NBER WORKING PAPER SERIES

INTEGRATION OF THE INTERNATIONAL CAPITAL MARKETS: THE SIZE OF GOVERNMENT AND TAX COORDINATION

Assaf Razin

Efraim Sadka

Working Paper No. 2863

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
February 1989

Prepared for the NBER conference on International Aspects of Taxation, held in Nassau, Bahamas, February 24-25, 1989. This paper is part of NBER's research programs in International Studies and in Taxation. Any opinions expressed are those of the authors not those of the National Bureau of Economic Research.

NBER Working Paper #2863
February 1989

INTEGRATION OF THE INTERNATIONAL CAPITAL MARKETS: THE SIZE OF GOVERNMENT AND TAX COORDINATION

ABSTRACT

International-capital market integration has become a key policy issue in the prospective integration of Europe of 1992. In this context this paper provides a theoretical analysis of the effects of relaxing restrictions on the international flow of capital on the fiscal branch of government: the optimal provision of public goods, the structure of taxation and income redistribution policies. Concerning issues of interdependent economies the paper analyzes the scope of tax coordination. The major findings are: (a) with no administrative barriers to capital flows the optimal policy is to tax income from investment abroad and from investments at home at the same time; (b) the cost of public funds falls and the supply of public goods rises if restrictions on international capital flows are relaxed: (c) the amount of income redistributions increases with the international-capital market liberalization; (d) some minimal degree of tax coordination (such as origin-based or source-based tax schemes) is essential for the existence of an equilibrium in an integrated world economy.

Assaf Razin
Department of Economics
Tel-Aviv University
Tel-Aviv 69978
ISRAEL

Efraim Sadka
Department of Economics
Tel-Aviv University
Tel-Aviv 69978
ISRAEL

I. Introduction

International capital market integration has become the subject of a major theoretical and practical interest in recent times. Policymakers are becoming more and more aware of the potential benefits accruing from such integration, which allows more efficient allocations of investment between the domestic and the foreign market. In particular, with the prospective comprehensive integration of capital markets in Europe in 1992, some key policy issues arise.[1]

The financial, monetary and exchange rate management policy implications of capital market integration have been widely discussed in the context of the European Monetary System (EMS); see, for instance, the survey by Micossi (1988). However, capital market integration has also profound effects on the fiscal branch of each country separately and on the scope of tax coordination among them. These issues have not been dealt with extensively so far. The present paper attempts to contribute to the economic analysis in this area.[2]

The opening up of an economy to international capital movements affects, as expected, the size and the structure of the fiscal branch of its government. Capital flows influence both the optimal structure of taxes, on domestic and foreign-source income, and the welfare cost of taxation. As a result, the optimal size of government (the optimal provision of public goods) and the magnitude of its redistribution (transfer) policies are affected as well. In this context the paper analyzes the effects of relaxing restrictions on the international flow of capital on the fiscal branch of government.

The optimal size of government, or more precisely the optimal provision of public goods, must be determined by an appropriate cost-benefit analysis. Such analysis implies that the marginal cost of public funds must be equated to the marginal utility from public goods. Accordingly, in order to find the effect of liberalization in the international capital markets on the optimal quantity of public goods we study here the effect of such a liberalization on the cost of public funds. This is done in section V in which we also distinguish between constant and variable internal terms of trade associated with nontradables.

In calculating the cost of public funds, one must take into account the optimal response of the structure of taxation (on incomes from all sources) to the liberalization policy because the cost of public funds is derived from a process of a tax optimization. Therefore, we also analyze the effect of liberalization on the structure of taxation. Of course, entangled with the structure of taxation is also the issue of the optimal size of income redistribution. For this reason we also analyze in section VI the effect of international capital market liberalization on the optimal redistribution (transfer) policy of the government.

Finally, integration of capital markets brings up the issue of international tax coordination. It turns out that perfect mobility of capital necessitates some minimal degree of coordination among the tax authorities. This is discussed in section VII.

We present in section II the analytical framework that serves for our analysis. Sections III and IV discuss alternative regimes of international capital mobility. Concluding remarks are included in the final section.

II. The Analytical Framework

Consider a stylized two-period model of a small open economy with one composite good, serving both for (private and public) consumption and for investment. In the first period the economy possesses an initial endowment of the composite good. Individuals can decide how much of their initial endowments to consume in the first period and how much to save. Saving is allocated to either domestic investment or foreign investment. In the second period, output (produced by capital and labor) and income from foreign investment are allocated between private and public consumption. For the sake of simplicity, we assume that the government is active only in the second period. The government employs taxes on labor, taxes on income from domestic investment, and taxes on income from investment abroad in order to finance optimally (taking into account both efficiency and equity considerations) both its (public) consumption and a (uniform lump-sum) subsidy for redistribution purposes.

