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Optimal Incentives to Domestic Investment in the Presence of Capital Flight

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Abstract

This paper develops a model of an open economy which employs distortionary taxes to finance public consumption, and with an access to the world capital market. The paper examines the efficiency of quantity restrictions on capital exports and the accompanying set of taxes. A distinction is made between a benchmark case where the government can fully tax foreign-source income and a more realistic case where the government cannot effectively tax foreign-source income.

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Contents

Summary

This paper examines the efficiency of quantity restrictions on capital exports. When a government can effectively tax foreign-source income, then it is not efficient to impose restrictions on capital exports and the optimal tax rates on foreign-source and domestic-source income are the same. Such a policy equates the marginal productivity of domestic capital and the world rate of interest, ensuring an efficient allocation of domestic savings between foreign and domestic investment.

However, when a government cannot effectively tax foreign-source income, as is often the case, it is not efficient to allow free capital exports. If no restrictions on capital exports apply, then rate-of-return arbitrage must equate the after-tax rate of return on domestic capital and the world rate of interest. Such an equalization implies that the before-tax rate of return on domestic capital will exceed the world rate of interest. Thus, free exports of capital will result in underinvestment at home and overinvestment abroad. A socially efficient policy ensures that capital exports do not go beyond the point where the marginal productivity of domestic capital falls below the world rate of interest. At this point, the stock of domestic capital induced by the efficient policy exceeds the stock that would be optimal if the government could fully tax foreign-source income. If the government could partially tax foreign-source income, the restrictive policy could become less severe.

If neither a tax on foreign-source income nor a quota on capital exports can be effectively imposed, the paper indicates, it is efficient either to subsidize domestic capital income or to tax this income at reduced rates.

Clearly, it is preferable for governments effectively to tax foreign-source income, and thus avoid resorting to quantity restrictions on capital exports. This may explain why the European Community, which is moving toward establishment of a single capital market in 1992, is searching for ways to enforce taxation of foreign-source income, and thus eliminate incentives to locate capital abroad.

I. Introduction

The fundamental result of the theory of second-best suggests that adding distortions to already existing ones may very well enhance efficiency and welfare. To put it differently, reducing the number of distortions in the economy may well lower well-being. Thus, even though there are in general gains from international trade, some restrictions on free trade may be called for in a distortion-ridden economy. Nevertheless, in a recent paper (Razin and Sadka (1989)), we showed that opening-up an economy to international capital movements enhances efficiency and welfare, even in the presence of distortionary taxes (taxes which affect margins of substitution between labor and leisure, between consumption and savings, etc.), provided these taxes are designed optimally. 1/ The setup employed in that analysis assumed that the government can tax residents on their income from abroad.

However, there is now substantial evidence that governments encounter severe enforcement difficulties in attempting to tax foreign-source income. Dooley (1987) estimates that in the 1980-82 time period as much as $250 billion may be classified as capital flight by U.S. residents. Tanzi (1987) reports that tax experts were concerned that lowering the U.S. individual and corporate tax rates in the U.S. Tax Reform Act of 1986 would induce capital drain from other countries by providing a tax advantage to investments in the U.S.. These concerns are based on an implicit assumption that the governments of these countries cannot effectively tax their residents on their U.S. income so as to wipe out the U.S. tax advantage. The issue of capital flight is even more relevant for developing countries. Cumby and Levich (1987) estimate that a significant portion of the external debt in developing countries is channelled into investments abroad through overinvoicing of imports and underinvoicing of exports. Dooley (1988) estimates that capital flight from a large number of developing countries amounts to about one-third of their external debt in the time period 1977-1984.

The purpose of this paper is to examine the efficiency (from a social viewpoint) of free international capital movements in the presence of severe difficulties of taxing foreign-source income due to capital flight. Specifically, we investigate the appropriateness of controls on capital exports or imports. The paper is organized as follows. Section II presents a stylized model of an open economy which is integrated in the world capital market and uses an optimal set of taxes to finance public consumption. Section III analyzes a benchmark case where

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1/ The reader who is familiar with the optimal-tax literature will no doubt recognize that this result is consistent with the aggregate production-efficiency proposition in a closed economy (see, for instance, Diamond and Mirrlees (1971) and Sadka (1977)).

income from abroad can be fully taxed. The central section of the paper, Section IV, examines the case where governments cannot effectively tax foreign-source income. A special attention is paid to the design of optimal incentives for investment at home and to the design of efficient restrictions on capital exports. Section V concludes the paper. In order to facilitate the exposition in the text, we relegate technical derivations of the main propositions to the appendices.

