $(1-\gamma_s^g)/(1-\gamma_s)$, exceeds the corresponding ratio of future spending, γ_s^g/γ_s; and government spending falls entirely on nontradable goods (so that $\beta_n^g = 1$). As indicated by equation (10), in this benchmark case, the domestic and, thereby, the world relative demand schedules shift leftwards from the position indicated by D and D^W to the position indicated by D' and $D^{W'}$, respectively. Further, as indicated by equation (14), with $\beta_n^g = 1$ the relative supply of world tradable goods does not change. It follows that in this case the equilibrium point shifts from point A to point A' in Panel I of Figure 1, and the world rate of interest falls from r_{x0} to r'_{x0}.

In Panel II of Figure 1 we show the effects of the rise in government spending on the paths of the domestic and foreign real exchange rates. As indicated by equation (7), in this benchmark case, the N schedule shifts outwards and, given the new lower world rate of interest, the domestic and foreign equilibrium points shift from a and a^* to a' and $a^{*'}$, respectively. Accordingly, the percentage change (per unit of time) of the real exchange rates increases in both countries. In concluding the presentation of this benchmark case we note that since the world rate of interest (measured in terms of tradable goods) falls and since in both countries the time-paths of the real exchange rates steepen, it follows that in both countries the consumption-based real rates of interest fall (even though, in general, the magnitude of this decline need not be the same for both countries).

It is important to note that we chose this specific benchmark case in which the rise in government spending lowers the world rate of interest in order to highlight the implications of government spending on nontradable goods. In fact, if government spending falls entirely on tradable goods,

TABLE 1

THE EFFECTS OF A RISE IN GOVERNMENT SPENDING ON THE WORLD RATE OF INTEREST IN A MODEL WITH NON-TRADABLE GOODS

Relation Between Temporal and Intertemporal Elasticities if Substitution	Intertemporal and Temporal Allocations of Government Spending			
	$\gamma_s > \gamma_s^g$		$\gamma_s < \gamma_s^g$	
	β_n^{g-0}	β_n^{g-1}	β_n^{g-0}	β_n^{g-1}
$\sigma_{nx} > \sigma$	+	+	-	-
$\sigma_{nx} = \sigma$	+	0	-	0
$\sigma_{nx} < \sigma$	+	-	-	+

Note: The world rate of interest is measured in terms of internationally tradable goods. This table assumes that initially $\gamma_s = \gamma_s^*$.

TABLE 2

THE EFFECTS OF A RISE IN GOVERNMENT SPENDING ON THE PATHS OF DOMESTIC AND FOREIGN REAL EXCHANGE RATES

Relation Between Temporal and Intertemporal Elasticities of Substitution	The Real Exchange Rate in the	Intertemporal and Temporal Allocations of Government Spending			
		$\gamma_s > \gamma_s^g$		$\gamma_s < \gamma_s^g$	
		$\beta_n^g=0$	$\beta_n^g=1$	$\beta_n^g=0$	$\beta_n^g=1$
$\sigma_{nx} > \sigma$	Domestic Economy	-	?	+	?
	Foreign Economy	-	-	+	+
$\sigma_{nx} = \sigma$	Domestic Economy	-	+	+	-
	Foreign Economy	-	0	+	0
$\sigma_{nx} < \sigma$	Domestic Economy	-	+	+	-
	Foreign Economy	-	+	+	-

Note: The paths of the real exchange rates are measured by p_{n0}/p_{n1} and p^*_{n0}/p^*_{n1}.

This table assumes that initially $\gamma_s=\gamma_s^*$.

so that $\beta_n^g = 0$) then the rise in spending does not alter the relative demand schedules in Figure 1 (as seen from equation (10) with $\beta_n^g = 0$) but it induces a leftwards shift of the relative supply schedule (as seen from equation (14) for the case $\gamma_s^g < \gamma_s$, $\beta_n^g = 0$. Thus, under such circumstances, the rise in government spending raises the equilibrium rate of interest.

