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ABSTRACT

The implications of a large public debt for the implementation of capital controls for an economy where tax revenue collection is costly are examined. Conditions are analyzed under which policymakers will resort to capital controls to reduce the cost of recycling domestic public debt. The linkages between a costly tax collection mechanism, capital controls, and domestic government debt are explored in terms of a two-period model of optimal taxation. Numerical simulations are provided to illustrate how capital controls are linked to different domestic public debt levels and to different degrees of efficiency in tax-revenue collection.

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I. Introduction

This paper explores the implications of a large domestic public debt overhang for the implementation of capital controls in an economy where tax-revenue collection is costly. It analyzes conditions under which the policymaker will be induced to introduce restrictions on capital flows in order to reduce the cost of recycling domestic public debt. On welfare grounds, reducing the recycling cost of the public debt cannot be the ultimate goal, because accomplishing this will introduce a new distortion into the economy in the form of a wedge between the domestic and the foreign interest rates. However, in a situation where raising taxes involves real costs and distortions, the logic of the second-best argument could suggest the presence of gains associated with cutting the costs of servicing the domestic debt and, therefore, with introducing capital controls. 1/

The analysis is motivated by the observation that, despite the relaxation of capital controls in various countries, unrestricted flows of capital are

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1/ The optimality of capital controls in a second-best world has been established also by Aizenman (1986). Aizenman (1986) relates the use of capital controls to commercial policy and the inflation tax. Recent work by Razin and Sadka (1990) examines the optimality of quantity restrictions on capital exports in an economy where taxes are distorting and the government is unable to effectively tax foreign-source income.

still the exception rather than the rule. 1/ Moreover, it appears that restrictions on capital flows have tended to be more prevalent in economies with large domestic public debt levels, as suggested, for example, by Table 1 providing information on capital controls and on the ratio of domestic public debt to GDP in a number of OECD countries for which data was accessible.

While there is broad agreement that free mobility of capital enhances welfare in a first-best environment, it is important to identify second-best conditions under which capital controls are likely to arise. It is worth stressing, therefore, that the purpose of the paper is not to justify capital controls as a first-best outcome, but rather to illustrate that their applicability may be related to the presence of distorting and costly means of tax collection in conjunction with the government's need to recycle its domestic debt at market terms.

1/ According to the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (1989), only 29 out of 153 member countries were classified at end-1988 as free of restrictions on capital flows. The large majority of the 29 countries which have no capital controls is comprised of high or upper-middle income countries.

Table 1. Capital Controls and Domestic Public Debt in Selected OECD Countries

	Net Domestic Public Debt, 1987 (In percent of GDP)
With no capital controls	
United States	30.8
Japan	21.9
Germany	22.9
United Kingdom	38.4
Canada	37.6
Australia	18.5
Netherlands	52.1
Denmark	4.8
Weighted Average	28.3
Unweighted Average	28.4
With capital controls	
France	25.5
Italy	87.8
Spain	29.5
Austria	57.5
Belgium	102.2
Greece	49.9
Ireland	81.2
Portugal	46.6
Weighted Average	54.9
Unweighted Average	60.0

Sources: Economic Outlook, OECD, December 1989; various OECD country reports; Exchange Arrangements and Exchange Restrictions, IMF, Annual Report 1988. Weighted averages are calculated using GDP weights.

The linkages between a costly tax collection mechanism, capital controls, and domestic government debt will be explored in terms of a simple two-period model of public finance, for a small open economy where the government may resort to an endowment tax and to capital controls to finance the service and

amortization of an initial stock of domestic public debt. For the sake of simplicity, capital controls will be modeled as a tax on foreign-interest income. This tax introduces a wedge between the international and the domestic real interest rate much in the same way as a quantitative restriction on capital flows would. Both the endowment tax as well as the tax on foreign interest income are costly to collect. Moreover, the capital control distorts the intertemporal private consumption-savings decision by introducing a wedge between the domestic and the foreign interest rate. However, precisely because the capital control may reduce the equilibrium domestic interest rate at which the government refinances its domestic debt, it may reduce the amount of revenue that the government needs to collect by means of the endowment tax. The precise financing structure chosen by the government in this context will be the outcome of an optimal taxation problem corresponding to a second-best welfare maximization. 1/

The discussion is organized as follows. Section II presents the basic model and characterizes the consumer's problem. Section III deals with optimal