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 good and individuals can decide how much of it to consume and how much of it to save. Savings are allocated either to investment at home or to investment abroad. In the second period, output (produced by capital and labor) and income from foreign investment are allocated between private and public consumption. To finance optimally its (public) consumption the government employs taxes on labor, taxes on income from investment at home, and taxes on income from investment abroad. For the sake of simplicity, we assume that the government spending takes place only in the second period.

In practice, governments encounter severe enforcement difficulties in attempting to impose taxes on foreign-source income. For instance, many foreign experts worried that lowering the individual and corporate tax rates in the U.S. Tax Reform Act of 1986 would induce a "capital drain" from other countries since it would increase the net return to capital in the U.S.. They implicitly assume that governments cannot effectively tax capital invested abroad and thus cannot reduce the net return on that capital to the level of the domestic rate of return (see Tanzi (1987)). Dooley (1988) estimated that a significant fraction of external claims and of external liabilities in various developing countries is unaccounted for due to capital flight. 1/ Therefore, after briefly analyzing the case where foreign-source income is fully taxable, we concentrate on the more realistic case where such income is effectively taxed only partially.

We consider a representative individual with a utility function of the form

$$(1) \qquad U(c_1, c_2, L, G) = u^p(c_1, c_2, L) + u^g(G),$$

where u^p and u^g are the private and public components of the utility function, respectively; c_1, c_2, and L are first-period consumption,

1/ See also Dooley (1987), Cumby and Levich (1987) and Giovannini (1989).

second-period consumption, and second period labor supply, respectively; and G is second-period public consumption. 1/

Denote saving in the form of domestic capital by K and saving in the form of foreign capital by B. Since the focus of our analysis is on the case where income from capital invested abroad cannot be fully taxed, we assume that the pattern of capital flows is such that the country is a capital exporter (i.e., $B \geq 0$). Hence, the amount of saving channeled through domestic investment constitutes also the domestic stock of capital in the second period. Evidently, in such a two-period model the returns on investment abroad are fully repatriated and no new investments (at home and abroad) take place in the second (and last) period.

The private-sector budget constraints in the first and second periods are given, respectively, by:

$$c_1 + K + B = \bar{I} \qquad (2)$$

$$c_2 = K\,[1+r(1-t_D)] + B\,[1+r^*(1-t_F)] + (1-t_w)wL, \qquad (3)$$

where:

t_D - tax on capital income from domestic sources;

t_F - tax on capital income from foreign sources;

t_w - tax on labor income;

r - domestic rate of interest;

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

w - wage rate;

and

$\bar{I}$ - Initial endowment.

Obviously, in the absence of quantity restrictions on capital flows, the private sector must earn the same rate of return on domestic investment and on investment abroad; that is:

1/ To ensure diminishing marginal rates of substitution between private and public commodities we assume, as usual, that u^p and u^g are strictly concave. Notice also that the separability between private and public commodities embodied in equation (1) ensures that government spending on public goods does not affect individual demand patterns for private goods or the supply of labor.

(4) $r(1-t_D) = r^*(1-t_F)$.

When quantity restrictions are imposed on investment abroad, the arbitrage condition (4) becomes:

(4a) $r(1-t_D) < r^*(1-t_F)$.

As is common, we consolidate the periodic budget constraints in equations (2) and (3) into a single (present value) budget constraint:

(5) $c_1 + qc_2 = I + B((1 + r^*(1-t_F))q - 1)$,

where

(6) $q = (1 + (1 - t_D)r)^{-1}$

is the consumer (i.e., after-tax) price of second-period consumption in present values. In order to highlight the issues associated with capital-income taxation (i.e., saving and investment incentives and government tax revenues), we abstract from issues pertaining to variable-labor supply and assume that the labor supply is inelastic. Accordingly, after-tax labor income is added to the initial endowment and their sum is denoted by I in equation (5). 1/

The second term on the right-hand side of equation (5), (namely $B((1 + (1 - t_F)r^*)q - 1))$ plays a crucial role in the analysis. In case there are no restrictions on capital exports, the arbitrage condition (4) must hold, and this term vanishes. Otherwise (when capital exports are restricted) condition (4a) applies and this term becomes positive, representing inframarginal gains to the savings of the private sector that are channeled to investment abroad.