The more general configurations of the effects of government spending on the world rate of interest, as implied by equations (10) and (13), are summarized in Table 1 where we assume that initially, $\gamma_s = \gamma_s^*$. The table demonstrates that if the commodity composition of government spending is strongly biased toward goods that are internationally tradable (so that β_n^g is small), then the key factor determining the direction of the change in the world rate of interest is the intertemporal allocation of government and private-sector spending. If government spending is biased toward the current period relative to private-sector spending, so that γ_s exceeds γ_s^g, then the world rate of interest rises and vice versa. On the other hand, if the commodity composition of government spending is strongly biased toward nontradable goods (so that β_n^g is close to unity), then the direction of the change in the interest rate depends on the interaction between the intertemporal allocation of government spending relative to the private sector and the difference between the temporal and the intertemporal elasticities of subsitution of the domestic private sector. In fact, since in this case the effects of government spending operate only through changes in the relative demand schedules, the rate of interest rises if $(\sigma_{nx}-\sigma)(\gamma_s-\gamma_s^g)$ is positive, and vice versa.

The various possibilities concerning the relative magnitudes of the key parameters also imply that the effects of government spending on the time-path of the domestic and foreign real exchange rates are not clear cut. The possible outcomes are summarized in Table 2. The results in the table show that if the commodity composition of government spending is strongly biased toward internationally tradable goods (so that β_n^g is about zero) then, as implied by equation (7), the change in government spending does not materially displace the N schedule in Panel II of Figure 1. Therefore, the induced change in the path of the domestic real exchange rate mirrors only the change in the rate of interest since it involves a movement along the given N schedule. It follows that, with β_n^g small, the change in the domestic time-path of the real exchange rate is inversely related to the change in the world rate of interest. This inverse relation is verified from a comparison between the entries appearing in Tables 1 and 2 in the columns corresponding to the case of $\beta_n^g = 0$.

In the other extreme case, in which government spending falls mainly on nontradable goods (so that β_n^g is close to unity) then, as long as the temporal elasticity of substitution, σ_{nx}, does not exceed the intertemporal elasticity of substitution, σ, the key factor determining whether the path of the real exchange rate steepens or flattens is the intertemporal allocation of government spending. If government spending is biased toward

the current period relative to private-sector spending, so that γ_s exceeds γ_s^g, then the rise in spending accelerates the time-path of the real exchange rate and vice versa. On the other hand, if σ_{nx} exceeds σ, then the time-path of the real exchange rate is influenced by two conflicting forces, the one operating through a movement along the N schedule (induced by the change in the rate of interest) and the other operating through a shift of the N schedule (induced by the direct effect of government spending on the relative supply of nontradable goods).

Finally, we note that since the foreign schedule, N^*, is not affected by domestic government spending, the time-path of the foreign real exchange rate, p^*_{n0}/p^*_{n1}, is always related negatively to the world rate of interest. On the other hand, since the correlation between the time-path of the domestic real exchange rate and the world rate of interest may be positive, zero, or negative (as may be verified by comparing the results reported in Tables 1 and 2), it follows that the cross-country correlations between the paths of the real exchange rates and between the (consumption-based) real rates of interest may also be negative, zero, or positive. The analysis underlying Tables 1 and 2 identifies the main factors governing the signs of the various cross-country correlations.

III. Tax Policies

Up to now we analyzed the effects of government spending under the assumption that taxes are nondistortionary. To analyze meaningfully the effects of tax policies we turn next to examine the effects of changes in distortionary taxes under the assumption that government spending remains intact. 1/ To focus on tax policies we set government spending to be zero. To isolate the key mechanism through which tax policies influence private-sector behavior, we incorporate taxes into the definition of the discount factor and consider two tax systems: a consumption tax system and an income tax system.

1. Consumption tax policies

Consider a value added tax system (VAT) under which export is exempt. Evidently, this tax is equivalent to a consumption tax. In the presence of such tax the effective (tax adjusted) discount factor is denoted by $\alpha_{x\tau 1}$ which is related to the undistorted world discount factor, α_{x1}, according to $\alpha_{x\tau 1} = ((1+\tau_{c1})/(1+\tau_{c0}))\alpha_{x1}$ where τ_{ct} is the ad valorem consumption tax rate period t (t = 0,1,). Correspondingly, the effective

1/ For an elaborate analysis of distortionary tax systems see Frenkel and Razin (1986b). An alternative mechanism through which lump-sum tax policies influence the real exchange rate and the economic system, in which the horizon governing private and public sectors' behavior do not coincide, is provided in Frenkel and Razin (1986a).

