International Capital Mobility and Tax Avoidance *

1. Introduction

International capital mobility is the main determinant of the effects of capital-income taxation in an open economy. In the presence of international capital mobility a country's savings can *ex post* differ from a country's investment. Therefore taxes on assets' income, once portfolios have optimally adjusted, have radically different effects on savings. This paper studies the welfare effects of two forms of taxation of capital income in a small open economy characterized by perfect capital mobility. The first regime is one where all domestic investment income is taxed, but foreign investment income is not taxed. This regime is labelled "source-based taxation". The second regime is one where domestic residents are taxed on all their investment income, domestic and foreign, at the same rate: this regime is labelled "residence-based taxation".

The comparison of these two regimes is relevant because they are the two polar cases in the spectrum of international tax systems actually in place. Even though the theoretical models considered here represent extreme cases which are not observed in practice, these stripped-down economies are a necessary step to identify clearly the types of extensions and applications that are more useful to policy formulations (see section 5 for a discussion).

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This paper is motivated both by the observation that tax incentives are an important determinant of international capital flows, and by the evidence suggesting that the response of capital flows to these incentives is large and significant. In many countries international investments can very effectively be resorted to for the purpose of avoiding, or evading, domestic taxes. The purchase of foreign assets makes it easy to avoid taxes for three reasons: (a) ownership of foreign assets by domestic residents cannot always be verified and tracked by tax authorities;[1] (b) some governments (like the US government currently) do not levy withholding taxes on income from domestic securities accruing to foreign residents; (c) it is often possible to defer the payment of taxes on foreign assets' income, by deferring the repatriation of such income.[2]

As for the response of capital flows to tax incentives, the evidence is widespread, and growing.[3] This evidence is adding, and

[1] Bank-secrecy laws are the typical example of a hurdle against release of information to foreign tax authorities.

[2] In addition, the complexity of national tax codes, and the differences of tax codes from country to country, can blur the distinction between (illegal) tax evasion, and (legal) tax avoidance, and multiply the opportunities of the private sector to minimize tax payments through international transactions. See OECD (1987) for several examples of transactions that are considered legal by some countries, and illegal by others. In my analysis, the distinction between tax avoidance and tax evasion is inconsequential.

[3] For surveys see KOPITS (1976), BREAN (1984) and ALWORTH (1988). See also HARTMAN (1984) on tax determinants of US direct investment, and the more recent work of PAPKE (1988) on withholding taxes and US corporate borrowing from abroad, and HINES and HUBBARD (1989) on the use of deferral by US multinationals.

A recent study by the OECD (1987) reports that in 1978 gross dividend, interest and other income payments to tax haven residents from sources in the United States represented 42 percent of all such payments to non-residents. (Tax "havens" are Panama, Hong Kong, Liberia, Bahamas, Netherlands Antilles, Cayman Islands and Bermuda). Similarly, in the period 1978-1983, Japanese direct investment to tax havens was on average 18 percent of total foreign direct investment of that country, reaching, in 1983, 27 percent of the aggregate.

International capital flows to evade domestic wealth and capital-income taxes are likely to be a widespread phenomenon also among developing countries (see, for example, WALTER 1986). TANZI (1983), reviewing the structure of tax revenues in developing countries, notes that (i) income tax revenue is accounted for almost exclusively by taxation of wages; (ii) in poor countries the revenue from corporate income taxes is very low; (iii) wealth taxes account for an almost insignificant fraction of total tax revenue. These facts are in principle consistent with the view that international capital mobility imposes severe constraints on fiscal authorities. DORNBUSCH (1987) argues that the repeal of withholding taxes on US government securities might have been an important determinant of capital flight from Latin American countries. GIOVANNINI (1988), discussing the interwar experience in Italy, indicates that international capital flows to evade wealth taxes were possibly very large, and capital controls were imposed to facilitate extraordinary taxation.

providing new insights, to the already large empirical literature on international capital mobility.[4]

Since Feldstein (1980) and Feldstein and Horioka (1983) have pointed to the implications of savings and investment behavior in different countries on international capital movements, a number of dynamic models of international capital flows have been applied to study the effects of distortionary taxes in open economies. Recent contributions include Aizenman (1985), Stockman and Hernandez (1988), Gordon and Varian (1986), Gordon (1986), Frenkel and Razin (1987), Sinn (1987, especially ch. 7 and 8) and Bovenberg (1988). Slemrod (1988) surveys the effects of capital income taxation in open economies, using models that are quite similar to the one adopted in this paper. He notes that the standard static models of capital income taxes consistently neglect the distortions affecting intertemporal terms of trade, an effect I concentrate on here. None of these authors, however, provide a formal analysis of the welfare properties of the two alternative forms of capital income taxation mentioned above, along the lines followed, for example, by Feldstein (1978) in the closed economy case.[5] In the tradition of the optimal tax literature, I offer such an analysis assuming that the government does not have free access to all possible sources of revenue.

Section 2 of this paper presents a two-period model of savings, investment, and the current account, which is applied to study the effects of the two tax regimes. The welfare comparison of source-based and residence-based taxes is carried out in section 3. Section 4 endogenizes government spending, showing the open-economy effects of dynamic inconsistency and "discretionary" equilibria first discussed by Fischer (1980) and Kydland and Prescott (1980) in closed-economy models. Section 5 contains some concluding remarks, and a discussion of the promising extensions of this line of research. Appendix A shows how the results on optimal taxation and production efficiency apply to the model discussed in this paper. Appendix B proves that a combination of source-based taxes and quantitative controls on international capital flows can achieve an allocation of resources identical to that under a regime of residence-based taxation.

[4] For a survey on international capital mobility, see OBSTFELD (1986).