A maximization of the utility function U, subject to the budget constraint in equation (5) yields the consumption demand functions:

(7) $c_i = c_i(q, I + B((1 + (1-t_F)r^*)q - 1)), \ i = 1,2$.

The utility obtained from these demand functions (the indirect utility function) is:

(8) $V = v(q, I + B((1 + (1-t_F)r^*)q - 1)) + u^g(G)$.

1/ It is straightforward to show that efficiency considerations usually require to tax the inelastic labor income first before moving on to taxing capital income. We assume that the size of government is large enough so that the tax on labor income does not suffice to finance government consumption and thus a distortionary tax on capital income is also needed. Formally, we conclude that $I = \overline{I}$.

Domestic output (Y) is produced in the second period by capital and labor, according to a production function which exhibits diminishing marginal products. Suppressing the fixed labor input, we write the production function as:

$$(9) \qquad Y = F(K) \quad .$$

The firm's demand for capital is determined by the marginal productivity condition:

$$(10) \qquad F'(K) = r \quad .$$

Equilibrium in the first period requires that the demand for domestic capital (i.e., K) is equal to the supply of domestic capital (i.e., $I - c_1 - B$):

$$(11) \qquad K = I - c_1 - B \quad .$$

Similarly, equilibrium in the second period requires the equalization of (private and public) demand for and supply of consumption goods 1/:

$$(12) \qquad c_2 + G = F(K) + K + (1 + r^*)B \quad .$$

Substituting equation (11) into equation (12) yields the single (consolidated) equilibrium condition: 2/

$$(13) \qquad c_2 + G - F(I - c_1 - B) - (I - c_1 - B) - (1 + r^*)B = 0 \quad .$$

As mentioned before, we employ the analytical framework to examine two distinct regimes. The first regime, which we may term the optimum, entails no constraints on the taxation of foreign-source income. This regime is considered as a benchmark case. In the second, more realistic regime, which we may term the suboptimum, foreign-source income cannot be taxed as effectively as domestic-source income. To highlight the distinction between the regimes we simply assume that in the second regime no tax can be levied on foreign-source income (i.e., $t_F = 0$).

III. The Optimal Regime

This section deals with the case where the government can tax foreign-source income as effectively as domestic-source income. The question naturally arises whether it would be indeed optimal to levy the

1/ This condition must hold because obviously there will be no savings and investment in the second (and last) period.

2/ The government budget constraint is $rt_DK + r^*t_FB + F(K) - rK = G$. Note that the term $F(K) - rK$ represents the revenue from taxes on labor income. Notice also, that by Walras' Law this constraint is satisfied in equilibrium.

same tax rate on the incomes from these two sources and abstain altogether from quantity controls on capital exports.

Since there are distortionary taxes as part of the optimal program, the resource allocation is obviously not Pareto-efficient. In general, the intertemporal allocation of consumption, the leisure-consumption choice, and the private-public consumption tradeoffs are all distorted. Nevertheless, we show in this section that the optimal program (namely, the regime in which no constraints on taxation of foreign-source income 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. To derive the optimal program, the government maximizes the indirect utility function in equation (8) subject to the equilibrium condition in equation (13). The control (policy) variables at the government's disposal are the tax rate on domestic interest income (t_D) or, more generally, the consumer price of future consumption (q), the tax rate on interest income from abroad (t_F), the level of public consumption (G), and the quota on capital exports (B). Carrying out the optimization problem indeed yields the efficiency condition

(14) $$F' = r^*$$

(see Razin and Sadka (1989) or Appendix 1).
Accordingly, savings of the private sector must be allocated efficiently between investment at home and investment abroad. Since $F' = r$, the arbitrage condition is satisfied if the two tax rates are equalized, that is:

(15) $$t_D = t_F \quad .$$

In such a case there is no need to impose any quantity restrictions on capital exports. 1/