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1/ The role of collection costs for optimal taxation has received significant attention. Barro (1979) discusses the implications of costly tax revenue collection for government borrowing. Aizenman (1983) and Végh (1989) discuss the implications of collection costs for the optimality of the inflation tax, while Végh and Guidotti (1989) discuss the implications for optimal taxation policies in the EMS. The relationship between capital controls and government debt has also been explored recently; see, for instance, Giovannini (1987) for a discussion of the fiscal implications of capital controls in Italy, and Alesina and Tabellini (1990) for a discussion in a political-economy context.

taxation. It characterizes the government's choice of taxes and capital controls, and provides some numerical simulations to illustrate how the restrictions on capital flows are linked, in equilibrium, to different levels of domestic public debt, as well as to different degrees of efficiency in tax-revenue collection. Section IV contains concluding remarks.

II. The Model

Consider the following model of a two-period (periods 1 and 2), real endowment economy. The analysis is carried out in a two-period, real model in order to present the main arguments of the paper in the simplest possible way. The representative consumer maximizes the following intertemporal utility function:

$$(1) \qquad U(c_1,c_2) = u(c_1) + \beta u(c_2)$$

where c_t stands for consumption in period t, β is the discount factor, and $u(c_t)$ is a twice-differentiable and strictly-concave function. Two assets (with a one-period maturity) are available to the consumer: a domestic government bond yielding an interest rate of r_t in period t, and a foreign asset yielding the foreign (exogenous) interest rate of ρ. Without loss of generality it will be assumed that $\beta=1/1+\rho$. The consumer's holdings of domestic government bonds and foreign assets at period t are denoted by d_t and b_t, respectively. Each period, in addition, the consumer receives an endowment, denoted by y_t, and pays taxes. There are two types of taxes levied: an endowment tax, and a tax on foreign interest income (which constitutes the capital control). Because the economy is

small, it can be shown that--in the presence of collection costs--it would not be optimal for the government to tax the interest income from government bonds; thus, the menu of available taxes implicitly reflects this fact. (A formal discussion of this issue is provided in the following section). The endowment tax rate is denoted by x_t, while the foreign interest income tax rate is denoted by τ. Thus, the consumer's budget constraints for periods 1 and 2, respectively, are given by:

$$(2) \qquad d_1 + b_1 + c_1 = (1-x_1)y_1 + d_0$$

$$(3) \qquad c_2 + \tau\rho b_1 = (1-x_2)y_2 + (1+r_1)d_1 + (1+\rho)b_1$$

where, for expositional simplicity, we have assumed that the initial stock of foreign assets is zero; d_0 denotes the initial and exogenous stock of government bonds held by the representative consumer. 1/

The foreign interest rate, ρ, and the interest rate on the domestic government bond, r_1, are tied via the following arbitrage condition:

$$(4) \qquad r_1 = \rho(1-\tau).$$

It is clear from equation (4) that the capital control in the form of a tax on foreign interest income drives a wedge between the domestic and the international interest rate.

1/ For notational simplicity we are assuming that $r_0=0$. Otherwise, d_0 should be interpreted as including interest.

By using condition (4), equations (2) and (3) can be combined into the following intertemporal budget constraint:

$$(5) \qquad c_1 + Rc_2 = (1-x_1)y_1 + R(1-x_2)y_2 + d_0$$

where $R=1/(1+r_1)$. On the left-hand side of equation (5) is the present discounted value of consumption, while on the right-hand side of the equation is wealth, that is, the present discounted value of the future stream of income minus taxes, $(1-x_1)y_1 + R(1-x_2)y_2$, plus the initial stock of government bonds, d_0. The discount rate used to calculate the above-mentioned present discounted values is the domestic interest rate, which equals the after-tax interest rate on foreign assets.

The consumer's problem is to maximize over (c_1,c_2) the utility function (1) subject to constraint (5). The first-order conditions for an interior optimum imply the following familiar Euler equation:

$$(6) \qquad u'(c_1)R = \beta u'(c_2)$$

where $u'(c_t)$ denotes the marginal utility of consumption at time t. Equations (5) and (6) determine equilibrium consumption in periods 1 and 2 as functions of wealth and the domestic interest rate. Hence, consumption in periods 1 and 2 is a function of the tax rates, x_1, x_2, and r.