[5] See, however, HARTMAN (1985) for a welfare analysis of alternative tax regimes in an open economy. Hartman does not concentrate, as this paper does, on source-based *versus* residence-based taxes. RAZIN and SADKA (1988) in their own analysis of savings and investment taxes reproduce the production efficiency result, which I discuss below.

2. The model

I consider the standard one-good, two-period Fisherian model of an open economy,[6] with no uncertainty. The country is small, in that its own savings and investment do not affect the world rate of interest. This case is both a useful theoretical benchmark, since it helps to highlight all the basic effects that are at work also in a world where countries are "large", and a reasonable empirical paradigm, since very few countries in the world economy are large enough to affect aggregate variables.[7]

There are three agents in the economy: a representative firm, a representative consumer-investor and the government. The "representative agent" paradigm is consistent with the presence of a large number of price-taker identical agents in each class.[8] The firm has a decreasing-returns-to-scale technology to produce period-2 goods with period-1 goods. It borrows from the consumer K_2 at the rate R and invests in the production technology to get $f(K_2)$ the second period. It maximizes pure profits, which are $Y = f(K_2) - K_2R$, and pays them, lump sum, to the domestic resident. The optimal investment decision is determined by solving the first-order condition:

$$f'(K_2) = R \qquad (1)$$

Notice that, since there are only two periods, there is no capital stock in the second period. The use of all the capital stock in the first period in the production process does not imply that the rate of depreciation is 100 percent, either. The concept of depreciation is itself meaningless: since in the second period productive capital does not exist, there is no need to "replace what is worn out".

The consumer-investor starts with an initial endowment K which she allocates between consumption C_1 and savings. Contrary to the

[6] Recent applications of the intertemporal current account model include Razin (1984) and Gardner and Kimbrough (1987). See also Obstfeld (1988) for a discussion of the problems analyzed in this paper. Bhagwati (1978) stresses the importance of the effects of taxation and exchange controls on savings for welfare analysis.

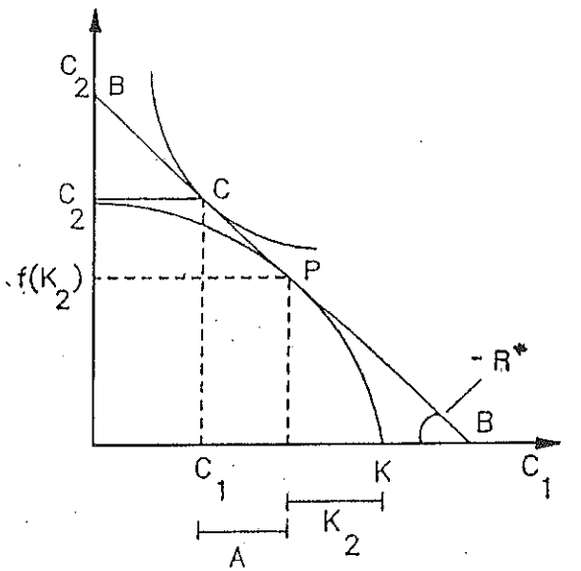
[7] International trade theorists will undoubtedly notice the similarity of the analysis in this paper with the analysis of the effects of consumption taxes and production subsidies in the standard international trade model.

[8] The assumption that agents are identical constitutes a potentially serious limitation in a number of applications of dynamic models, but does not seem to represent a hindrance for the analysis that follows.

firm, however, she has access to the world capital market, where she can borrow or lend at a fixed rate R*. Portfolio allocation is determined by market equilibrium: the firm borrows the profit-maximizing level of productive investment, and given total savings, international borrowing or lending (denoted by a positive or negative quantity A) is the residual. This result is due to the absence of uncertainty, which makes the consumer to any changes in the shares of the two assets in her portfolio. In the second period, the consumer receives income from the domestic investment, RK_2, the lump-sum transfer of pure profits Y, and income from foreign investments, R*A, and is taxed by the government according to the rules specified below. Notice that, here too, the distinction between gross and net interest income and principal repayment is meaningless, because in the second period investment capital is worthless. Thus R and R* represent in this model income from foreign and domestic investments.

Figure 1 shows the determination of equilibrium with no taxes. The bowed-out production-possibility frontier characterizes the domestic technology. Maximum consumption at time 1 equals the stock of available resources, K, plus the present discounted value (at the world rate of interest) of future investment income. In the absence of

Figure 1



arbitrage opportunities, R = R*, hence the investment level by the domestic firm is determined by the equality of the marginal return on domestic and on foreign investment, *i.e.* the tangency of the production possibility frontier with the world intertemporal terms of trade – the BB line with slope – R*. Savings, the current account, and consumption in the two periods are determined by the tangency of the consumption indifference curve and the BB line.

The remaining agent in the economy, the government, announces its policy (taxes and spending) in the first period. Taxes are levied on the consumer's income from domestic and foreign sources, but not on the firm's income. Under the "source" principle, only income from domestic sources is taxed, while under the "residence" principle income from both domestic and foreign sources is taxed at the same rate. In the second period the government collects tax revenue, and uses it to pay for its expenditure G, which yields utility to private agents. Since I assume that government spending affects utility separably from consumption, the effects of the two systems of taxation can be studied, without loss of generality, *for any given level* of G.[9]

Before proceeding further, it is useful to underline some of the main features of the model, in order to clarify the issues involved in modelling real-world tax systems. First, in this economy the firm does not pay taxes. In other words, there is perfect integration between corporate and individual taxation. This is clearly not verified in the real world, although the popular *imputation system* is designed to approximate the setup of this model. The absence of issues of corporate-personal income tax integration seems to be most appropriate for this paper, whose main objective is to characterize alternative international tax regimes.[10]

The absence of any imposition on corporate income implies, in particular, that pure profits are not taxable at the firm level. As we shall see in the next section, this is a crucial feature of the model. It amounts to assume that the government does not have complete freedom in the menu of taxes it chooses from. The assumption is motivated both by the well known fact that the corporate income tax is generally not a tax on pure profits, and by the appropriateness to

[9] This analysis is in the rest of this section and in the next section. Section 4 shows the case where the government's behavior is endogenous.