(consumption-based) real discount factor is denoted by $\alpha_{c\tau 1}$ where $\alpha_{c\tau 1} = (P_1/P_0)\alpha_{x\tau 1}$. With such taxes, private sector demands depend on $\alpha_{c\tau}$ rather than on α_{c1} and, therefore, changes in the time profile of taxes alter private sector behavior. To simplify, we assume that foreign government spending and taxes are zero.

A budget deficit arising from a current period tax cut (a reduction in τ_{c0}), must be accompanied by a corresponding rise in future taxes (a rise in τ_{c1}) so as to maintain government solvency as long as government spending policies remain intact. The effects of such a change in the time profile of taxes are analyzed with the aid of Figure 2. The initial equilibrium is described in Panel I by point A in which the world rate of interest is r_{x0}. For convenience of exposition we assume that in the initial situation the time profile of taxes is "flat" (that is, $\tau_{c0} = \tau_{c1}$), so that initially the domestic and foreign rates of interest (in terms of tradable goods) are equal to each other. Thus the flat tax system is neutral with respect to the real equilibrium. The time-paths of the domestic and foreign real exchange rates associated with the initial equilibrium is indicated in Panel II by points a and a* along the N and the N* schedules. Thus, the initial equilibrium is identical to the one portrayed in Figure 1.

Consider the effects of a budget deficit arising from a tax cut. Such tax policy breaks the "flatness" of the tax system. Given the initial value of the world rate of interest, r_{x0}, the reduction in τ_{c0} and the increase in τ_{c1} (implied by the government budget constraint) raise the domestic effective discount factor, $\alpha_{x\tau 1}$, and induce an upward displacement of the domestic relative demand schedule from D to D', and assuming initially $\gamma_s = \gamma_s^*$ so that the change in the domestic country weight in the world relative demand does not affect the world relative demand, the proportional vertical displacement of the schedule equals the proportional change in the effective discount factor. This displacement is necessary in order to offset the effect of the tax-induced reduction in the effective rate of interest on the desired domestic consumption ratio. Corresponding to the new domestic schedule D', the world relative demand schedule shifts from D^W to $D^{W'}$. The new equilibrium is described by point A' in Panel I of Figure 2. Hence the world rate of interest rises from r_{x0} to r'_{x0}. The proportional vertical displacement of the world relative demand schedule, D^W (indicated by the distance AA'), is smaller than the corresponding displacement of the domestic schedule, D (indicated by the distance BC) since the world schedule is a weighted average of the domestic and the (given) foreign schedules. It follows that the domestic effective rate of interest must fall from r_{x0} to a lower level such as $\tilde{r}'_{x0}$.

The change in the time profile of taxes which (for any given level of the world rate of interest) raises the effective discount factor, also alters the position of the domestic schedule N in Panel II of Figure 2. In analogy to the previous analysis of the displacement of the relative demand schedule, the proportional vertical displacement of the N schedule equals the percentage change in the effective discount factor. As indicated by equation (11), this displacement is necessary in order to offset

the effects of the tax-induced reduction in the effective rate of interest on the time-path of the domestic real exchange rate. Hence, given the new domestic effective rate of interest $\tilde{r}'_{x0}$, the rate of increase of the domestic real exchange rate from period zero to period one accelerates (as p_{n0}/p_{n1} rises). Likewise, given the new world rate of interest, r'_{x0}, the rate of increase of the foreign real exchange rate decelerates (as p^*_{n0}/p^*_{n1} falls). These changes are indicated in Panel II of Figure 2 by the displacement of the equilibrium points a* and a to a*' and a', respectively. 1/