III. Optimal Taxation

This section examines the government's optimal taxation problem. The government starts with a given initial stock of domestic liabilities due to be amortized or recycled in the first period. To focus sharply on the role of debt, it will be assumed that there is no government expenditure. 1/ The government problem is to find the desirable allocation between retiring the debt today and/or rolling it over to the second period.

To finance debt amortization the government resorts to the endowment tax and the tax on foreign interest income. Both taxes are assumed to carry collection and enforcement costs, which are assumed to be described by an increasing and convex function of revenues. For the sake of symmetry, we assume that the collection cost function is identical for all taxes and is denoted by $\Psi(T)$, where T stands for tax revenue. Therefore, results will not be dependent on differential collection costs among the various taxes. 2/ Specifically, it is assumed that

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1/ Adding government expenditure is straightforward and would not alter the results of the paper.

2/ At a conceptual level, it is useful to focus on the symmetric case to isolate the interaction between government debt and capital controls when tax collection is costly. Of course, differential collection costs across different taxes may be of relevance in practice. While not pursued here, it is straightforward to analyze the non-symmetric case within the framework presented in this paper.

$$\Psi'(T) > 0, \ \Psi''(T) > 0, \text{ for } T > 0$$

$$\Psi'(0) = k \geq 0, \ \Psi''(0) > 0$$

where a prime denotes the derivative of the function with respect to its argument and k is a constant.

The government budget constraint in periods 1 and 2, respectively, are given by: 1/

$$(7) \qquad d_1 + x_1 y_1 = d_0 + \Psi(x_1 y_1)$$

$$(8) \qquad \tau\rho b_1 + x_2 y_2 = (1+r_1)d_1 + \Psi(x_2 y_2) + \Psi(\tau\rho b_1).$$

Equation (7) states that, in period 1, the government may raise revenue from the endowment tax, $x_1 y_1$, and resort to new borrowing, d_1, to finance the amortization of the initial stock of debt, d_0, plus the collection cost associated with levying the endowment tax, $\Psi(x_1 y_1)$. Similarly, equation (8) states that, in period 2, the government may raise revenue from the tax on foreign interest income, $\tau\rho b_1$, and from the endowment tax, $x_2 y_2$, to finance the repayment of the outstanding debt obligations, $(1+r_1)d_1$, plus the collection costs associated with the endowment tax, $\Psi(x_2 y_2)$, and with the tax on foreign interest income, $\Psi(\tau\rho b_1)$.

1/ To assume away the possibility of time-inconsistency of government behavior, the tax τ is determined in period 1, simultaneously with the interest rate r_1.

Using the interest parity condition (4), it is illuminating to rewrite equation (8) as follows:

$$(8') \qquad r\rho(b_1 + d_1) + x_2y_2 = (1+\rho)d_1 + \Psi(x_2y_2) + \Psi(r\rho b_1).$$

Equation (8') reveals *an important feature of the tax on foreign interest income: its effective tax base is given by the aggregate asset holdings of the private sector, $b_1 + d_1$, while its collection costs depend only on the private holdings of foreign assets, b_1.* This feature reflects two phenomena. On the one hand, since the imposition of a tax on foreign interest income reduces the equilibrium interest rate which applies to new government debt issues, the government is enjoying, in terms of gross revenue, the equivalent of issuing new domestic government bonds at the foreign interest rate of ρ while simultaneously taxing the interest income from those bonds. On the other hand, however, *the revenue effect obtained through the fall in the domestic interest rate does not carry a collection cost.* Therefore, while taxing the interest income from both foreign assets and domestic government bonds is equivalent in terms of gross revenue to the alternative of taxing only the interest income on foreign assets, the two alternatives are not equivalent from the standpoint of the collection costs involved. In fact, the latter alternative amounts to saving the collection costs that would otherwise be associated with the revenue from taxing

the interest income of government bonds. 1/ The ensuing analysis will examine the implications of these phenomena for the applicability of capital controls.

To gain further insight it is useful to combine equations (7) and (8') into the following intertemporal government budget constraint:

$$(9) \qquad d_0 + \Psi(x_1y_1) + R[\Psi(x_2y_2) + \Psi(\tau\rho b_1)] = x_1y_1 + R[\tau(\rho b_1) + x_2y_2],$$

where, as in the case of the consumer, the discount rate is expressed in terms of the domestic interest factor, R.