[10] Yet, the analysis of this paper can be easily extended to deal with these questions. For example one could apply the formulas developed by ALWORTH (1988) to the equilibrium model used here.

consider, along the lines of the optimal tax literature, the important role played by constraints in the choice of taxes.

Finally, the perfect symmetry of the two taxation systems modelled here should be stressed. Under the source principle, when $A>0$ foreign investment income is not taxed, but – if $A<0$ – foreign interest payments are not deductible. By contrast, when the residence principle is applied, foreign interest is added to domestic income both when it is positive and when it is negative (hence foreign interest costs are deductible). We are now in a position to turn to the formal description of the two tax regimes.

2.1 *Source-based taxes*

The consumers' problem is:

$$\max_{C_1,C_2} U(C_1,C_2) + v(G) \tag{2}$$

subject to:

$$K_2 + C_1 + A = K \tag{3}$$

$$AR^* + (1-\tau)(K_2R + Y) = C_2 \tag{4}$$

Utility is maximized over consumption, for given R and Y. The solution to the consumption-savings problem gives the sum $A+K_2$, whose breakdown is determined by the firm's investment decision. Equilibrium – for any given level of G that satisfies the government budget constraint (see below) – is defined by the following set of equations:

$$f'(K_2) = R$$

$$R = R^*/(1-\tau), \tag{5}$$

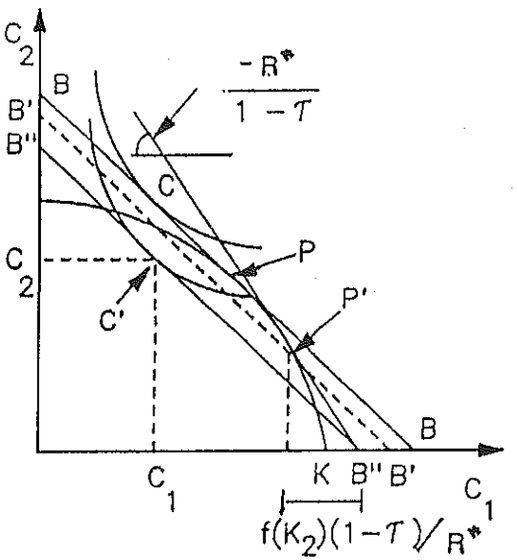
$$U_1(C_1,C_2) = R^*U_2(C_1, C_2) \tag{6}$$

plus, of course, the budget constraints (3)-(4), and the definition of profits Y. Equation (5) is the no-arbitrage-profits condition, which implies that the net return on savings is always equal to the world

interest rate.[11] Equation (6) is the standard Euler equation, setting the marginal rate of substitution between present and future consumption equal to the marginal rate of transformation, R*. Note that since R > R* the pre-tax marginal productivity of domestic investment exceeds the world rate of interest.

Figure 2 is a graphical illustration of this model. Equalization of the after-tax return on domestic investment with the world interest rate decreases the domestic capital stock and domestic production: the fall in K is caused by tax avoidance, which takes place because domestic residents can substitute home capital with tax-free foreign securities. The production distortion originating from the tax, however, does not affect the marginal rate of substitution between present and future consumption, since the fall in domestic investment insures that the return on savings is still R*. The budget line shifts further down and to the left, from B'B' to B''B'', since tax revenue is not rebated in a lump sum fashion to consumers, but is used to provide for utility-generating "infrastructures". At the consumption

FIGURE 2



[11] Notice that equation (5) would hold also in the case where foreign residents have direct access to the domestic investment technology, but are charged taxes on domestic investment income that equal the taxes paid by domestic residents.

point c', the vertical distance between the lines B'B' and B''B'' is equal to tax revenue and government spending. Consumption at time 2 is accordingly decreased, for every level of investment. What is the effect of the tax on savings? If present and future consumption are normal goods, an increase in τ increases savings, whereas savings decreases if future consumption is an inferior good. Since the no-arbitrage condition insures that the rate of return on savings is unchanged, savings is here affected exclusively by the income effect of the tax increase.

2.2 *Residence-based taxes*

When residence-based taxes are levied, income from all assets, domestic and foreign, is taxed at the same rate. The budget constraint, equation (4), becomes:

$$(AR^* + K_2R + Y)(1 - \tau) = C_2 \tag{7}$$

The equilibrium conditions are:

$$f'(K_2) = R$$

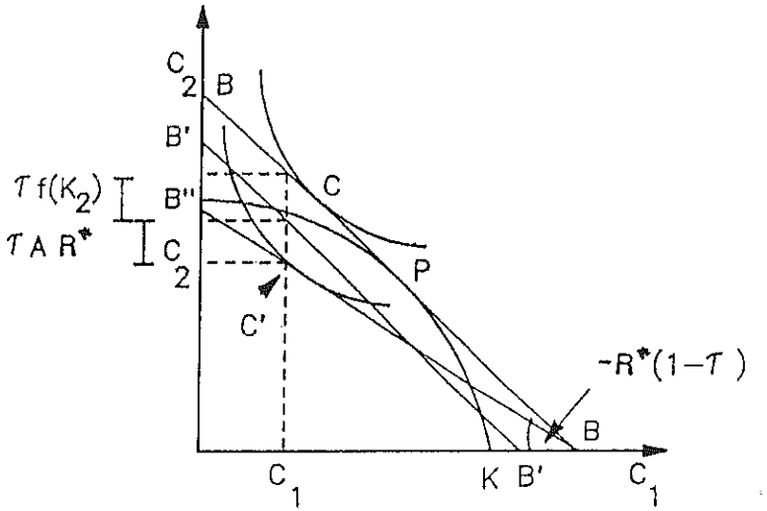
$$R = R^* \tag{8}$$

$$U_1(C_1,C_2) = R^*(1 - \tau)\, U_2(C_2,C_2) \tag{9}$$

Figure 3 illustrates the effects of the tax distortions in this case. Investment and the domestic capital stock are now unaffected by changes in τ. Thus international capital mobility now prevents capital income taxes from distorting the production side of the economy.[12] By contrast, as indicated by (9), the relevant rate of interest for savings is now the *after-tax* world interest rate. The line from B to B'' shows the consumption possibilities of domestic residents. At point B, first-period consumption equals the sum of the present discounted value (at world interest rates) of second-period output and the initial endowment K, second-period consumption equals zero, the revenue from taxation of domestic production identically offsets the tax rebates on foreign interest payments, and government spending is zero.

[12] Notice that this would not happen in a closed economy, see, for example, DIAMOND (1970).

FIGURE 3



The vertical distance between the line from B to B″ and the production point P is the revenue from taxation of domestic production. Equilibrium consumption, government spending, and the structure of tax revenues can be easily characterized as indicated in the figure. Line B′B′ shows the consumption possibilities of domestic residents before taxation of foreign assets' income. The vertical distance between BB and B′B′ is the revenue from the tax on domestic income, while the distance between the line from B to B″ and the B′B′ line is the revenue (or outlay) from foreign interest income (or payments). What is the response of savings to an increase in taxes? In the absence of international investment for tax avoidance, intertemporal substitutability in consumption tends to decrease savings, while the income effect – if both periods' consumption levels are normal goods – increases savings. Thus the response of savings to an increase in the tax rate is ambiguous, because of conflicting income and substitution effects.

3. Welfare comparison of the two regimes

Since the utility function of the private investors is separable in government spending and consumption, it is useful to analyze an optimal tax problem, where, taking government revenue as given, the menu of residence-based and source-based taxes is chosen so as to minimize welfare losses.[13] By showing the determinants of the optimal combination of savings taxes and investment-income taxes to raise a given amount of revenue, I will be able to determine the conditions under which a source-based regime – where all revenue originates from investment taxes – is superior to a residence-based regime – where all revenue originates from savings taxes. Thus I turn now to a problem where both source- and residence-based taxes are used.

Substituting the firm's into the private agent's budget constraint, we have:

$$C_1 + \frac{C_2}{(1-\tau_2)R^*} = K + \frac{(1-\tau)f(K_2)}{R^*} - K_2 \qquad (10)$$

The tax rate on income from domestic investment is τ_1, while the savings tax rate is τ_2. In this setup, the firm's first-order condition plus the no-arbitrage condition jointly imply:

$$f'(K_2)(1-\tau_1) = R^* \qquad (11)$$

Equations (10) and (11) comprise the two extreme cases studied above. Under a source-based regime, $\tau_2 = 0$ and $\tau_1 \neq 0$. Under a residence-based regime, $\tau_1 = 0$ and $\tau_2 \neq 0$.

The two main features of the optimal tax problem considered here are clearly illustrated in the budget constraint, reported in equation (10). First, the second term on the left-hand side shows that the intertemporal terms of trade to consumers are only affected by savings taxation, while the second term on the right-hand side shows that taxation of investment income only introduces production distor-

[13] For surveys of the optimal taxation literature, see SANDMO (1976), ATKINSON and STIGLITZ (1980) and AUERBACH (1985). HORST (1980) and FINDLAY (1986) use the same techniques to evaluate double taxation of international income flows and the optimal structure of international tax treaties.

tions. Second, since the domestic production technology displays decreasing returns to scale, the present value of pure profits are added to the initial resource endowment. This can be verified by noting that, given the no-arbitrage-profits condition,

$$\Pi = \frac{(1-\tau_1)f(K_2)}{R^*} - K_2 = \frac{f(K_2)}{R} - K_2 = \frac{Y}{R}, \quad (12)$$

where Π denotes the present value of pure profits.

In this problem, the optimal way to raise a given amount of revenue would involve proportional taxation of all goods, first- and second-period consumption, and would give rise to no distortions. Using the budget constraint, it can be shown that this solution is equivalent to lump-sum taxation of the present value of profits, Π, and first-period endowment, K. Since in our case first-period consumption, profits and first-period endowment are not taxable, taxes necessarily give rise to distortions. Furthermore, since particular profits are not taxable directly, it might be desirable to deviate from aggregate production efficiency, as an indirect means of taxing profits.