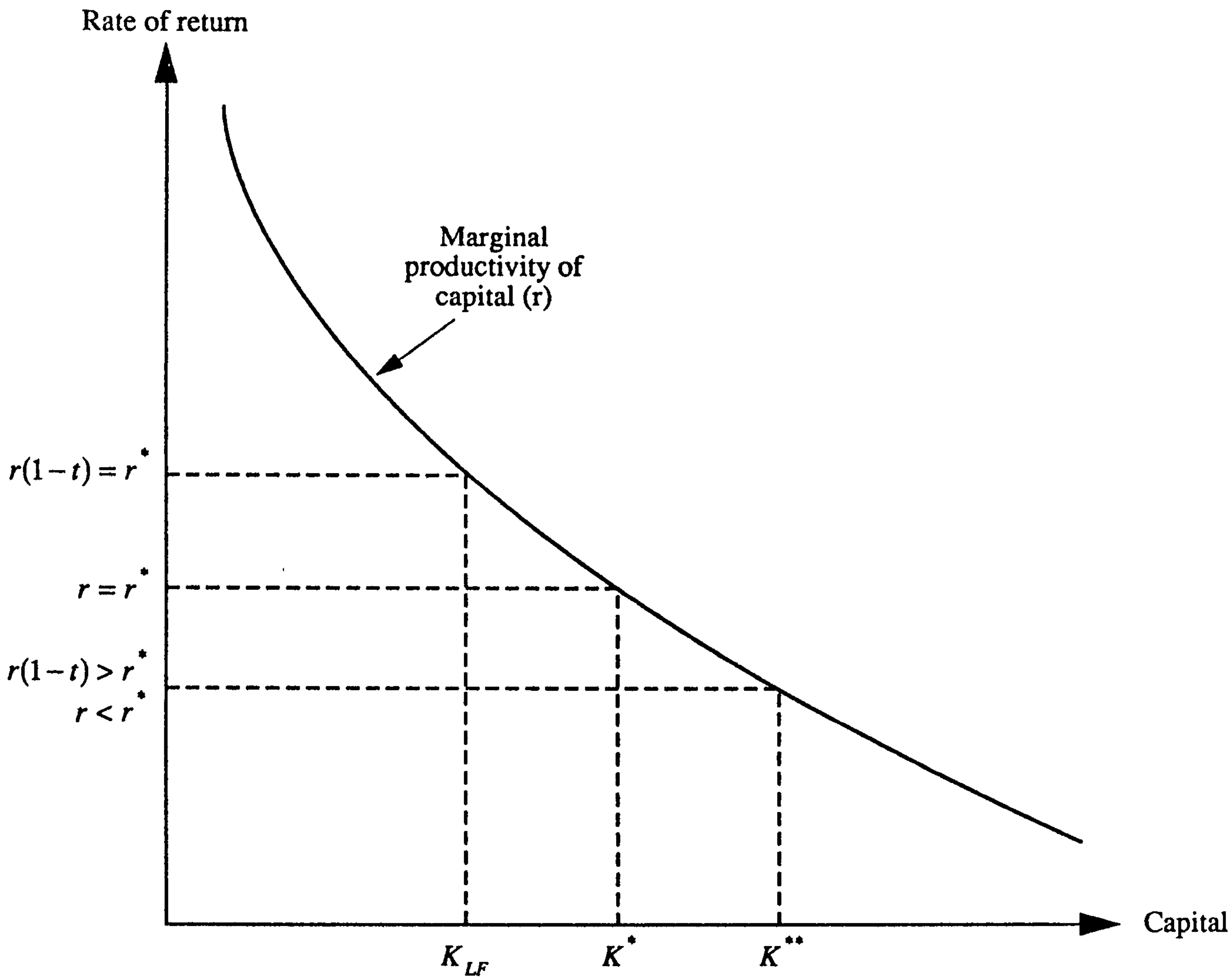
IV. The Suboptimal Regime

We turn now to a more realistic case where the government cannot effectively tax income from investment abroad. To highlight this phenomenon we set $t_F = 0$ and write $t_D = t$. In this case, if the government allows unlimited exports of capital, then capital will flow out of the country up to the point where the net return on domestic investment equals the net return on investment abroad:

(16) $$(1 - t)r = r^* \quad .$$

1/ Evidently, this is an open-economy variant of the aggregate efficiency theorem in optimal tax theory (e.g. Diamond and Mirrlees (1971), Sadka (1977), and Dixit (1985)).

FIGURE 1: EFFICIENT STOCK OF DOMESTIC CAPITAL WITH AND WITHOUT TAXATION OF FOREIGN-SOURCE INCOME



Note: K^* = Efficient stock of capital with taxation of foreign-source income.