2. Income tax policies

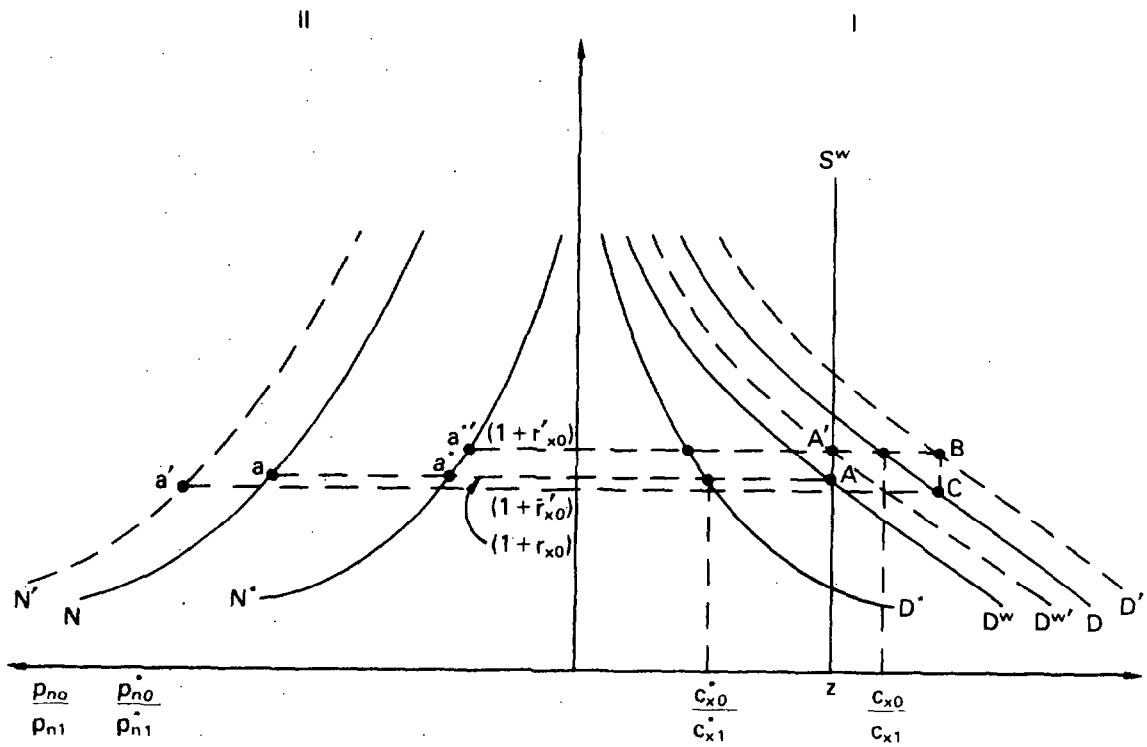
The foregoing analysis focused on the effects of budget deficits arising from changes in consumption taxes. We now examine the effects of corresponding changes in income taxes. For this purpose the analytical framework which allows for tradable and nontradable goods, can be reinterpreted and applied to the analysis of the effects of income tax policies on real wages in a model with variable labor supply. The reintepretation of the model treats leisure as the nontradable good, the real wage as the real exchange rate, and the temporal elasticity of substitution as the (compensated) elasticity of labor supply. With this interpretation, government hiring of labor is viewed as government purchases of nontradable goods, and the relative share of government expenditure on nontradable goods, β_n^g, corresponds to the relative share of wages in the government budget. Likewise, the private sector expenditure share, β_n, is viewed as the relative share of leisure in private sector total spending (inclusive of the imputed value of leisure). 2/ With this interpretation an income tax operates like a tax on tradable goods only (since leisure--the nontradable good--is not taxable).

1/ The foregoing analysis implies that the budget deficit arising from the cut in taxes raises the world rate of interest and lowers the domestic effective rate of interest (both measured in terms of tradable goods). Further, the deficit raises the periodic percentage change of the domestic real exchange rate and lowers the corresponding foreign percentage change. These changes in the time-paths of relative prices imply from the equation in footnote 4 that the foreign (consumption-based) real rate of interest rises and that the domestic (consumption-based) effective real rate of interest falls. Further, the magnitudes of the changes in the rates of interest are smaller if the rates of interest are measured in terms of the consumption baskets than if they are measured in terms of internationally tradable goods (the absolute difference between the two magnitudes rises with the ratio of the temporal to the intertemporal elasticities of substitution, σ_{nx}/σ). We conclude that the budget deficit results in a negative cross-country correlation between changes in the domestic and the foreign (consumption-based) real rates of interest.

2/ This interpretation suggests that the effects of government spending on the rate of interest and on the time-path of real wages depend critically on the relative importance of wages in the government budget. For the remainder of this section we continue to assume zero government spending.

Figure 2:

The Effects of a Budget Deficit Arising From a Cut in a Value Added Tax on the World Rate of Interest and on the Paths of the Real Exchange Rates.