The optimal combination of taxes on domestic investment income (deviation from production efficiency) and taxes on savings, *i.e.* taxes on second-period consumption, is found by direct application of the formulas in Stiglitz and Dasgupta (1971), and Auerbach (1985) – whose derivation I outline in Appendix A. Optimal tax formulas can be obtained for a *specific* tax on second-period consumption (the tax on savings) and for the desirable deviation from production efficiency. Let t be the specific tax on second period consumption. Then the first-order condition for the optimal tax problem yields:

$$St = -\Phi\left(C_2 - \frac{d\Pi}{R^* d(1-\tau_2)}\right) \quad (13)$$

$$R^* = f'(K_2) + \Phi \frac{d\Pi}{R^* dA} \quad (14)$$

Where S is the Hicks-Slutsky substitution between period-1 and period-2 consumption (a negative number), and the factor Φ measures the marginal excess burden of taxation.[14] Equation (13)

[14] Equal to the expression $(\mu-\alpha)/\mu$ in the appendix.

shows that *other things equal* the optimal level of taxation of savings is larger, the lower the intertemporal substitution in consumption, and the lower the effects of changes in the intertemporal terms of trade on capital accumulation and profits. Equation (14) shows that *other things equal* taxation of domestic investment income is larger, the more profits can be decreased by increasing foreign investment. Thus, a large deviation from production efficiency would be desirable when driving a wedge between domestic and foreign rates of return, by lowering domestic investment, can lower profits significantly. Given savings, an increase in foreign investment obtained by a corresponding decrease in domestic investment affects profits as follows:

$$\frac{d\Pi}{dK_2} = \frac{d\left(\frac{f(K_2)}{f'(K_2)} - K_2\right)}{dK_2} = \frac{|f''(K_2)|}{[f'(K_2)]^2} \quad (15)$$

Notice that, the smaller the curvature of the domestic production function, the more similar, or "substitutable" are the domestic and foreign investment technologies, and the less effective is a reallocation of domestic and foreign investments in affecting pure profits.

These observations suggest a general criterion for the welfare comparison of source-based and residence-based taxes.[15] With low intertemporal substitution and high substitutability between domestic and foreign investment optimal savings taxes are large, while the optimal taxation of domestic investment is low: this is the case where source-based taxation is welfare-inferior. Conversely, optimal savings taxes are low and domestic investment taxes are high when intertemporal substitution in consumption is high, while the substitution between domestic and foreign investment technologies is low: in this case foreign investment for domestic tax avoidance, by correcting the distortions on intertemporal terms of trade that would arise if all savings were taxed, can improve welfare.

Since closed-form solutions to (13) and (14) cannot be obtained, I perform numerical simulations by assuming the following functional forms for U and f:

[15] This criterion, however. cannot be proved analytically since the system of non-linear equations (13)-(14) has in general no tractable solution. The validity of this criterion is further verified below, in the numerical simulations.

$$U(C_1,C_2) = [C_1^{1-\theta} + C_2^{1-\theta}/(1+\delta)](1-\theta) \quad (16)$$

$$f(K_2) = (1/\beta)K_2^{\beta} \quad (17)$$

Under these assumptions, the elasticity of intertemporal substitution and the elasticity of returns to scale are constant, and equal to $1/\theta$ and β, respectively.

The fixed parameters in the simulations, are first-period GNP $K = 1$, (one plus) the foreign rate of interest $R^* = 1.3$, and the utility discount factor $\delta = 0.25$. I compute the tax rate required to raise given amounts of revenue, equal to 10, 20 and 30 percent of first-period GNP. The tax rate is computed both when the source principle is applied (results in the columns labelled 1) and when the residence principle is applied (results in the columns labelled 2). I also compute, for every level of G – that is for every level of taxation – the resulting equilibrium level of domestic production $f(K_2)$ and level of foreign assets A. The last column on the right of the table reports an estimate of the welfare ranking of the two regimes. The estimate is the difference between the (equilibrium) value of the utility function when residence-based taxes are used to provide the given government revenue and the (equilibrium) value of the utility function when instead source-based taxes are used. In order to express this difference in terms of consumption units, I divide it by the value (in equilibrium) of the marginal utility of first-period consumption in the case where the residence-based tax is applied.[16] Thus the welfare loss from source-based taxation is expressed, for every level of tax revenue, as percent of first-period GNP.

The model is solved for different taste and technology parameters. In the top panel, with $\beta = 0.4$, $\theta = 4$ and G = 30 percent of GNP, international tax avoidance with source-based taxes makes second-period GDP fall by roughly 10 percent, and gives rise to a loss (relative to a residence-based tax) equivalent to 1.2 percent of GNP. In the second panel I double the elasticity of intertemporal substitution in consumption, with the result that the welfare loss of a source-based tax at G = 30 percent of GNP is roughly halved. The two bottom panels in the table show the cases where domestic investment and production are almost unaffected by international

[16] The method I follow relies on the simple expression for the normalized change in utility in comparative statics exercises:

$$dU/U_1 = dC_1 + (U_2/U_1)dC_2$$

investment for tax avoidance, because θ is very small. In these cases a source-based tax is welfare-superior to a residence-based tax, especially when the intertemporal substitution elasticity raises to 2 (θ = 0.5), as in the bottom panel of the table.

Thus table 1 broadly supports the criterion suggested by the optimal taxation formulas: source-based taxation is less desirable, the higher the substitution between domestic and foreign investments and relative to the substitution between present and future consumption, and *vice versa.*

TABLE 1

WELFARE COMPARISONS OF SOURCE-BASED AND RESIDENCE-BASED TAXES WITH EXOGENOUS GOVERNMENT SPENDING

G	τ		$f(K_2)$		A		U(2)–U(1)
	(1)	(2)	(1)	(2)	(1)	(2)	
			$\beta = 0.4$ $\theta = 4$				
10	.049	.086	203	210	– 65	– 72	0.0885
20	.102	.165	195	210	– 55	– 68	0.4293
30	.160	.240	187	210	– 45	– 65	1.1935
			$\beta = 0.4$ $\theta = 2$				
10	.049	.086	203	210	– 65	– 72	0.0379
20	.102	.168	195	210	– 55	– 70	0.2129
30	.160	.246	187	210	– 44	– 67	0.6681
			$\beta = 0.2$ $\theta = 4$				
10	.021	.044	466	468	–184	–187	–0.0033
20	.043	.087	463	468	–177	–183	–0.0104
30	.065	.128	460	468	–171	–180	–0.0162
			$\beta = 0.2$ $\theta = 0.5$				
10	.021	.044	466	468	–177	–188	–0.1794
20	.043	.092	463	468	–171	–193	–0.7991
30	.065	.142	460	468	–165	–198	–2.0303

Notes: All variables, except tax rates, are expressed as percent of first-period GNP (= K). The columns labelled (1) contain the simulation results for the source-based tax. Columns (2) denote the residence-based tax regime. U(2) – U(1) is the difference between $U(C_1,C_2)$ under residence-based taxes and $U(C_1,C_2)$ under source-based taxes. This difference is also expressed as percent of first-period GNP.