Combining equation (5) and (9) the economy's intertemporal resource constraint is obtained (recall that $\beta=1/(1+\rho)$)

$$(10) \qquad c_1 + \beta c_2 = y_1 - \Psi(x_1y_1) + \beta[y_2 - \Psi(x_2y_2) - \Psi(\tau\rho b_1)],$$

where it is clear that the relevant discount rate for the economy as a whole is the foreign interest rate, ρ, and

$$(11) \qquad b_1 = y_1 - \Psi(x_1y_1) - c_1.$$

1/ It can be easily shown that, because of these facts, it would not be optimal for the government to tax the interest income from government bonds when tax collection is costly. The imposition of such a tax (denoted by ϕ) would only result in higher collection costs; it would not alter the equilibrium interest rate facing the consumer--which would still be equal to $\rho(1-\tau)$--and would result in an equivalent increase in r_1--since arbitrage would imply that $\rho(1-\tau)=r_1(1-\phi)$--generating no increase in government revenues.

The Ramsey problem facing the government is how to raise the tax revenue required to meet the public debt obligations in a way that maximizes the consumer's utility, that is, find the tax allocation (x_1,x_2,r) which maximizes the consumer's utility subject to the government's budget constraint and the private behavioral relationships by which c_1, c_2, and b_1 are functions of the tax structure. It is useful to solve the optimal taxation problem in two stages. First, the optimal allocation of endowment taxes is identified. Then, the conditions under which the addition of a tax on foreign interest income is beneficial are analyzed.

1. Endowment taxes

The first-order conditions associated with this type of optimal taxation problem yield the familiar condition requiring that the marginal rate of substitution between any pair of tax instruments along an utility-indifference curve be equal, at an optimum, to the marginal rate of substitution between the two taxes along an iso-revenue curve (see, for instance, Auerbach (1985)). Consider, therefore, a revenue-neutral perturbation (tax reform) of an initial equilibrium by which we alter x_1 and x_2 (and, hence, alter c_1 and c_2). From the consumer's optimality condition (6) it follows that

$$(12) \qquad \Delta U(c_1,c_2)/u'(c_1) = \Delta c_1 + \beta[u'(c_2)/u'(c_1)]\Delta c_2 = \Delta c_1 + R\Delta c_2,$$

where ΔX denotes a marginal change in X. From the consumer's intertemporal budget constraint, the above-mentioned tax reform implies that $\Delta c_1 + R\Delta c_2 = -y_1\Delta x_1 - Ry_2\Delta x_2$. Thus, equation (12) can be written as

(13) $\Delta U(c_1,c_2)/u'(c_1) = - y_1\Delta x_1 - Ry_2\Delta x_2.$

Consider first the case in which the tax reform is effected at an equilibrium where there are no capital controls, i.e., where $r=0$ and $R=\beta$. Since the change in endowment taxes is neutral in terms of revenue, it follows that (recalling that $R=\beta$)

(14) $[1-\Psi'(x_1y_1)]y_1\Delta x_1 + \beta[1-\Psi'(x_2y_2)]y_2\Delta x_2 = 0.$

Applying (14) to (13), the welfare effect of the revenue-neutral tax reform is obtained at an equilibrium where $R=\beta$:

(15) $\Delta U(c_1,c_2)/u'(c_1) = \{[\Psi'(x_1y_1) - \Psi'(x_2y_2)]/[1 - \Psi'(x_1y_1)]\}\beta y_2\Delta x_2.$

If the tax reform is effected at an optimum, then it must have no effect on welfare. Thus, an optimal tax allocation requires setting equation (15) equal to zero. This is achieved by setting endowment taxes so as to equate the marginal collection costs across periods (i.e., $\Psi'(x_1y_1) = \Psi'(x_2y_2)$), the familiar tax-smoothing result (see, for instance, Barro (1979)). Consequently, since the collection cost function is time invariant, it follows that, in the absence of capital controls, the optimal policy requires equating the endowment-tax revenue across periods, i.e., $x_1y_1 = x_2y_2$.