To provide a meaningful analysis of the effects of income tax policies we relax the assumption that labor is inelastically supplied. To simplify, we suppose that the production functions are linear, that preferences are homothetic, that the leisure and ordinary goods (in our case, the tradable goods) are separable in the utility function, and that the amounts of leisure (the nontradable good) consumed in two consecutive periods are gross substitutes. These assumptions imply that the effective discount factor governing the relative supply of tradable goods $S = Y_{x0}/Y_{x1}$, is $\alpha_{n\tau 1} = \left((1-\tau_{y1})/(1-\tau\ 0)\right)\alpha_{c1}$ which measures the price of future leisure in terms of current leisure. As is evident, the relative supply depends negatively on the effective discount factor $\alpha_{n\tau 1}$.

The positively sloped S schedule in Figure 3 reflects the positive dependence of the relative supply on the rate of interest. A higher rate of interest (measured in terms of tradable goods) corresponds to a higher consumption-based real rate of interest 1/ which, in turn, induces substitution of current-period labor for future-period labor, resulting in a higher relative supply of tradable goods. The positively sloped S^* schedule is derived in an analogous manner for the foreign economy. The relative supply schedule pertaining to the world, S^W, is a weighted average of the domestic and foreign relative supplies so that $S^W = \mu_s S+(1-\mu_s)S^*$ where the domestic-country weight μ_s corresponds to the relative share of domestic output of tradable goods in world output in the second period. That is, $\mu_s = Y_{x1}/(Y_{x1}+Y^*_{x1})$. 2/ Finally, in Figure 3, the world relative demand schedule, D^W, as well as the nontradable good market equilibrium schedules N and N*, are analogous to the corresponding schedules in Figures 1 and 2, where the real wages w and w* are identified with the relative price of nontradable goods. 3/ The initial equilibrium is shown in Figure 3 by point A at which the world rate of interest is r_{x0}, and the relative world quantities of tradable goods are indicated by point z. The paths of the domestic and foreign real wages (the reciprocals of the real exchange rates) are indicated by points a and a*, respectively.

A budget deficit arising from a current cut in the income tax rate, τ_{y0}, which is compensated by a corresponding rise in the future income tax rate τ_{y1}, lowers the effective discount factor $\alpha_{n\tau 1}$ at any given level of α_{c1}. This change induces an equiproportional downward

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1/ The precise positive dependence of $\alpha_{n\tau 1}$ on α_{x1} is described by an equation similar to the one shown in footnote 4, adjusted for the dependence of output on the relative price, p_{n0}/p_{n1}.

2/ Thus, the expression specifying the world relative supply is the analogue to equation (13) modified to allow for a variable labor supply with zero government spending.

3/ Again, in the present case the N and N* schedules are adjusted for the dependence of the relative output of nontradable goods on the percentage growth rate of the real exchange rate.

displacement of the domestic relative supply schedule (drawn against the reciprocal of the world discount factor) from S to S'. Since the world relative supply schedule is a weighted average of the corresponding domestic and foreign schedules, and assuming that initially $\gamma_s = \gamma_s^*$ so that the change in the domestic country weight, μ_s, does not affect the world relative supply, the displacement of the domestic schedule induces a smaller displacement of the world schedule from S^w to $S^{w'}$. In contrast with the effect of this shift in the timing of income tax on the relative supply schedules, the relative demand schedules remain intact since relative demand for tradable goods depends on the consumption discount factor, α_{c1}, which is not influenced by income taxes. As seen in Figure 3, the new equilibrium obtains at point A' at which the world rate of interest falls from r_{x0} to r'_{x0} and the relative quantity of tradable goods rises from z to z'. In the new equilibrium the domestic effective rate of interest (applicable to the intertemporal labor-supply decision) rises to $\tilde{r}'_{x0}$. The wedge between the world and the domestic effective rates of interest is indicated by the distance BC reflecting the existence of income taxes.

The change in the time profile of income taxes also alters the position of the domestic market-clearing schedule for nontradable goods, from N to N' in Panel II of Figure 3. This downward shift of the schedule is necessary in order to eliminate the excess supply of current-period labor induced by the change in the time profile of taxes, since a lower rate of interest raises current demand for leisure relative to future demand and thereby eliminates the current excess supply of labor. Hence, given the new lower world rate of interest, the rate of growth of the foreign real wage decelerates as indicated by the move from point a* to point a*' along the N* schedule. Analogously, given the new higher domestic effective rate of interest, the rate of growth of the domestic wage accelerates as indicated by the move from point a, along the N schedule, to point a', along the N' schedule.