The result of this section should be compared with the standard production efficiency result obtained in models where the domestic technology is constant-returns-to-scale. In that case, as it is clear from the analysis above, source based taxes are always inferior.[17] By contrast, I show in this paper that, unless the tax system is sufficiently flexible and efficient (in the sense that the government does not face constraints on the types and extent of use of different taxes), it is in general inappropriate to rule out source-based taxation in an open economy. Hence this paper has provided a more general criterion, which admits constraints in the government taxing power.

The special case considered here is one where there exist pure profits in production, that are not taxable. This case is probably the most relevant, since it is well known that corporate income taxes are quite unlikely to tax pure profits. However, the main argument would also go through in the presence of another productive factor – say, labor – if the amount of tax revenue obtainable from it was subject to a ceiling. Similarly, as Auerbach (1985) shows, this type of criterion would still be valid when profits are taxable, but only up to a fixed limit.[18]

4. The inconsistency of optimal plans: capital levies and capital flight

In this section I endogenize government spending. The government maximizes the representative individual's utility function, taking the optimal responses to taxation as given. As Kydland and Prescott (1980) and Fischer (1980) show, in this type of problem the optimal plans of the government are in general reneged as time goes by, since the *ex ante* price elasticity of the demand for capital goods differs from the *ex post* elasticity.[19]

What are the government's incentives to impose a capital levy and their effects on investors' behavior? In the analysis that follows, I consider only source-based taxes. The arguments are easily extended

[17] See Razin and Sadka (1988) for an application of the production efficiency theorem to the problem discussed here.

[18] See Phelps (1986) for an analysis of the effects of profits taxation in open economies with capital mobility.

[19] This problem is also discussed by Krugman (1987).

to a residence-based tax. The two regimes are explicitly compared in the numerical simulations at the end of this section. Under source-based taxation, the government's problem at time 1 is:

$$\max_{\tau} \; W(R^*,\Pi+K)+v(G) \tag{18}$$

subject to:

$$G = \tau f(K_2) \tag{19}$$

$$R^* = f'(K_2)(1-\tau) \tag{20}$$

$$\Pi = f(K_2)\frac{(1-\tau)}{R^*} - K_2 \tag{21}$$

Where W represents the indirect utility function. The first-order conditions are:

$$v'(G)\left[1-\frac{f'(K_2)}{f(K_2)}\;\frac{f'(K_2)}{f''(K_2)}\;\frac{\tau}{1-\tau}\right] = \frac{W_2}{R^*} \tag{22}$$

and equations (19), (20) and (21). The solution of the problem yields a value of τ that investors would use in their portfolio and savings decisions. At time 2 the government might want to renege on the announced tax rate. The problem at time 2 is:

$$\max_{\tau} \; U(C_1,C_2)+\upsilon(G) \tag{23}$$

subject to:

$$K_2+C_1+A = K \tag{24}$$

$$AR^*+f(K_2)(1-\tau) = C_2 \tag{25}$$

$$\tau f(K_2) = G \tag{26}$$

$$A = \bar{A} \tag{27}$$

$$A = \bar{K}_2 \tag{28}$$

Since both A and K_2 are given at time 2, C_1 and $f(K_2)$ are given as well. Therefore, the first-order conditions are:

$$v(G) = \frac{\partial U}{\partial C_2} \qquad (29)$$

and equations (24), (25) and (26).

In the first period the tax base is elastic, hence the first order condition which equalizes the marginal (utility) costs and benefits of the tax takes that into account – as shown by the second term on the right-hand side of (22). In the second period, by contrast, the tax base is inelastic: hence the first-order condition implies that the marginal utility of consumption is equal to the marginal utility of government spending. Are the optimal *ex post* taxes higher than *ex ante*? The right-hand side of equation (22) equals U_1/R^*, since the derivative of the indirect utility function with respect to the present discounted value of available resources equals the Lagrange multiplier associated with the present-value budget constraint, and in turn, the marginal utility of period-one consumption. Therefore, given the consumption Euler equation (6), the right-hand side expressions in equations (22) and (29) are identical. Thus, a comparison of the left-hand sides of the two equations shows that *ex post* government spending and taxes are always greater than *ex ante*, if the marginal utility of government expenditure is decreasing.

Equations (22) and (29) also reveal that the government's incentive to raise higher taxes *ex post* is stronger, the larger the response of international capital flows to future taxes, *i.e.* the more "substitutable" the domestic and foreign investment technologies: in this case the marginal tax revenue term in equation (22) is relatively small, thus driving a larger wedge between the *ex ante* and *ex post* marginal utility of government spending.

By a similar argument it is possible to show that, in the uniform taxation case, the government's incentives to raise higher taxes *ex post* are positively related to the response of the current account to the savings tax rate: the higher the intertemporal elasticity of substitution the larger the difference between *ex post* and *ex ante* taxes.

Historically, examples of extraordinary taxation, like capital levies, debt repudiation, or exchange-rate "maxi" devaluations, are numerous. For this reason, and since the "fooling" equilibrium just described is unlikely to be self-replicating, it is plausible to study equilibria where the public anticipates the government's actions.