For simplicity, while still capturing real-world basic features, we assume that government spending on public goods does not affect individual demand patterns for private goods or the supply of labor. That is, only the taxes that are needed to finance these expenditures affect individual demands and supplies, but not the expenditures themselves. Formally, this feature is obtained by assuming that the utility function is weakly separable between private goods and services, on the one hand, and public goods and services, on the other. That is, individual h's utility is:

$$(1) \qquad U^h(C_{1h}, C_{2h}, L_h, G) = u^h(C_{1h}, C_{2h}, L_h) + m^h(G),$$

where u^h and m^h are the private and public components of the utility function, respectively; C_{1h}, C_{2h} and L_h are first-period consumption, second-period consumption and (second-period) labor supply, respectively; and G is (second-period) public consumption.[3]

Denote saving in the form of domestic capital by K_h and saving in the form of foreign capital by B_h. The aggregate saving in the form of domestic capital is equal to the the stock of capital in the second period, since we assume for concreteness, without affecting the results of the paper, that the patterns of capital flows are such that the country is a capital exporter (i.e. $\Sigma_h B_h \geq 0$). Hence, the budget constraints of individual h are:

$$(2) \qquad C_{1h} + K_h + B_h = I_h$$

$$(3) \qquad C_{2h} = K_h[1+r(1-t)] + B_h[1+r^*(1-t')] + (1-\theta)wL + S'$$

where:

t - tax on capital income from domestic sources;

t' - tax on capital income from foreign sources;

θ - tax on labor income;

S' - lump-sum subsidy;

r - domestic rate of interest;

r^* - foreign rate of interest (net of taxes levied abroad);

w - wage rate;

I_h - initial (first-period) endowment.

Obviously, in the absence of (quantity) restrictions on capital flows, individuals must earn the same net return on both forms of investments, that is $r(1-t) = r^*(1-t')$. With restrictions on capital flows the latter equality does not have to hold. In such a case there is an infra-marginal profit on foreign investment, resulting from the net interest differential. (This differential is equal to the capital export tax rate which is equivalent to the quota on capital exports.) One possibility is for this profit to accrue to the individual investors. Another possibilty is for the government to fully tax away this profit. (This is the equivalent capital-export tax version of the capital-export quota.) We adopt the second possibility, namely that the government chooses the level of the tax on income from foreign investments (t') so as to eliminate any infra-marginal profits. This implies that whether or not there are restrictions on foreign investment, the government chooses t' so as to maintain the equality

$r(1-t) = r^*(1-t')$. That is, the rate of tax on income from foreign investment is equal to[4]

$$t' = \frac{r^* - r(1-t)}{r^*}.$$

Under this tax scheme, the individual is indifferent between investing at home (K_h) or abroad (B_h), caring only about the level of total investment $(K_h + B_h)$. Thus, at equilibrium, the size of the aggregate domestic capital is determined by the demand for capital by domestic firms. The latter is determined by the standard equalization of the marginal product of capital to the domestic rate of interest, r.

We can consolidate the two budget constraints into a single (present-value) constraint:

$$(4) \qquad C_{1h} + q_2 C_{2h} = I_h + q_L L_h + S$$

where

$$(5) \qquad q_2 = [1 + (1-t)r]^{-1}$$

is the consumer (after-tax) price of second-period consumption,

$$(6) \qquad q_L = (1-\theta)w[1 + (1-t)r]^{-1}$$

is the consumer price of labor and $S = q_2 S'$ is the present value of the subsidy. Maximization of the utility function u^h, subject to the budget constraint (4), yields the consumption demand functions

$$(7) \qquad C_{ih} = C_{ih}(q_2, q_L; I_h + S) \quad , \quad i = 1,2,$$

the labor supply function

$$(8) \qquad L_h = L_h(q_2, q_L; I_h + S),$$

and the utility obtained from these demand and supply functions, namely, the indirect utility function:

$$(9) \qquad v^h = v^h(q_2, q_L; I^h + S).$$

Domestic output (Y) is produced in the second period by capital and labor, according to a constant-returns-to-scale production function

$$(10) \qquad Y = F(K, L),$$

where $K = \Sigma_h K_h$ is the stock of domestic capital and $L = \Sigma_h L_h$ is the aggregate supply of labor.

The resource constraints of this economy require that

(11a) $\quad I = C_1 + B + K$

and

(11b) $\quad Y + (1 + r^*)B + K = C_2 + G,$

where $I = \Sigma_h I_h$ is aggregate first-period endowment, $B = \Sigma_h B_h$ is aggregate investment abroad, $C_1 = \Sigma_h C_{1h}$ is aggregate consumption in the first period and $C_2 = \Sigma_h C_{2h}$ is aggregate consumption in the second period.

Substituting (2), (7), (8), (10) and the first-period resource constraint (11a) into the second-period resource constraint (11b) yields the equilibrium condition:

$$
\begin{aligned}
(12) \qquad & F(I - C_1(q_2, q_L; I_1 + S, \ldots, I_H + S) - B, \\
& \qquad L(q_2, q_L; I_1 + S, \ldots, I_H + S)) \\
& + (1+r^*)B + (I - C_1(q_2, q_L; I_1 + S, \ldots, I_H + S) - B) \\
& - C_2(q_2, q_L; I_1 + S, \ldots, I_H + S) - G = 0.
\end{aligned}
$$

Observe that aggregate consumptions, C_1 and C_2, depend not only on aggregate income, but also on its distribution.