K_{LF} = Laissez-faire stock of capital with no taxation of foreign-source income.

K^{**} = Efficient stock of capital with no taxation of foreign-source income.

This means that $F' = r > r^*$, so that the domestic stock of capital is smaller than in the optimal regime (where $F' = r^*$), given that the marginal productivity of capital is diminishing. The mirror image of such an underinvestment in capital at home is an overinvestment in capital abroad.

Therefore, an interesting issue that arises in this context is whether it is now efficient from the society standpoint to restrict the exports of capital, and if so, how severe should the restriction be? One may ask, for instance, whether the restriction on exports of capital should bring the domestic capital stock all the way back to a level which is even higher than in the optimal regime (i.e., an overinvestment in domestic capital). Furthermore, is it possible that capital exports should be altogether banned when foreign-source income cannot be effectively taxed? We address these issues below.

To derive the effects of a change in the capital-export quota on welfare we totally differentiate the indirect utility function in equation (8) with respect to B (see Appendix 2). This yields:

$$(17) \qquad \frac{dv}{dB} = -v_y \frac{K}{q} \frac{dq}{dB} + v_y \, ((1 + r^*)q - 1),$$

where $v_y > 0$ is the marginal utility of income.

Similarly, total differentiation of the market-clearing condition in equation (13) yields the general-equilibrium effect of a change in the capital-exports quota on the after-tax price of future consumption (see Appendix 3):

$$(18) \qquad \frac{dq}{dB} = (-((1 + r)\, c_{1y} + c_{2y})\, ((1 + r^*)\, q - 1) + r^* - r)\, A^{-1},$$

where:

$$(19) \qquad A = (1 + r)c_{1q} + c_{2q} + ((1+r)c_{1y} + c_{2y})(1 + r^*)\, B < 0 \quad .$$

The terms c_{1y} and c_{2y} are the income effects on present consumption and future consumption, respectively, and the terms c_{1q} and c_{2q} are the gross (future consumption) price effects on present consumption and future consumption, respectively.

Consider now the point where no restrictions on capital exports are imposed. We refer to this case as the <u>laissez-faire</u> case. The arbitrage condition in equation (4) then implies that:

$$(20) \qquad q = (1 + r^*)^{-1} \quad .$$

Hence, employing (17) and (18), we conclude that:

$$(21) \qquad \frac{dv}{dB} = -v_y K(r^* - r)A^{-1} \quad .$$

Since $r^* < r$ and $A < 0$, it follows from equation (21) that $dv/dB < 0$ at the laissez-faire point. This means that reducing B is welfare-improving. Namely, the government should impose a binding quota on capital exports in order to reduce the amount invested abroad. We show in Appendix 4 that, as expected, such a quota usually increases the stock of domestic capital.

Having established that some restrictions on capital exports are desirable in the suboptimal regime (when the government cannot effectively tax the income from the capital exported) we turn now to the question of how severe the restrictions should be. As a benchmark consider K^*, the stock of domestic capital exported under the optimal, regime defined by $F'(K^*) = r^*$. Given this benchmark we then investigate the question whether the restrictions on exports of capital should be severe enough so as to bring the stock of domestic capital to a level which even exceeds K^*; or whether the restrictions should not be so severe so that the level of domestic capital remains still below K^*.

To do this, we evaluate the derivative of the indirect utility function, dv/dB, at the point where $K = K^*$ (and consequently, $r = r^*$). This derivative (see Appendix 5) is:

$$(22) \qquad \left[\frac{dv}{dB} \right]_{K = K^*} = v_y((1 + r^*)q - 1)\, A^{-1}\, rt\, c^o{}_{1q} \quad ,$$

where $c^o{}_{1q}$ is the Hicks-Slutsky compensated effect of a change in the price of future consumption (q) on present consumption (c_1). Since two goods must always be net substitutes it follows that $c^o{}_{1q} > 0$. Hence, $dv/dB < 0$ at the point $K = K^*$. This means that reducing B further, beyond the point where $K = K^*$ (and $r = r^*$), enhances individual welfare. This implies that the stock of domestic capital rises to a level which exceeds the corresponding level in the optimal regime, implying that $r < r^*$ (see Appendix 6). Thus, when the government cannot effectively tax the income from the capital invested abroad, it is efficient to overinvest capital at home up to a point where the marginal product (r) falls below the world rate of interest (r^*).