Suppose now that the above-mentioned tax reform is effected at an initial equilibrium where $r>0$ and, hence, $R>\beta$. In this case, by using equations (5),

(6), (10), (11), and (13), we obtain that, at an interior optimum, endowment taxes must satisfy the following condition:

$$(16) \qquad \Psi'(x_2y_2) - \Psi'(x_1y_1) = [(R-\beta)/\beta]\Psi'(x_1)[1 - \Psi'(\tau\rho b_1)].$$

Since the R.H.S. of equation (16) is positive when $\tau>0$, it follows that the imposition of capital controls induces the government to postpone the tax-revenue collection of the endowment tax; that is, optimal taxation calls for setting $x_2y_2>x_1y_1$ when $\tau>0$. Moreover, it can be easily shown that--as a result of postponing the collection of the endowment tax--the imposition of capital controls induces the government to leave a larger stock of domestic public debt in the second period compared to the policy followed in the absence of capital controls; i.e., optimal b_1 is larger when $\tau>0$ than when $\tau=0$.

The above findings have an intuitive explanation. The imposition of a capital control depresses the domestic real interest rate and, relative to a first-best optimum, it induces a reduction in private savings. Postponing the collection of the endowment tax has two beneficial effects. Firstly, it induces an increase in private savings, thereby counteracting the intertemporal distortion introduced by the capital control. Secondly, by postponing the collection of the endowment tax the government postpones the repayment of its domestic debt; the postponement of debt repayment enhances, by previous arguments, the revenue effect of the capital control which is not directly associated with collection costs.

2. Capital controls

We now turn to examine the desirability of imposing a capital control in the form of a tax on foreign interest income. To this effect, consider a perturbation effected at an equilibrium by which we increase marginally the tax on foreign interest income while lowering the endowment tax in period 2 so as to keep government revenue unchanged. 1/ Hence, using the government's budget constraint (9), we find that this revenue neutral perturbation satisfies (setting $\Delta x_1=0$):

$$(17) \qquad -Ry_2\Delta x_2[1-\Psi'(X)] = R[1-\Psi'(\tau\rho b_1)]\tau\rho\Delta b_1 + \{x_2y_2 - \Psi(X) - \Psi(\tau\rho b_1) + \tau\rho b_1 + [1-\Psi'(\tau\rho b_1)](b_1/R)\}\Delta R.$$

Similarly, from the consumer's intertemporal budget constraint, the tax reform implies that $\Delta c_1 + R\Delta c_2 = -Ry_2\Delta x_2 + [(1-x_2)y_2 - c_2]\Delta R$; thus, by using (17), we obtain that the welfare effect associated with the tax reform is given by

$$(18) \qquad \frac{\Delta U(c_1,c_2)}{u'(c_1)} = \left\{[(1-x_2)y_2 - c_2] + \frac{R\tau\rho[1-\Psi'(\tau\rho b_1)]}{1-\Psi'(x_2y_2)}\frac{\Delta b_1}{\Delta R} + \frac{1}{1-\Psi'(x_2y_2)}\left[x_2y_2 - \Psi(x_2y_2) - \Psi(\tau\rho b_1) + \tau\rho b_1 + \frac{1-\Psi'(\tau\rho b_1)}{R}b_1\right]\right\}\Delta R$$

Given that, at an equilibrium, $x_2y_2 - \Psi(x_2y_2) - \Psi(\tau\rho b_1) = (d_1/R) - \tau\rho b_1$ and $c_2 - (1-x_2)y_2 = (b_1+d_1)/R$, we can rewrite equation (18) as follows:

1/ A similar perturbation can be, of course, analyzed by altering R and x_1.

$$(19) \qquad \frac{\Delta U(c_1,c_2)}{\Delta R[u'(c_1)]} = \frac{\Psi'(x_2y_2)}{1 - \Psi'(x_2y_2)} \frac{d_1}{R} + \frac{\Psi'(x_2y_2) - \Psi'(\tau\rho b_1)}{1 - \Psi'(x_2y_2)} \frac{b_1}{R} +$$

$$\left(\frac{R - \beta}{\beta} \right) \frac{1 - \Psi'(\tau\rho b_1)}{1 - \Psi'(x_2y_2)} \frac{\Delta b_1}{\Delta R} .$$

At an interior optimum, the tax perturbation must not change welfare; hence, an optimal tax allocation requires setting equation (19) equal to zero. Equation (19), therefore, is the central piece of analysis for examining the desirability of imposing capital controls and the role of government debt in determining the optimal tax allocation.