III. International Capital Flows: Alternative Regimes

We consider two alternative regimes. In the first regime the government sets quantity restrictions on capital exports. In the second regime, there are no restrictions on capital exports and B is thus determined by market clearance.

The optimal tax/transfer policy and provision of public goods are obtained as a solution to the program of maximizing the indirect social welfare function

$$(13)\ W(q_2,\ q_L;\ \ I_1 + S,\ldots,I_H + S) = \Sigma_h\gamma_h v^h(q_2,q_L;I_h+S) + \Sigma_h\gamma_h m^h(G),$$

subject to the resource constraint (12). In this setup, common in the public finance literature, the government does not directly operate on private sector quantities, but rather on prices (through taxes) which affect these quantities. The government tax policy focuses on q_2, q_L and S as the control variables. In the first regime we treat B as a parameter. In the second regime, B is also a control endogenous variable. Notice, however, that this does not mean that the government directly determines the level of investment abroad; rather, the government, through its tax policy, affects total savings (K+B) and domestic investment (K) and B is determined as a residual (the difference between total savings and domestic investment).

Notice that, by Walras Law, the government budget constraint is satisfied. Also, the wage rate (w) and the domestic rate of interest (r) are determined by the standard marginal productivity conditions: $F_1 = r$ and $F_2 = w$. Given q_2 and q_L, we can solve for the tax rates, t and θ, by using (5) and (6).

IV. Efficient Capital Flows

Since there are distortionary taxes as part of the optimal program, obviously the resource allocation is not Pareto-efficient: the intertemporal allocation of consumption, the leisure-consumption choice, and the private-public consumption tradeoffs are all distorted. Nevertheless, the fully optimal program (namely, the second regime where no restrictions on B exist) requires an efficient allocation of capital between investment at home and abroad, so that $F_1 = r^*$. That is, the marginal product of domestic capital must be equated to the foreign rate of return on capital (net of foreign taxes).

To see this, observe that the endogenous variable B does not appear in the objective function (13), so that the first-order conditions for optimality require that the derivative of the resource constraint (12) with respect to B, i.e. $-F_1 + (1+r^*)-1$, be equal to zero. Hence, $F_1 = r^*$. Evidently, this is an open economy variant of the aggregate efficiency theorem in optimal tax theory (see Diamond and Mirrlees (1971), Sadka (1977), and Dixit (1985)).

Notice also that this production-efficiency result implies also that there should be no differential tax treatment of foreign and domestic sources of income, namely:

$$t = t'.$$

However, in the presence of restrictions on capital exports the production efficiency result does not necessarily hold: the return to capital at home may be lower than the net (after foreign taxes only) return on investment abroad.

We turn next to the study of the effects of relaxing the restrictions on investments abroad.

V. The Cost of Public Funds in an Open Economy

In the presence of distortionary taxes, the social cost of an additional dollar raised by taxes (namely the marginal cost of public funds) may exceed one dollar, due to the existence of excess-burden (deadweight loss) of taxation. The optimal provision of public goods is determined by equating their marginal benefit with the marginal cost of public funds. In this section we directly examine the effect of relaxing the restrictions on B on the optimal level of G. Since we have assumed that the marginal benefit from G is diminishing (a concave m), it follows that the optimal G increases if and only if the marginal cost of public funds declines. Thus, we indirectly analyze the effect of a liberalization of the international capital markets on the marginal cost of public funds.

For this purpose, we treat B as a parameter and examine the effect of changing B on the optimal quantity of the public good. Specifically, the optimal level of the public good is a function of B, denoted by $\bar{G}(B)$. We then look for the sign of $d\bar{G}/dB$ in the region where $F_1 = r < r^*$, so that increasing B enhances production efficiency and, thus, social welfare.

We proceed as follows. For given levels of G and B, let us maximize the private component of W in (13), (namely, $\Sigma_h \gamma_h v_h(q_2, q_L; I_h + S)$) subject to the resource constraint (12). Denote the value of the maximand by $N(B, G)$. Then, for a given B, the optimal G is determined by solving

(14) $$\max_{G}\{N(B,G) + M(G)\},$$

where $M(G) = \Sigma_h \gamma_h m^h(G)$.

The first-order condition is

(15) $$N_2 + M' = 0$$

and the second-order condition is

(16) $$N_{22} + M'' \leq 0.$$

Totally differentiating (15) with respect to B yields

(17) $$\frac{d\bar{G}}{dB} = \frac{N_{12}}{-(N_{22} + M'')}.$$

By (16), the denominator in (17) is positive. Hence,

$$(18) \qquad \mathrm{Sign}(\frac{d\tilde{G}}{dB}) = \mathrm{Sign}(N_{12}).$$

To proceed further, at this point, we first abstract from redistribution considerations.