Define a *discretionary* equilibrium as one where the public perfectly anticipates future taxes, and the government has no incentives to renege on previous committments.[20] In the government's problem at time 2, the values of C_1, A, and K_2 – that the government takes as given – are functions of taxes expected at time 1. To make sure that the government will have no incentives to change the announced tax rate, the public has to choose A, C_1, and K_2 conditional on a value of τ consistent with the solution of the problem (23)-(25) and (26) above. Since *ex post* taxes are always greater than their *ex ante* optimal values, the discretionary equilibrium is characterized by "over-accumulation" of foreign assets.[21] The accumulation of foreign assets in the discretionary equilibrium is larger, the more similar are the domestic and foreign investment technologies. Therefore, the arguments for preventing international capital flows in a source-based regime are the same even when the endogeneity of government spending, and the effects of dynamic inconsistency, are explicitly accounted for:[22] if the interest elasticity of domestic investment is large relative to the interest elasticity of savings, tax evasion lowers national welfare relative to a regime where domestic and foreign investment income are taxed at the same rate.

TABLE 2

WELFARE COMPARISONS OF SOURCE-BASED AND RESIDENCE-BASED TAXES: THE CASE OF ENDOGENOUS GOVERNMENT SPENDING

β	θ	τ		$f(K_2)$		A		U(2)–U(1)
		(1)	(2)	(1)	(2)	(1)	(2)	
0.4	4.0	.381	.411	152	210	– 9	– 55	10
0.2	0.5	.277	.644	432	468	–107	–271	–80

Notes: See table 1.

[20] See FISCHER (1986) for the a complete discussion of the welfare ranking of "first best", "time inconsistent" and "discretionary" equilibria.

[21] An interesting historical example of this phenomenon is provided by the Italian experience in 1919. A capital levy was passed by the Italian government in November, and was publicly debated since the beginning of the year. The dollar price of liras in New York fell by 52 percent from December 1918 to December 1919, and many contemporary observers argued that capital flight for fear of the capital levy reached serious proportions in that year. See GIOVANNINI (1988).

[22] Since the logical structure of the proof of this proposition – as well as its intuition – are clearly the same as in section 3, I omit it for brevity's sake.

Table 2 illustrates these points, by reporting simulations of the full time-consistent discretionary equilibrium, assuming $v(G) = G^{1-\theta_1}/1-\theta_1$ and $\theta_1 = 1.5$. When $\beta = 0.4$, the public's anticipations of future confiscatory taxes much worsens the production distortions associated with a source-based tax: output falls 25 percent below the first-best optimum of 210. Similarly, when β=0.2 and θ=2, the relative ranking of the two regimes is sharply reversed.[23]

5. Conclusions, limitations and extensions

This paper has performed the analysis of source-based and residence-based taxes in a simple general equilibrium dynamic model,[24] and discussed the welfare rankings of the two tax regimes. The main result is that the welfare costs of international capital outflows to avoid domestic taxes – which occur under a source-based tax – are larger, the larger the interest elasticity of domestic investment, *relative* to the interest elasticity of savings. Thus the relative importance of portfolio substitution and intertemporal substitution provide a simple criterion to evaluate the welfare effects of the two regimes, from an individual country's perspective, taking the rest of the world as given. I have argued that the criterion offered here is more generally applicable than the production efficiency criterion – which suggests that source based taxes are always inferior – since in general governments do not have unlimited ability to tax all sources of income. Whenever the taxing power of the government is subject to exogenous constraints (of political or administrative nature) the criterion offered here is the appropriate one to use.

[23] This result stresses the large costs of savings taxation, rather than the superiority of tax evasion, with high intertemporal substitution, and low interest-rate elasticity of domestic investment. Tax evasion is of course still inferior to the regime where both domestic investment income and savings are taxed at differential rates.

[24] The model in this paper can be straightforwardly extended to an economy with many goods, as long as there is a single capital good (see, for example, SVENSSON and RAZIN, 1983). With many capital goods the negative relation between the stock of capital and the rate of interest is not guaranteed (see, for example, PASINETTI, 1966). Whether the basic result of my analysis – that the substitutability of present and future consumption determine the relative welfare effects of alternative taxation regimes – would hold in that more general setup is an interesting question in its own right. This question however goes beyond the scope of this paper.

The paper has also shown that the criterion for the welfare-comparison of the two tax regimes is robust to an extension: allowing governments to choose spending and taxes endogenously, and the private sector to guess out the government policies. Numerical simulations suggest that in this case the effects highlighted by the analysis under exogenous tax revenue are magnified. In Giovannini (1989) I show that the criterion offered in this paper is robust also to an extension of the model to allow non-cooperative interaction among tax authorities. Under a source-based system, the externalities from non-cooperative tax setting are worse, the higher the substitutability of investments in the different countries, relative to the intertemporal substitution of consumption. *Vice versa*, the externalities are small under a residence-based system, if intertemporal substitution in consumption is small relative to substitution of international investments.

Section 2 has stressed the simplifying assumptions about the tax structure on which the analysis has relied to highlight the basic effects of the two forms of taxation. This has also produced the additional effect of indicating important extensions of the analysis, which would be aimed at enriching the tax structure, and capture more empirically-relevant tax regimes. In particular, future work could profitably apply the general equilibrium model used here to the study of alternative forms of integration of corporate and individual taxes, of the effects of credits *versus* exemption of foreign taxes, of tax deferral,[25] and of different tax rules depending on the form of ownership of the foreign investment.[26]

In addition, a potentially illuminating extension of this analysis should allow for multi-period investment decisions[27] and for the presence of uncertainty. These and the above-mentioned extensions would lead to a deeper understanding of the production distortions originated by source-based taxes in the presence of international capital mobility, and would ultimately produce strong analytical support for policy design.