To facilitate intuition, consider first under which conditions it is optimal to impose a tax on foreign interest income to begin with. For expositional purposes, consider the case in which k=0, that is, when the marginal collection costs of the first unit of tax revenue are equal to zero. At an initial equilibrium where τ=0 (and, hence, β=R), equation (19) reduces to

$$(19') \qquad \frac{\Delta U(c_1,c_2)}{\Delta R[u'(c_1)]} = \frac{b_1 + d_1}{\beta} \frac{\Psi'(x_2y_2)}{1 - \Psi'(x_2y_2)} ,$$

which is greater than zero whenever $b_1 + d_1 > 0$. Thus, as long as there are collection costs associated with endowment taxes and the private sector's financial wealth, $b_1 + d_1$ is positive, welfare increases as a result of introducing a capital control in the form of a tax on foreign interest income. The welfare enhancement depends directly on both the marginal collection costs associated with endowment taxes and aggregate private financial asset holdings.

The rationale for this outcome is that, by reducing the domestic interest rate on government debt, the "effective" tax base of the foreign interest income tax is given by the sum of combined private holdings of foreign assets holdings and domestic public debt. In addition, since the marginal collection costs associated with the foreign interest income tax are zero when $\tau=0$, the welfare effect of imposing the foreign interest income tax is positive (when $b_1+d_1>0$) because it allows a reduction of the endowment tax and, hence, results in a reduction of the collection costs associated with that tax (since $\Psi'(x_2y_2)>0$ when $x_2>0$). 1/ In addition, note that, in the presence of collection costs, which generate welfare costs of a first-order magnitude, the intertemporal distortion usually associated with capital controls (but not with endowment taxes) plays no role in equation (19') because it generates, at the equilibrium where $\tau=0$, a welfare cost of a second-order magnitude.

Interestingly, a tax on foreign interest income may be optimal even when $b_1 < 0$; i.e., the private sector (and, in this model, the economy) is externally indebted (recall that since initial foreign assets are zero, b_1 represents both the first-period capital account balance as well as the stock of foreign assets in period 1). If $b_1 < 0$ but $b_1+d_1>0$, then the government benefits from

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1/ The fact that $\Psi'(0)=0$ is not important for any of the arguments. If $\Psi'(0)=k>0$, then one would have, instead of equation (19'),

$$\frac{\Delta U(c_1,c_2)}{\Delta R[u'(c_1)]} = \frac{d_1}{\beta}\left(\frac{\Psi'(x_2y_2)}{1-\Psi'(x_2y_2)}\right) + \frac{b_1}{\beta}\left(\frac{\Psi'(x_2y_2)-k}{1-\Psi'(x_2y_2)}\right)$$

where, clearly, $\Psi'(x_2y_2)>k$.

subsidizing interest payments on foreign debt because it reduces the cost of servicing the domestic public debt.

The optimal tax structure involving capital controls, at an interior optimum, satisfies setting equation (19) equal to zero, which yields the following condition:

$$(20a)\quad \Psi'(x_2y_2) = \frac{b_1}{b_1 + d_1}\,\Psi'(\tau\rho b_1) + \frac{b_1}{b_1 + d_1}\,\frac{R - \beta}{\beta}\,[1-\Psi'(\tau\rho b_1)]\eta \ , \ \text{if } b_1 \neq 0$$

$$(20b)\quad \Psi'(x_2y_2) = -\frac{1}{d_1}\,\frac{R - \beta}{\beta}\,\frac{\Delta b_1}{\Delta R}\,R \ , \quad \text{if } b_1 = 0$$

where $\eta \equiv -(R/b_1)(\Delta b_1/\Delta R) > 0$ and we assume that $d_1 > 0$. 1/ Equation (20) equates the marginal collection cost of the endowment tax (on the L.H.S. of (20)) to the sum of the "effective" marginal collection cost of the foreign interest income tax (the first term on the R.H.S. of (20)) plus the familiar welfare cost of a capital control resulting from the intertemporal distortion of the consumer's consumption-savings decision (the second term on the R.H.S. of (20)).

The "effective" marginal collection cost of the foreign interest income tax is a weighted average--the weights being $b_1/(b_1+d_1)$ and $d_1/(b_1+d_1)$--of the marginal collection cost of the foreign assets component, i.e., $\Psi'(\tau\rho b_1)$, and the collection cost associated with implicitly taxing domestic public debt holdings, which is equal to zero. It is clear that, if $b_1>0$ and $d_1>0$, then the

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1/ Note that (20b) is obtained by setting the R.H.S. of (19) equal to zero for the case in which $b_1 = 0$.