The key consequences of the budget deficits are summarized in Table 3 which highlights the contrast between the consumption and the income tax systems. 1/

IV. Concluding Remarks

This paper deals with the effects of government spending and tax policies on the world economy. It extends our previous analysis in Frenkel and Razin (1985) in two dimensions: first, we introduce nontradable goods and, thereby, focus on the real exchange rates; second, we allow for distortionary taxes and, thereby focus on the effects of budget deficits under alternative tax systems.

1/ The reader may infer from Figures 3 and 4 some additional consequences concerning the growth rates of tradable goods consumption.

Figure 3:

The Effects of a Budget Deficit Arising From a Cut in an Income Tax on the World Rate of Interest and on the Paths of Real Wages (Real Exchange Rates).

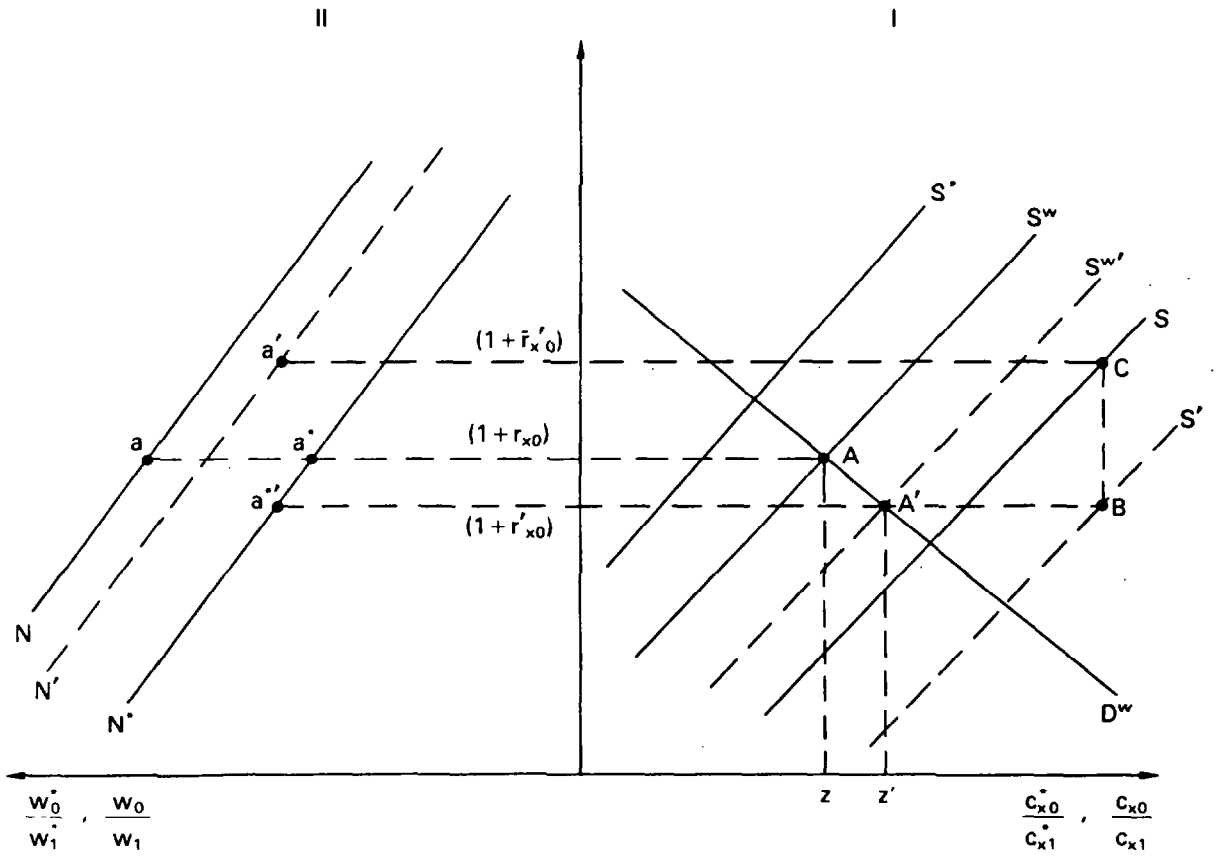

TABLE 3

THE EFFECTS OF DOMESTIC BUDGET DEFICITS ARISING FROM A CUT IN TAXES ON CONSUMPTION AND INCOME

	r_{x0}	$\bar{r}_{xc}$	r_{x1}	g_w	g_w^*
Consumption taxes	+	-	+	-	+
Income taxes	-	-	+	+	-