1. **Efficiency Considerations**

Suppose that all individuals are alike so that we may consider a single representative individual and drop the index h. (Alternatively, we may assume that redistribution can be done via nondistortionary means.) Alleviating the constraint on foreign lending affects the optimal size of government through two channels. First, increasing B generates an additional source of revenues for the government, thereby allowing lower taxes on existing sources. This tends to lower the marginal cost of public funds (and raise the size of government). Second, increasing B may adversely affect the internal terms of trade (associated with nontradable factors or goods) for government expenditures. This effect can raise the marginal cost of public funds (and lower the size of government). To highlight these two effects we consider first in the next subsection the pure income effect.

a. **Constant internal terms of trade**

Assume a linear production function, yielding constant real factor prices: $\bar{r}$ $(\leq r^*)$ and $\bar{w}$, for capital and labor, respectively. In this case we can unambiguously show that $N_{12} > 0$ and consequently, that $d\tilde{G}/dB > 0$.

The function $N(B,G)$ is defined in this case by:

$$(19) \qquad N(B,G) = \max_{(q_2, q_L, S)} v(q_2, q_L; I + S))$$

$$\text{s.t.:} \quad \bar{r}[I - C_1(q_2, q_L; I + S) - B] + \bar{w} L(q_2, q_L; I+S) + (I - C_1(q_2, q_L; I + S) - B) + (1+r^*)B - C_2(q_2, q_L; I + S) - G = 0.$$

Hence, by the envelope theorem, we obtain

$$(20) \qquad N_2(B,G) = -\lambda(B,G) \le 0,$$

where $\lambda(B,G) \ge 0$ is the Lagrange multiplier associated with the constraint in (19).

From (20):

$$(21) \qquad N_{21}(B,G) = -\lambda_1(B,G).$$

Similarly, equation (19) (using the envelope theorem) yields

$$(22) \qquad N_1(B,G) = \lambda(B,G)\ (r^* - \bar{r}) \ge 0.$$

Therefore:

$$(23) \qquad N_{11}(B,G) = \lambda_1(B,G)(r^* - \bar{r}).$$

One can show (see Appendix A) that $N(\cdot,\cdot)$ is concave. Hence, $N_{11} < 0$, and it follows from (23) that $\lambda_1 < 0$. Thus, (21) implies that $N_{21} > 0$. Therefore, $d\bar{G}/dB > 0$. That is, the relaxation of international capital controls, in the absence of adjustment in the internal terms of trade, lowers the marginal cost of public funds and increases the optimal size of government.

b. **Variable internal terms of trade**

To analyze the effect of variable internal terms of trade on government's expenditures in a simple manner, we assume that labor, the nontradable factor of production, exhibits diminishing marginal productivity and that government's expenditures are used entirely to hire labor. Specifically, we continue to assume constant internal intertemporal terms of trade, that is, r is constant (at the level $\bar{r}$). However, in the second period consumption can be provided in that period (in addition to being transferred from the first period) by a concave production function, $f(L)$, using labor alone. The rent (pure profit) generated by such a technology is assumed to be fully taxed by the government. The government hires L_G units of labor in the second period at the prevailing wage, $w = f'$; the government does not purchase any quantity of the consumption good. We thus replace G by L_G.

In this case, the function $N(B, L_G)$ is defined by:

$$
\begin{aligned}
(19a) \qquad & N(B, L_G) = \max_{\{q_2, q_L, S\}} v(q_2, q_L; I + S) \\
& \text{s.t.:}\ \bar{r}[I - C_1(q_2, q_L; I + S) - B] + f[L(q_2, L_L; I+S) - L_G] \\
& + I - C_1(q_2, q_L; I + S) - B + (1 + \bar{r})B \\
& - C_2(q_2, q_L; I + S) = 0.
\end{aligned}
$$

Following the same procedure as in the preceding subsection, we conclude that

$$
\begin{aligned}
(21a) \qquad N_{21}(B, L_G) = & - \lambda_1(B, L_G)w \\
& - \lambda(B, L_G) \frac{dw}{dB}.
\end{aligned}
$$

The first term in the expression for N_{21} is similar to (21). As before, it is straightforward to show that $\lambda_1 < 0$, so that this term contributes toward making N_{21} positive, i.e., to increase the size of government in response to alleviating controls on foreign lending (see equation (17)). However, the second term will usually work in the opposite direction: the pure income effect of raising B tends to increase the consumtion of leisure, thereby increasing the cost of labor that the government hires. Thus, the optimal L_G (namely, the real magnitude of government's consumption) may at the end decline in response to a liberalization of the international capital market.

2. Redistribution Considerations

Now, let us return to the framework of sub-section (1a) and reintroduce the redistribution motive.

To simplify the exposition, suppose that the economy consists of two individuals (or two classes of individuals), denoted by indices A and B. We further simplify the analysis by assuming a fixed labor supply (and dropping it altogether from the model). Thus, we are left only with intertemporal decisions and tax-induced intertemporal distortions. Still, to proceed further, we employ a log-linear utility function, in order to keep the analysis tractable.