"effective" marginal collection costs associated with the capital control are lower than those given by $\Psi'(\tau\rho b_1)$. The rationale for this is straightforward. The imposition of τ yields a government revenue (through a reduction of the domestic interest rate) which does not carry collection costs.

Three additional observations can be drawn from equation (20). Firstly, because, unlike the endowment tax, capital controls introduce an intertemporal distortion, the optimal tax on foreign interest income is equal to zero if revenue collection is not costly, i.e., when $\Psi = 0$. Note that, in this case, equation (19) boils down to

$$(19'') \qquad \frac{\Delta U(c_1,c_2)}{\Delta R[u'(c_1)]} = \frac{R - \beta}{\beta} \frac{\Delta b_1}{\Delta R} ,$$

where $\Delta b_1/\Delta R < 0$. Hence, the presence of collection costs is essential for the optimality of capital controls. Secondly, when $b_1 = 0$ at the optimum, then the optimal tax structure equates the marginal collection cost of the endowment tax to the welfare cost of the intertemporal distortion introduced by the capital control, as shown by equation (20b). Finally, if $b_1 > 0$ and $d_1 = 0$, then the revenue collected by the endowment tax is always larger than that collected by the tax on foreign interest income, since $\Psi'(X) > \Psi'(\tau\rho b_1)$ implies that $X > \tau\rho b_1$.

3. Numerical simulations

The previous arguments suggest that governments may have incentives to resort to capital controls when tax collection is costly and particularly so in periods when substantial portions of the domestic public debt need to be

recycled. It is useful at this point to obtain a sense of the orders of magnitude involved for the optimal tax on foreign interest income which would be suggested by the present model and, more importantly, for how domestic real interest rates depend on the size of the domestic public debt recycled. To this effect, we simulate numerically the model.

The consumer's utility function (1) is assumed to take a logarithmic form, i.e.,

$$(1') \qquad U(c_1,c_2) = \ln(c_1) + \beta\ln(c_2) \ ,$$

and collection costs are assumed to be quadratic, i.e., $\Psi(T) = \alpha T^2$, where α is a positive constant.

In order to examine the degree of capital controls associated with recycling a given level of domestic public debt, the endowment values were chosen so as to generate, in equilibrium, a zero net saving; i.e., $b_1 = 0$. Endowments were given values of (y_1=) 1.018 and (y_2=) 0.992 in the first and second periods, respectively. (Periods are, henceforth, interpreted as years.) The international interest rate equals 10 percent (i.e., ρ=0.1 so that β=0.9091), the parameter α=.1, and the initial domestic public debt level equals 50 percent of GDP (i.e., $d_0 = 0.5$).

The above parameter specification yields the following results. The revenue raised in equilibrium by the endowment tax amounts to 25.7 percent of GDP in the first period and 27.1 percent of GDP in the second period. In both periods, the collection cost associated with the endowment tax is in the order

of 0.7 percent of GDP. 1/ In equilibrium, the stock of debt recycled in the first period amounts to 23.1 percent of GDP (i.e., $d_1 = 0.231$). The domestic interest rate is 7.1 percent (i.e., r=0.071 so that R=0.934), that is, the recycling of the domestic public debt is associated with a reduction of 2.9 percentage points in the domestic interest rate as a result of an imposition of a tax on foreign interest income at a rate of 27 percent (i.e., τ=0.27). The revenue collected implicitly through the fall in domestic interest rate amounts to 0.6 percent of GDP, which is small--about 2.3 percent of total revenue--compared to the revenue of 27 percent of GDP collected by the endowment tax in period 2.

We now turn to illustrate how the implementation of capital controls depends on the initial domestic public debt burden and, consequently, on the stock of domestic public debt to be recycled. The corresponding simulation results are presented in Table 2.

1/ A collection cost of 0.7 percent of GDP represents around 2.7 percent of the revenues raised by the endowment tax. According to estimates of collection costs for the U.S. reported by Hyman (1983), a figure for collection costs of 2.5-3 percent of total revenues could be taken to be representative for industrial countries. One would expect this figure to be higher in the case of developing countries.