Finally, we turn to investigate an extreme possibility: Should capital exports be altogether banned (i.e., $B = 0$) when the government cannot effectively tax the income from the capital exported? Obviously, if $dv/dB < 0$ at $B = 0$, then no capital exports should be allowed.

It turns out that the latter is a real possibility. To see this, notice that equations (17)-(19) imply (see Appendix 7) that at $B = 0$ we have:

$$(23) \qquad \left[\frac{dv}{dB} \right]_{B = 0} = v_y\, A^{-1}\, (rtc^o{}_{1q}\, ((1+r^*)q-1) - c_2(r^*-r)) \quad .$$

Now, when r is sufficiently close to r*, then dv/dB < 0 because A < 0 and $c^{o}_{1q} > 0$. In this case, a total ban on capital exports is called for. The rationale for this result is straightforward. When r is close to r*, there is very little gain for the society as a whole from investing abroad, because this gain is equal only to the difference between r and r* (though the private sector can still gain considerably from investing abroad if r(1-t) is considerably below r*). However, the government loses a significant amount of tax revenues from the outflow of capital. Therefore, in this case, it is not efficient to allow exports of capital.

V. Conclusion

This paper examines the efficiency of restrictions on capital exports. We show that when governments can tax the income from this capital no quantity restrictions should apply. This implies that before-tax rate of return on domestic capital (i.e., the marginal productivity of domestic capital, denoted by r) should be equated to the world rate of interest (denoted by r*). Such an equality insures an efficient allocation of the country's savings between investment at home and investment abroad (see Figure 1).

When governments cannot effectively tax foreign-source income and apply no restrictions on capital exports then the rate-of-return arbitrage condition equates the after-tax rate of return on domestic capital (i.e., (1-t)r) to the world rate of interest (i.e., r*). This equality implies that the before-tax rate of return on domestic capital exceeds the world rate of interest (i.e., r > r*). We show that a socially efficient restriction on capital exports should reduce the quantity of capital exported and increase the stock of domestic capital up to a point where the before-tax rate of return on domestic capital falls below the world rate of interest (i.e., r < r*). This means that the stock of domestic capital induced by the efficient policy exceeds the level of capital that is optimal when the government is able to fully tax foreign-source income.

Obviously, the case where governments can effectively tax foreign-source income and impose no restrictions on capital exports is preferable for the country to the case where it cannot effectively tax foreign-source income and thus having to resort to quantity restrictions on capital exports. Indeed, this argument may explain why the European Community, which is moving towards a single capital market in 1992, searches for ways to enforce taxation of foreign-source income (by a proposed system of origin-based taxation) so as to eliminate incentives to locate capital abroad (see Giovannini (1989)).

1. In this appendix we derive equation (14). The lagrangian expression of the optimization problem is:

$$L = v(q,\ I + B((1 + (1-t_F)\ r^*)q - 1)) + u^g(G)$$

$$+ \lambda\ (F(I - c_1(q,\ I + B((1 + (1 - t_F)r^*)q - 1)) - B)$$

$$+ I - c_1(q,\ I + B((1 + (1 - t_F)r^*)q - 1)) - B) - B$$

$$+ (1 + r^*)B - c_2(q,\ I + B((1 + (1 - t_F)r^*)\ q - 1)) - G),$$

where $\lambda \geq 0$ is a Lagrange multiplier. Differentiating L with respect to t_F and B and setting the derivatives equal to zero, yields:

$$\text{(A1)}\quad v_y = \lambda((1 + F')c_{1y} + c_{2y})$$

and

$$\text{(A2)}\quad v_y((1 + (1-t_F)r^*)q - 1) - \lambda((1 + F')c_1y + c_2y)((1 +(1-t_F)r^*)q-1)$$

$$= - \lambda\ (1 + F') + \lambda(1 + r^*),$$

where v_y, c_1y, and c_2y denote respectively derivatives of v, c_1 and c_2 with respect to income $(I + B((1 +(1 - t_F)r^*)q - 1))$.

Now, equation (14) follows from equations (A1) and (A2).