To emphasize the equity issues, we consider the extreme case of a max-min social welfare criterion, that is, we assume for the social welfare function in (13) that $\gamma_B = 0$ and $\gamma_A = 1$ (where $I_A < I_B$). The function N, the maximized value of the private component in the social welfare function W, is defined in this case by:

$$(24)\ N(B,G) = \underset{t,S}{\mathrm{Max}}\{\alpha \log[\alpha(I_A + S)] + (1-\alpha)\log[(1-\alpha)(I_A+S)(1+\bar{r}(1-t))]\}$$
$$\text{s.t.:}\quad (1+\bar{r})[(I_A + I_B)(1-\alpha) - 2\alpha S]$$
$$- (1-\alpha)[1 + \bar{r}(1-t)](I_A + I_B + 2S)$$
$$+ (r^* - \bar{r})\, B - G = 0,$$

where the log-linear individual utility function is given by

(25) $$u(C_1, C_2) = \alpha \log C_1 + (1-\alpha)\log C_2.$$

Employing the constraint to eliminate S, we can reduce (24) to:

(26) $$\begin{aligned} N(B,G) = \max_t \bigl(&\log[2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B - I_A) \\ &+ (r^* - \bar{r})B - G] \\ &- \log[1 + \bar{r}(1 - (1-\alpha)t)] \\ &+ (1-\alpha)\log[1+\bar{r}(1-t)] + \text{constant}\bigr) \\ = \max_t\ &H(t,B,G). \end{aligned}$$

The first-order condition for t is

(27) $$H_1(t, B, G) = 0,$$

while the second-order condition is

(28) $$H_{11}(t, B, G) \leq 0.$$

By the envelope theorem:

$$N_1(B,G) = H_2(t, B, G)$$

and hence:

$$(29) \qquad N_{12} = H_{21} \frac{\partial t}{\partial G} + H_{23}.$$

Total differentiation of (27) with respect to B yields:

$$(30) \qquad \frac{\partial t}{\partial G} = - \frac{H_{13}}{H_{11}}.$$

Hence, from (29) and (30) we obtain the expression for N_{12} as follows.

$$(31) \qquad N_{12} = \frac{H_{12}H_{13} - H_{23}H_{11}}{- H_{11}}.$$

Since $H_{11} < 0$ (by 28), it follows that

$$(32) \qquad \mathrm{Sign}(N_{12}) = \mathrm{Sign}(H_{12}\, H_{13} - H_{23}\, H_{11}).$$

Using the definition of H (namely, equation (26)) to find the partial derivatives H_{ij} we substitute these derivatives into (32). This substitution yields

$$(33) \qquad \mathrm{Sign}(H_{12}\, H_{13} - H_{23}\, H_{11}) = \mathrm{Sign}\left(\frac{1}{[1+\bar{r}(1-t)]^2} - \frac{(1-\alpha)}{[1+\bar{r}(1-(1-\alpha)t)]^2}\right)$$

(see Appendix B).

Since $0 < 1 - \alpha < 1$, it follows that (33) is positive and hence $d\bar{G}/dB > 0$.[5]

VI. Tax Structure and Redistribution in an Open Economy

In this section we examine the effects of relaxing some of the controls on international capital flows on the structure of taxation and the size of redistribution. We continue to adopt the simplified framework of subsection V.2. Assume further that public component in the utility function $m^A(G)$ is equal to $\delta \log G$. In this case, the optimal policy is the solution to the following problem:

$$\text{(34)} \qquad \max_{(t,G)} \{H(t, B, G) + \delta \log G\},$$

where $H(\cdot)$ is defined in (26).

As before, B is a parameter and we consider the relationships between this parameter and the optimal values of t and G (denoted by $\bar{t}(B)$ and $\bar{G}(B)$, respectively). In doing so, we find also the effect of changing B on t' and S, as will be shown later.

The first-order conditions are:

$$\text{(35)} \qquad H_1(t, B, G) = 0,$$

$$\text{(36)} \qquad H_3(t, B, G) + \frac{\delta}{G} = 0.$$

Total differentiation of (35)-(36) with respect to B yields:

$$\frac{d\bar{t}}{dB} = \frac{1}{\Delta}(-H_{12}H_{33} + H_{13}H_{23} + H_{12}\delta/G^2), \tag{37}$$

where Δ is positive by the second-order conditions for the solution to (34).[6] In Appendix B we show that

$$-H_{12}\ H_{33} + H_{13}\ H_{23} = 0 \tag{38}$$

and

$$H_{12} < 0. \tag{39}$$

Hence, $d\bar{t}/dB < 0$.

Thus, relaxing the controls on investments abroad reduces the optimal rate of tax on income from domestic investment. This is a natural result in view of the fact that relaxing the controls improves welfare. Since $t' = [r^* - (1 - t)\bar{r}]/r^*$, it follows that t' should be lowered too. That is, the optimal response to relaxing the restrictions on investments abroad is to lower the tax on income from such investments.

To find $d\bar{S}/dB$, recall that the constraint in (24) was employed in order to solve for S in terms of t, B and G:

$$S = \frac{\bar{r}t(1-\alpha)(I_A+I_B) + (r^*-\bar{r})B - G}{2\{1+\bar{r}[1-(1-\alpha)t]\}}. \tag{40}$$

We have already concluded that an increase in B raises G and lowers t. These changes have conflicting effects on S, as can be seen from (40). We employed numerical calculations to demonstrate the effect of raising B on the optimal S. These calculations suggest that raising B increases the size of the demogrant S. Again, this result is natural in view of the fact that relaxing the restrictions on international capital flows improves the efficiency of total investment, thereby enabling the economy to devote more resources for redistribution of income.