Table 2. Capital Controls and Government Debt

d_0	d_1	b_1	$r-\rho$	τ	$\tau\rho(b_1+d_1)$	$\frac{\tau\rho(b_1+b_1)}{x_2y_2+\tau\rho(b_1+d_1)}$
25	11.6	-0.3	-0.7	6.6	0.1	0.8
50	23.1	-1.2	-2.8	26.3	0.6	2.2
75	34.8	-2.6	-6.2	60.0	1.9	4.5

Note: Columns 1, 2, 3, and 6 are expressed in percent of GDP.
Columns 4, 5, and 7 are expressed in percent.

For these calculations, α=0.1 and the endowment is assumed constant over time (i.e., $y_1=y_2=1$). As the amount of debt recycled in the first period grows from 11.6 to 34.8 percent of GDP, the optimal tax on foreign interest income increases sharply inducing a fall in the domestic interest rate ranging from 0.7 to 6.2 percentage points. The proportion of total revenue raised by the capital control increases from 0.8 percent to 4.5 percent as the amount of public debt recycled increases.

Simulation results--for an initial stock of domestic public debt of 50 percent of GDP--presented in Table 3 illustrate the importance of collection costs in determining the government's choice of capital controls. These results show that growing inefficiency of tax administration, while reducing only slightly the amount of debt to be recycled, induces a substantial increase in the use of capital controls. As the parameter α increases from 0 to 0.2--implying an increase in collection costs from zero to 5.6 percent of the revenues from the endowment tax--, τ increases from zero to over 50 percent.

The revenue raised by the capital control increases correspondingly from zero to 3.6 percent of total government revenues.

Table 3. Capital Controls and Collection Costs

α	d_1	$r-\rho$	τ	$\frac{r\rho(b_1+d_1)}{x_2y_2+r\rho(b_1+d_1)}$	$\frac{\Psi(x_2y_2)}{x_2y_2}$
0	23.8	0	0	0	0
0.1	23.1	-2.8	26.3	2.2	2.7
0.2	22.2	-5.5	52.5	3.6	5.6

Note: Column 1 is expressed in percent of GDP.
Columns 2, 3, 4, and 5 are expressed in percent.

In sum, numerical simulations suggest that both the efficiency of tax administration as well as the level of domestic public debt could have a potentially important impact on government incentives to impose capital controls. In particular, this indicates that enhancing the efficiency of tax collection may reduce substantially government incentives to lower the cost of servicing the public debt by reducing the domestic real interest rate, a policy which distorts intertemporal private consumption-savings decisions.

IV. Conclusions

This paper has shown that, in an economy where all means of taxation generate welfare costs, policymakers may be induced to impose capital controls in order to reduce the cost of refinancing the domestic public debt at market terms. The main reason why the use of capital controls is linked to the

recycling of the domestic government debt is that, by reducing the domestic equilibrium real interest rate, the government mitigates the loss associated with collecting taxes. Moreover, by lowering the interest bill on its domestic debt, the government obtains revenue that is not subject to collection costs. Of course, since the reduction of the interest rate is obtained by introducing a distortion to the private consumption-savings choice, the gains from imposing capital controls are eventually exhausted.

Distorting taxation was modeled in this paper in the form of collection costs in order to emphasize the interaction between domestic government debt, capital controls, and the efficiency of tax administration. One of the conclusions emerging from the analysis is that the improvement in the efficiency of tax collection may induce the removal of restrictions to capital flows.

Of course, since conventional taxes are distorting in our model only because they carry collection costs, the presence of these costs is crucial for the optimality of capital controls. It should be obvious, however, that the main results of the paper would remain unchanged if distorting taxation were to be modeled as, for instance, a distortion to the consumption-leisure choice. In such a case, capital controls would be used even if collection costs are zero and they would be related positively to the level of domestic government debt. In fact, we believe that the link between domestic government debt and capital controls--illustrated in this paper by means of a very stylized model--should be a fairly robust one.

Finally, it should be pointed out that while the analysis focused on the case of symmetric collection costs in order to sharpen intuition, it would be of interest to explore the additional implications for the issues discussed in this

paper which would stem from the presence of non-symmetric costs structures. In particular, the presence of non-symmetric collection costs could introduce the possibility of endogenous changes in the menu of taxes used by the government as a result of changes in public debt levels.

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