2. In this appendix we derive equation (17). Assuming $t_F = o$, total differentiation of the indirect utility function in equation (8) with respect to B yields:

$$\text{(B1)}\quad \frac{dv}{dB} = v_q\ \frac{dq}{dB} + v_y((1 + r^*)\ q - 1) + v_y\ B(1 + r^*)\ \frac{dq}{dB},$$

where $-v_q$ is the marginal disutility of an increase in the price of future consumption. Roy's identity states that

$$\text{(B2)}\quad v_q = -c_2\ v_y \quad .$$

Substituting (B2) into (B1) and re-arranging terms yields:

$$\text{(B3)}\quad \frac{dv}{dB} = -v_y\ (c_2 - B(1 + r^*))\ \frac{dq}{dB} + v_y((1 + r^*)q - 1) \quad .$$

Employing the present-value budget constraint of the private sector (equation (5)) we conclude that

$$\text{(B4)}\quad q(c_2 - (1 + r^*)B) = I - c_1 - B \quad .$$

Since $I - c_1 - B = K$ (equation (11)), it follows from (B4) that:

$$\text{(B5)}\quad c_2 - (1 + r^*)B = K/q \quad .$$

Finally, substituting equation (B5) into equation (B3) yields equation (17).

3. In this appendix we derive equations (18) and (19). Total differentiation of equation (13) with respect to B yields:

$$\begin{aligned}\text{(C1)}\quad & c_{2q}\frac{dq}{dB} + c_{2y}((1 + r^*)q - 1) + c_{2y}\, B(1 + r^*)\frac{dq}{dB} \\ & + (1 + F')\,(c_{1q}\frac{dq}{dB} + c_{1y}((1 + r^*)q - 1) + c_{1y}\, B(1 + r^*)\frac{dq}{dB}) \\ & + (1 + F') - (1 + r^*) = 0 \quad .\end{aligned}$$

Recalling that $F' = r$ and rearranging terms, we conclude that:

$$\begin{aligned}\text{(C2)}\quad & ((1 + r)c_1q + c_2q + ((1 + r)c_{1y} + c_{2y})B(1 + r^*))\frac{dq}{dB} \\ & = - ((1 + r)c_{1y} + c_{2y})((1 + r^*)q - 1) + r^* - r \quad .\end{aligned}$$

Defining, as in equation (19),

$$\text{(C3)}\quad A = ((1 + r)c_1q + c_2q + ((1 + r)c_{1y} + c_{2y})B(1 + r^*))^{-1},$$

then equation (18) follows from equation (C2) and equation (C3).

It remains to show that the right-hand side of equation (19) is indeed negative. Denote the expression on the left-hand-side of the market-clearing condition in equation (13) by E. This expression is nothing else but the economy's excess demand for future consumption. Recall that q is the price of future consumption. For the equilibrium to be Walras-stable, the excess demand curve must be downward slopping, namely $dE/dq < 0$. Since

$$\frac{dE}{dq} = c_2q + c_{2y}\, B(1 + r^*) + (1 + F')\,(c_1q + c_{1y}\, B(1 + r^*))$$

and since $F' = r$, it follows that $A = dE/dq < 0$. This proves that the right-hand side of equation (19) is negative.

4. We analyze in this appendix the effect on the domestic stock of capital of a restriction on capital exports. Since $K = I - c_1 - B$ (see equation (11)), it follows that:

$$\text{(D1)}\quad \frac{dK}{dB} = -(c_{1q} + c_{1y}\, B(1 + r^*))\, \frac{dq}{dB} - c_{1y}((1 + r^*)\, q - 1) - 1 \quad .$$

Substituting equations (18) and (20) into equation (D1), we conclude that at the laissez-faire point we must have:

$$\frac{dK}{dB} = -(c_{1q} + c_{1y}\, B(1 + r^*))(r^* - r)A^{-1} - 1 < 0,$$

assuming that present consumption is a normal good (i.e., $c_{1y} > 0$) and that present consumption and future consumption are gross substitutes (i.e., $c_{1q} > 0$).

Therefore, imposing a small binding quota on capital exports (i.e., a small reduction in B) increases the stock of domestic capital.