The results of the numerical calculations are given in Table 1.

TABLE 1: The Effect of Capital Controls on the Optimal Supply of the Public Good (G), on the Tax Rates (t and t') and on the Demogrant (S)

B	G	t	t'	S
0	0.191	1.399*	1.266*	0.381
0.25	0.193	1.391*	1.261*	0.402

parameter values:

$\alpha = 0.6$, $\delta = 0.05$, $\bar{r} = 0.50$, $r^* = 0.75$, $I_A = 1.0$, $I_B = 3.0$, $W = U^A = \alpha \log C_1^A + (1-\alpha) \log C_2^A + \delta \log G$.

* Note that physical investment and foreign lending are the only forms of transferring resources from the present to the future. Hence, t and t' may well exceed one, as long as $1 + (1-t)\bar{r}$ and $1 + (1-t')r^*$ are still positive.

VII. Capital Mobility and International Tax Coordination

Capital market integration between two large countries brings out the issue of tax coordination between them. When residents of one country invest in the other country, one must reckon with the possibility of tax arbitrage that may undermine the feasibility of integration. It is quite obvious that some coordination between countries may in general improve the welfare of both countries. In the case of tax coordination, however, we show that coordination is essential for a sensible world equilibrium (with nonzero interest rates) to at all exit.

To highlight this issue, consider a two-country world with perfect capital mobility. Denote the interest rates in the home country and the foreign country by r and r^*, respectively. In principle, the home country may have three different tax rates applying to interest income:

(i) t_{RD} - the tax rate levied on domestic residents on their domestic-source income;

(ii) t_{RF} - the tax rate levied on domestic resident on their foreign-source income

(iii) t_{NRD} - the tax rate levied on non-residents on their interest income in the home country.

The foreign country may correspondingly have three tax rates which we denote by t^*_{RD}, t^*_{RF} and t^*_{NRD}. Furthermore, let us assume that these rates apply symmetrically for both interest earned and interest paid (i.e., full deductibility of interest expenses, including tax rebates).

A complete integration of the capital markets between the two countries (including the possibility of borrowing in one country in order to invest in the other country) requires, due to arbitrage possiblities, the fulfillment of the following conditions:

$$(41) \qquad r(1 - t_{RD}) = r^{*}(1 - t^{*}_{NRD})(1 - t_{RF})$$

and

$$(42) \qquad r(1 - t_{NRD})(1 - t^{*}_{RF}) = r^{*}(1-t^{*}_{RD}).$$

The first condition applies to the residents of the home country and it requires that they be indifferent between investing at home or abroad. Otherwise, they can borrow an infinite amount in the low (net of tax) interest rate country in order to invest an infinite amount in the high (net of tax) interest rate country. The second condition similarly applies to the residents of the foreign country.

Notice that unless

$$(43) \qquad (1-t_{RD})(1 - t^{*}_{RD}) = (1 - t_{NRD})(1 - t^{*}_{RF})(1 - t^{*}_{NRD})(1 - t_{RF}),$$

the only solution to the linear system of equations (41)-(42) is a zero rate of interest in each country:

$$r = r^{*} = 0.$$

Thus, some international tax coordination is needed in order to satisfy (43) and yield a sensible world equilibrium.

Somewhat surprisingly, the two most common polar schemes of source-based or origin-based taxation are examples of workable tax coordinations (although, by no means globally efficient arrangements) even when the two countries do not adopt the same scheme. Consider first the case in which both countries adopt the source-based tax scheme. In this case income is taxed according to its source, regardless of the origin of the taxpayer. This implies that

$$(44) \qquad t_{RD} = t_{NRD}, \quad t^*_{RD} = t^*_{NRD}, \quad t_{RF} = t^*_{RF} = 0,$$

so that (43) is satisfied and we can have a world equilibrium with positive rates of interest.

Similarly, consider the case where both countries adopt the origin-based tax scheme: income is taxed according to the origin of the taxpayer, regardless of its source. This implies that

$$(45) \qquad t_{RD} = t_{RF}, \quad t^*_{RD} = t^*_{RF}, \quad t_{NRD} = t^*_{NRD} = 0,$$

so that, again, (43) is satisfied.

Next, consider the case in which one country adopts one tax scheme while the other adopts another one. Suppose, for instance, that the home country adopts the origin-based tax scheme, while the foreign county adopts the source-based tax scheme. In this case we have

$$t_{RD} = t_{RF}, \quad t_{NRD} = 0, \tag{46}$$
$$t^*_{RD} = t^*_{NRD}, \quad t^*_{RF} = 0,$$

and, again, (43) is satisfied.