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[25] For this at least a 3-period model would be required.

[26] An analysis of the first-order effects of these types of tax rules is offered by ALWORTH (1988).

[27] NIELSEN and SORENSEN (1989) provide some results on the neoclassical growth model in an open economy applied to the analysis of alternative tax rules.

APPENDIX A

Optimal taxation and production efficiency with decreasing returns to scale

In this appendix I outline the solution of the optimal tax problem, in the presence of a decreasing-returns-to-scale domestic technology, and of an alternative constant-returns-to-scale foreign investment technology. This problem is solved by Auerbach (1985), following the earlier contributions by Stiglitz and Dasgupta (1971), and Diamond and Mirrlees (1971). The government is assumed to choose optimally a specific tax on second-period consumption, by setting the intertemporal terms of trade p (since this model implies a one-to-one relation between p and t), and the allocation of resources to the foreign investment technology A: this latter choice determines the optimal deviation from production efficiency (equality of the marginal productivity of domestic investment to foreign rate of interest).

The problem is formally stated as follows:

$$\max_{p,s} W(p, K+\Pi v) \tag{30}$$

subject to:

$$h(C+G-s) = 0, \tag{31}$$

$$g(s) = 0, \tag{32}$$

where:

$$h(z) = -K_2 + f(K_2) = 0 \tag{33}$$

$$g(s) = A + AR^* = 0 \tag{34}$$

$$p = q + t \tag{35}$$

$$q = dh \tag{36}$$

$$zq = \Pi \tag{37}$$

q represents the vector of producer prices, normalized taking the price of first-period capital to equal 1. Similarly, the price of first-period consumption equals 1. Equations (35) and (36) indicate that taxes are specific, and that the domestic investment industry is competitive. zq stands for the inner product of the vectors z and q. The vectors C and G represent, respectively, consumption and government revenue: (C_1, C_2), and (0,G). Using (30) to (34) it is possible to verify the intertemporal budget constraints, equations (3) and (4) in the text.

This problem implies two first-order conditions:[1]

$$St = -\left(\frac{\mu-\alpha}{\mu}\right)\left(C_2 - \frac{d\Pi}{dp}\right) \tag{38}$$

$$g_2 = h_2 - \left(\frac{\mu-\alpha}{\mu}\right)\frac{d\Pi}{ds_2} \tag{39}$$

Where the subscripts on the g and h function denote their partial derivative with respect to their period-2 arguments, S is the substitution between period-1 and period-2 consumption, μ is the multiplier associated with (33) and (34), and

$$\alpha = \lambda + \mu \frac{\partial C_2}{\partial(\Pi+K)},$$

where λ is the marginal utility of initial resources, $\Pi+K$. $\mu-\alpha$ represents the difference between raising a dollar of revenue at the actual margin and raising it by taking income from the consumer: this latter method induces a secondary loss from the fall in spending and tax revenue.

Equation (38) is the standard result from the theory of optimal taxation, corrected for the effect of the tax on profits, through savings and capital accumulation. Equation (39) can be rewritten after substituting for h_2 and g_2 – noting that first-period goods prices are normalized to 1:

$$1+r^* = f'(K_2) + \left(\frac{\mu-\alpha}{\mu}\right)\frac{d\Pi}{R^* dA} \tag{40}$$

[1] See AUERBACH (1985) for a detailed analysis of these formulas.

APPENDIX B

Quantitative capital controls can achieve the uniform taxation solution

A residence-based tax like the one described in section 2 might be difficult to achieve, since, for many governments, monitoring international trade in assets and estimating foreign assets' holdings by domestic residents is too costly.[1] Traditionally, outright prohibitions of purchases of foreign assets are a frequently used form of capital controls. Below I show that appropriately-set quantitative controls achieve the same allocation of resources as a regime of uniform taxation. Consider the following problem:

$$\max_{C_1,C_2} U(C_1,C_2)+v(G) \tag{41}$$

subject to:

$$K_2+C_1+A = K \tag{42}$$

$$AR^*+f(K_2)(1-\tau) = C_2 \tag{43}$$

$$A \leq \bar{A} \tag{44}$$

Equation (44) represents the quantitative controls on purchases of foreign assets. The first-order conditions for the problem (41)-(43) plus (44) are:

$$U_1(C_1,C_2) = U_1(C_1,C_2)f'(K_2)(1-\tau) \tag{45}$$

$$U_1(C_1,C_2) = U_1(C_1,C_2)-\zeta \tag{46}$$

and the intertemporal budget constraint (42)-(43), together with the "complementary slackness" condition:

$$\zeta(\bar{A}-A) = 0$$

In this problem, $\bar{A}$ can in fact be set at a level such that distortions on the production side of the economy are avoided. Let $\tau f'(K_2)U_2(C_1,C_2) = \zeta$: from equations (45) and (46), it follows that $f'(K_2) = R^*$, as implied by equation (8) in section 2.2, and $\zeta = \tau R^*U_2(C_1,C_2)$. Substituting into equation (46) yields equation (8) of section 2.2, the other first-order condition from the uniform taxation problem. The full solution produces the values for consumption, savings, and foreign asset accumulation that are obtained in the uniform-taxation problem. Furthermore, given the value of ζ, auctioning the rights to purchase foreign assets generates the same revenue as in the case where foreign assets' income is taxed. Therefore, even when foreign assets' income cannot be taxed, appropriately-set quantitative restrictions can achieve an allocation of resources identical to that obtainable with a residence-based tax.

[1] Tornell (1986) and Velasco (1987) argue that capital controls might be desirable as second-best devices in the presence of distortionary taxation.

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