5. In this appendix we derive equation (22). At $K = K^*$ we have

$$\text{(E1)}\quad r = r^* \quad .$$

Hence, $q > (1 + r^*)^{-1}$ and, consequently

$$\text{(E2)}\quad (1 + r^*)q - 1 > 0 \quad .$$

Substituting equation (18) into equation (17) and employing (E1) we conclude that

$$\text{(E3)}\quad \left[\frac{dv}{dB}\right]_{K = K^*} = v_y\, ((K/q)\ ((1 + r)c_{1y} + c_{2y})((1 + r^*)q - 1)A^{-1}$$

$$+ (1 + r^*)q - 1) =$$

$$v_y((1 + r^*)q - 1)((K/q)\ ((1 + r)c_{1y} + c_{2y})$$

$$+ (1 + r)c_{1q} + c_{2q} + ((1 + r)c_{1y} + c_{2y})(1 + r^*)B)A^{-1} \quad .$$

Since $K/q = c_2 - (1 + r^*)\, B$, by equations (5) and (11), it follows from (E3) that

$$\text{(E4)}\quad \left[\frac{dv}{dB}\right]_{K = K^*} = v_y\, ((1 + r^*)\, q - 1)\, A^{-1}\, ((1 + r)c_2c_{1y} + c_2c_{2y}$$

$$+ (1 + r)c_{1q} + c_{2q}) \quad .$$

Substituting into equation (E4) the Hicks-Slutsky equations

$$c_{1q} = c^{\circ}_{1q} - c_2 c_{1y},$$

and

$$c_{2q} = c^{\circ}_{2q} - c_2 c_{2y},$$

where c°_{iq}, $i = 1,2$, is the Hicks-Slutsky compensated price effects, it follows that:

$$\text{(E5)} \quad \left[\frac{dv}{dB} \right]_{K = K*} = v_y \left((1 + r*)q - 1\right) A^{-1} \left((1 + r)\, c^{\circ}_{1q} + c^{\circ}_{2q}\right) \quad .$$

Since the Hicks-Slutsky compensated demand functions are homogenous of degree zero in prices, it follows from the Euler's equation that:

$$\text{(E6)} \quad c^{\circ}_{1q} + q c^{\circ}_{2q} = 0 \quad .$$

Substituting $q = (1 + (1 - t)r)^{-1}$ into equation (E6) we conclude that:

$$\text{(E7)} \quad (1 + r)c^{\circ}_{1q} + c^{\circ}_{2q} = rtc^{\circ}_{1q} > 0,$$

because two commodities are always net substitutes. Finally substituting equation (E7) into equation (E5) yields equation (22).

6. In this appendix we investigate the effect of reducing B below the point where $K = K*$ (and $r = r*$) on the stock of domestic capital. Since $K = I - c_1 - B$ (see equation (11)), it follows that

$$\text{(F1)} \quad \frac{dK}{dB} = -(c_{1q} + c_{1y}B(1 + r^*)) \frac{dq}{dB} - c_{1y} \left((1 + r^*)q - 1\right) - 1 \quad .$$

Substituting $r = r*$ into equation (18) we conclude that

$$\text{(F2)} \quad \left[\frac{dq}{dB} \right]_{K = K*} = - \left((1 + r)c_{1y} + c_{2y}\right)\left((1 + r*)q - 1\right)A^{-1} > 0,$$

as we assume that present consumption and future consumption are normal goods (i.e., $c_{1y} > 0$ and $c_{2y} > 0$). Thus, it follows from equations (F1) and (F2) that

$$\left[\frac{dK}{dB} \right]_{K = K*} < 0 \quad .$$

Namely, reducing capital exports increases the stock of capital invested at home. Thus, it is efficient to overinvest at home.

7. In this appendix we derive equation (23).

At $B = 0$, we have from equations (18) and (19):

$$\text{(G1)} \quad \left[\frac{dq}{dB} \right]_{B = 0} = \frac{-((1 + r)\, c_{1y} + c_{2y})\, ((1 + r^*)\, q - 1) + r^* - r}{(1 + r)\, c_{1q} + c_{2q}}$$

Since $K/q = c_2$ at $B = 0$ (see equations (5) and (11)), we conclude from equation (17) and equation (G1) that

$$\text{(G2)} \quad \left[\frac{dv}{dB} \right]_{B = 0} = v_y\, A^{-1}((1 + r)(c_{1q} + c_2 c_{1y}) + c_{2q} + c_2 c_{2y}) \cdot$$

$$((1 + r^*)q - 1) - c_2(r^* - r))$$

$$= v_y\, A^{-1}(((1 + r)c^{o}_{1q} + c^{o}_{2q})((1 + r^*)q - 1) - c_2(r^* - r)),$$

where use is made, as in Appendix E, of the Hicks-Slutsky equations. Substituting equation (E7) into equation (G2) yields equation (23).

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