However, if the two countries do not stick to one or the other of the two polar schemes, then (43) need not hold in and no sensible world equilibrium exists. Suppose, for instance, that each country levies the same tax rate on its residents (irrespective of the source of their income) and also all non-residents investing in that country. In this case, we have

$$t_{RD} = t_{RF} = t_{NRD}, \quad t^*_{RD} = t^*_{RF} = t^*_{NRD}. \tag{47}$$

Hence, unless $(1-t_{NRD})(1 - t^*_{NRD}) = 1$, which is just a sheer coincidence, condition (43) is violated.

Thus, some tax coordination is essential for a full capital market integration. Any mutually beneficial tax coordination must satisfy the tax arbitrage condition (43).

VIII. Conclusion

We analyzed in this paper the policy implications of the integration of the international capital markets. Special attention was paid to the effects on the marginal cost of public funds, a crucial factor in the determination of the optimal size of government and the magnitude of income redistribution. Inherent in the determination of the cost of public funds is the design of the structure of taxation (on labor income, domestic-source capital income and foreign-source capital income).

In the context of a world economy with integrated capital markets, there arises the issue of international tax coordination. This issue has two aspects. First, the elementary problem of what international tax arrangements are at all viable in the wake of capital market arbitrage possiblities. This issue was dealt with in this paper. A second, yet to be investigated, aspect is the determination of mutually beneficial international tax arrangements from the set of viable arrangements.

APPENDIX A

In this appendix we prove that $N(B, G)$ is concave. Recall that $N(B, G)$ is defined by (19). Since there is only one individual and a lump-sum tax/subsidy is allowed, it follows that the government can choose any bundle (C_1, C_2, L) which is feasible (i.e., which satisfies the resource constraint in (19)). Thus, N may be equivalently defined by

$$\text{(A1)} \qquad N(B, G) = \max_{C_1, C_2, L} u(C_1, C_2, L)$$
$$\text{s.t.: } \bar{r}(I - C_1 - B) + \bar{\omega}L + I - C_1 + r^*B - C_2 - G \geq 0.$$

We have to show that

$$N(aB' + (1-a)B'', aG' + (1-a)G'')$$
$$\geq aN(B', G') + (1-a)N(B'', G'')$$

for all (B', G'), (B'', G'') and $0 \leq a \leq 1$.

Suppose the bundle (C_1', C_2', L') is a solution to (A1) for $(B,G) = (B', G')$ and the bundle (C_1'', C_2'', L'') is a solution to (A1) for $(B, G) = (B'', G'')$, namely: $N(B', G') = u(C_1', C_2', L')$ and $N(B'', G'') = u(C_1'', C_2'', L'')$.

By being solutions to optimum problems, the bundles (C_1', C_2', L') and (C_1'', C_2'', L'') satisfy the constraint in (A1), namely:

(A2) $$\tilde{r}(I-C_1'-B') + \tilde{w}L' + I-C_1' + r^*B' - C_2' - G' \geq 0$$

and

(A3) $$\tilde{r}(I-C_1''-B'') + \tilde{w}L'' + I-C_1'' + r^*B'' - C_2'' - G'' \geq 0.$$

Hence, upon multiplying (A2) by the factor a and (A3) by the factor (1-a) and adding them together, it follows that:

(A4) $$\begin{aligned}&\tilde{r}(I - [aC_1' + (1-a)C_1''] - [aB' + (1-a)B''])\\ &+ \tilde{\omega}[aL' + (1-a)L''] + I - [aC_1' + (1-a)C_1'']\\ &+ r^*[aB' + (1-a)B''] - [aC_2' + (1-a)C_2'']\\ &-[aG' + (1-a)G''] \geq 0.\end{aligned}$$

Thus, the bundle $(aC_1' + (1-a)C_1'',\ aC_2' + (1-a)C_2'',\ aL' + (1-a)L'')$ is feasible for $(B, G) = (aB' + (1-a)B'',\ aG' + (1-a)G'')$. Therefore:

(A5) $$\begin{aligned}&N(aB' + (1-a)B'', aG' + (1-a)G'') \geq\\ &u(aC_1' + (1-a)C_1'', aC_2' + (1-a)C_2'', aL' + (1-a)L'')\\ &\geq au(C_1', C_2', L') + (1-a)u(C_1'', C_2'', L'')\\ &= aN(B', G') + (1-a)N(B'', G''),\end{aligned}$$

where the first inequality in (A5) follows from the definition of $N(\cdot,\cdot)$ as the value of the maximand in (A1), and the second inequality follows from the concavity of u. This completes the proof of the concavity of N.

APPENDIX B

In this appendix we verify the expressions of (33) and (38)-(39).