Note: $r_{x0}m$, r_{xc} and r_{x1} denote, respectively, the world rate of interest and the domestic effective rates of interest applicable to decisions concerning consumption of tradable goods and leisure; g_w and g_w^* denote, respectively, the growth rates of domestic and foreign real wages measured in terms of tradable goods (the growth rates of the reciprocals of the corresponding real exchange rates). This table assumes that initially $\gamma_s = \gamma_s^*$.

In the absence of nontradable goods the effects of government spending on the world rate of interest are clear cut: a current transitory rise in government spending raises the rate of interest, whereas a future transitory rise in spending lowers the rate of interest. The presence of nontradable goods alters this simple result. Our analysis shows that the effects of government spending depend critically on two biases: the bias in the intertemporal allocation of government spending relative to the domestic private sector and the bias in the commodity composition of government purchases relative to the domestic private sector. If government spending is strongly biased toward purchases of tradable goods, then the key factor determining whether the world rate of interest rises or falls is the intertemporal pattern of government spending relative to the private sector: if the latter is biased toward current spending then the rate of interest rises, and vice versa. These adjustments in the rate of interest reflect the changes in the country's borrowing needs that arise from the intertemporal pattern of government spending.

The analysis also provides information about the time-paths of the domestic and foreign real exchange rates. If the relative share of government spending on tradable goods is high, then a rise in government spending decelerates the rate of change of the domestic and foreign real exchange rates if the intertemporal allocation of government spending (relative to the private sector) is biased toward the present. On the other hand, if the intertemporal allocation of government spending (relative to the private sector) is biased toward the future, then the rates of change of the real exchange rates accelerate. It follows that in this case government spending induces positive cross-country correlations between the time-paths of the real exchange rates as well as between the (consumption-based) real rates of interest.

In contrast, if the commodity composition of government spending is strongly biased toward purchases of nontradable goods, then the interest-rate effects depend on the interaction between the bias in the intertemporal allocation of government spending relative to the private sector and the temporal-intertemporal substitution bias of the domestic private sector. Accordingly, in the absence of an empirical assessment knowledge of the magnitudes of the saving propensities of the government and of the private sector, as well as on the private-sector temporal and intertemporal elasticities of substitution, there is no presumption as to whether a rise in government spending raises or lowers world rates of interest. It is important to emphasize, however, that once tradable and nontradable goods are present, then even though there is no a priori presumption concerning the precise effects of government spending on the world rate of interest and on the time-paths of the real exchange rates, our analysis identified the key (estimatable) parameters whose relative magnitudes determine these effects.

The second section of the paper analyzes the effects of distortionary tax policies under alternative tax systems: consumption tax and income tax systems. It is shown that with consumption taxes a budget deficit raises the world rate of interest and lowers the domestic effective interest rate applicable to domestic consumption decisions. In addition, the deficit decelerates the rate of change of the domestic real exchange rate and accelerates the corresponding foreign rate of change. Thereby, the deficit lowers the domestic (consumption-based) effective real rate of interest, and raises the corresponding foreign real rate of interest. These changes result in a negative cross-country correlation between the (consumption-based) real effective rates of interest. In contrast, under an income tax system, a budget deficit lowers the world rate of interest and raises the domestic effective rate applicable to intertemporal labor supply decisions. It is shown that the deficit accelerates the rate of growth of the domestic real wage and decelerates the corresponding foreign growth rate.

We conclude by reiterating one of the principal implications demonstrated by this paper. A proper analysis of the effects of fiscal policies on the world economy must specify on the one hand the composition of government spending between tradable and nontradable goods and its intertemporal allocations and, on the other hand, the characteristics of the tax system, including the timing of taxes and the types of taxes used to finance the budget.

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