The function H (see (26)) is given by:

$$(B1)\qquad H(t,\, B,\, G) = \log[2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B - I_A) + (r^*-\bar{r})B - G] - \log(1+\bar{r}[1-(1-\alpha)t]) + (1-\alpha)\log[1+\bar{r}(1-t)].$$

The first-order derivatives are:

$$(B2)\quad H_1 = [2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B-I_A) + (r^*-\bar{r})B - G](1-\alpha)\bar{r}(I_B-I_A) + (1 + \bar{r}[1-(1-\alpha)t])^{-1}\bar{r}(1-\alpha) - \bar{r}(1-\alpha)[1+\bar{r}(1-t)]^{-1},$$

$$(B3)\qquad H_2 = [2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B-I_A) + (r^*-\bar{r})B - G]^{-1}(r^*-\bar{r})$$

and

$$(B4)\qquad H_3 = -\frac{H_2}{r^*-\bar{r}}.$$

The second-order derivatives are:

$$(B5)\quad H_{11} = -(1-\alpha)^2\bar{r}^2(I_B-I_A)^2[2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B-I_A) + (r^*-\bar{r})B - G]^{-2} + \bar{r}^2(1-\alpha)^2(1+\bar{r}[1-(1-\alpha)t])^{-2} - \bar{r}^2(1-\alpha)[1+\bar{r}(1-t)]^{-2},$$

(B6) $$H_{12} = -(r^* - \bar{r})[2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B - I_A) + (r^* - \bar{r})B - G]^{-2} \cdot$$
$$\cdot (1-\alpha)\bar{r}(I_B - I_A),$$

(B7) $$H_{13} = \frac{-H_{12}}{r^* - \bar{r}},$$

(B8) $$H_{22} = \frac{H_{12}(r^* - \bar{r})}{(1-\alpha)\bar{r}(I_B - I_A)},$$

(B9) $$H_{23} = \frac{-H_{12}}{(1-\alpha)\bar{r}(I_B - I_A)},$$

and

(B10) $$H_{33} = \frac{H_{12}}{(r^* - \bar{r})(1-\alpha)\bar{r}(I_B - I_B)}.$$

Hence,

$$H_{12} H_{13} - H_{11} H_{33} =$$

$$= \left(\frac{1}{[1+\bar{r}(1-t)]^2} - \frac{(1-\alpha)}{[1+\bar{r}(1-(1-\alpha)t)]^2}\right)(r^* - \bar{r})\bar{r}^2(1-\alpha) \cdot$$

$$\cdot \frac{1}{[2I_A(1+\bar{r}) + t(1-\alpha)\bar{r}(I_B - I_A) + (r^* - \bar{r})B - G]^2}.$$

This completes the proof of(33).

Next, we prove (38) and (39).

Employing (B6), (B7), (B9) and (B10) we find that

$$-H_{12}\, H_{33} + H_{13}\, H_{23} = \frac{-(H_{12})^2}{(r^* - \bar{r})(1-\alpha)\bar{r}(I_B - I_A)} + \frac{(H_{12})^2}{(r^* - \bar{r})(1-\alpha)\bar{r}(I_B - I_A)} = 0$$

which proves (38). From (B6), we observe that $H_{12} < 0$, which proves (39).

FOOTNOTES

1 In a recent paper Micossi (1988) provides a succint survey of the proposed institutional arrangements for the 1992 Europoean integration. He writes:

"The European integration entails the elimination of restrictions and discriminatory regulations and administrative practices concerning: (i) the right of establishment and acquisition of participations by foreign institutions in domestic financial markets; (ii) permitted operations of foreign-controlled financial institutions; (iii) cross-border transactions in financial services. The first two items basically involve the freedom to supply services in EC national markets, the third, the freedom to move capital throughout the Community."

2 For an earlier discussion of the interaction among taxes, government consumption, and international capital flow, see Razin and Svensson (1983).

3 To ensure diminishing marginal rates of substitution between private and public commodities we assume, as usual, that u^h and m^h are strictly concave.

4 An equivalent policy to taxing away the infra-marginal profits (resulting from the net interest differential) is to auction off the quotas on investment abroad.

5 The reader who is familiar with the optimal income tax literature may realize that the issue of the sign of $d\bar{G}/dB$ is related to the issue of the concavity of the maximized (reduced-form) social welfare function with respect to tax revenues; see Balcer and Sadka (1982) and Stiglitz (1982).

6 The derivative $d\bar{G}/dB$ is negative as shown in section V.2.

REFERENCES

Yves Balcer and Efraim Sadka, "Horizontal Equity, Income Taxation and Self-Selection with an Application to Income Tax Credits," **Journal of Public Economics**, 19, 1982, 291-309.

Peter A.Diamond and James A.Mirrlees, "Optimal Taxation and Public Production," **American Economic Review**, March and June, 1971, 8-27 and 261-278.

Avinash Dixit, "Tax Policy in Open Economies," in: Alan Auerbach and Martin Feldstein (eds.), **Handbook on Public Economics**, Chapter 6, pp.314-374., North Holland, 1985.

Stefano Micossi, "The Single European Market: Finance," **Banca Nazionale del Lavoro Quarterly Review**, No.165, June, 1988, pp.217-235.

Assaf Razin and Lars E.O.Svensson, "The Current Account and the Optimal Government Debt," **Journal of International Money and Finance**, 2 (2), August 83, 215-224.

Efraim Sadka, "A Note on Producer Taxation and Public Production," **Review of Economic Studies**, 44 (2), June 1977, 385-387.

Joseph E.Stiglitz, "Utilitarianism and Horizontal Equity: The Case for Random Taxation," **Journal of Public Economics**, 18, 1982, 1-33.

</ref_section>