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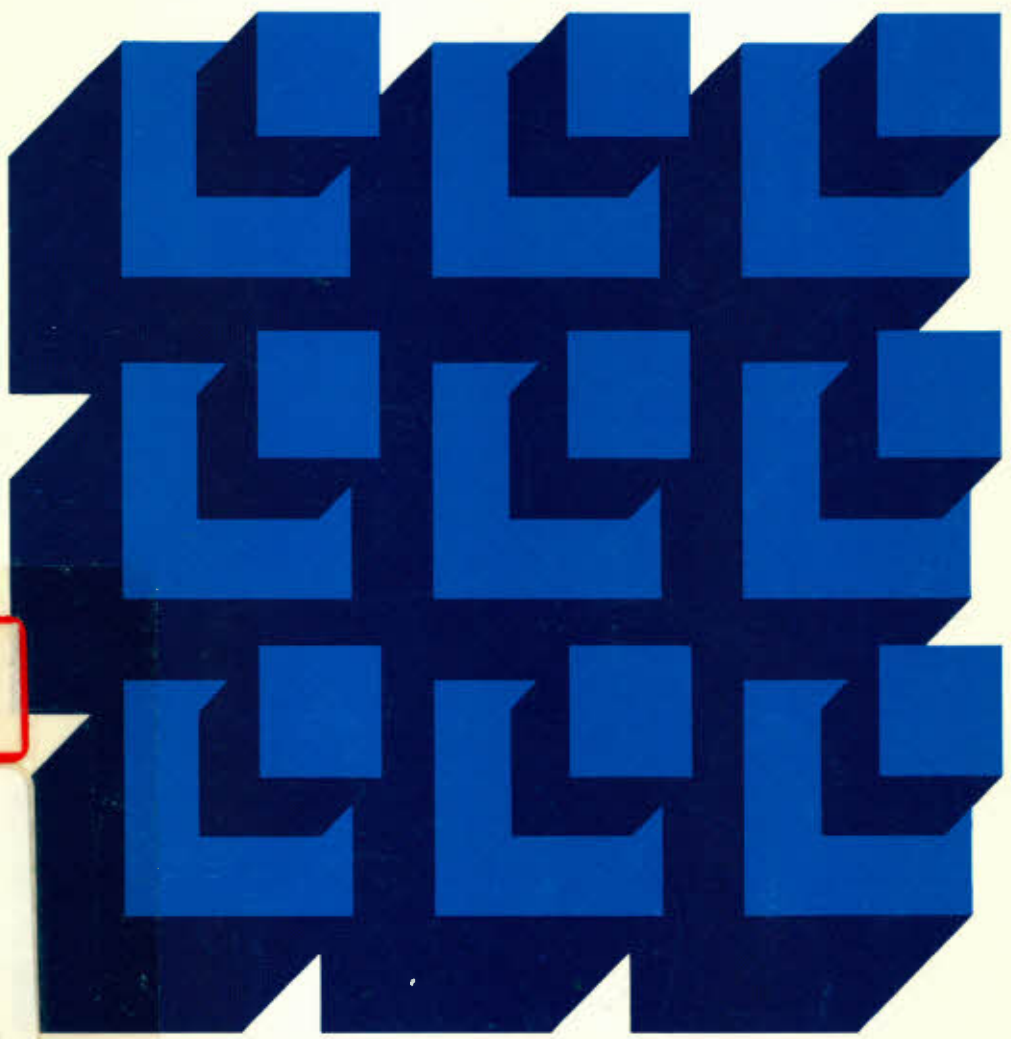

DISCUSSION PAPER NO. 306

Taxation and Life Cycle Savings Behaviour in a Small Open Economy

by Denis Gauthier

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RÉSUMÉ

Dans le présent document, la question de la réforme fiscale dans le contexte d'une petite économie ouverte est examinée à l'aide d'un modèle de croissance équilibrée avec comportement des agents fondé sur l'hypothèse du cycle de vie à période multiple. Les effets sur le bien-être des systèmes d'impôt sur le revenu, sur les salaires et traitements et sur la consommation sont évalués dans le cadre d'un équilibre général. L'analyse est effectuée pour trois genres d'accords internationaux concernant l'imposition des revenus du capital étranger. Les résultats obtenus varient selon la proportion de l'investissement domestique qui est financé à partir de capitaux étrangers et le genre d'accords fiscaux internationaux. Il est aussi démontré que les résultats sont sensibles à différentes hypothèses sur la valeur de l'élasticité de l'épargne domestique par rapport au taux d'intérêt. Dans certains cas, les effets sur le bien-être d'une réforme fiscale particulière peuvent être inversés simplement en changeant la valeur de cette élasticité.

ABSTRACT

In this paper, a multi-period life cycle growth model is used to examine the question of tax reform in the context of a small open economy. General equilibria for equal-yield income, wage and cosumption tax systems are simulated, and their effects on welfare calculated, for three types of international arrangements concerning the taxation of foreign capital income. The results turn out to depend on the extent of foreign financing of domestic investment and the nature of the international tax arrangements. It is also shown that the results are quite sensitive to different assumptions about the domestic economy's interest rate elasticity of saving. In certain cases, changing the value of this elasticity leads to a reversal of conclusions concerning the welfare effects of a particular tax change.

CONTENTS

1 INTRODUCTION

Feldstein's [1978] critical article on the welfare cost of capital income taxation has generated a renewed interest among economists in the welfare implications of dynamic tax reform. Using a general equilibrium approach and formulating the consumer's intertemporal optimization problem in an enriched version of the life cycle model covering fifty periods instead of just two, Summers [1981a] simulated steady-state equilibria under different tax bases and concluded that "the annual welfare gain from a shift to consumption taxation is conservatively estimated at 10 per cent of GNP." (Summers [1981a, p. 543]) This startling result attracted criticisms and modifications to Summers' work by other economists such as Auerbach, Kotlikoff and Skinner [1983], Evans [1983], Seidman [1983], and Chamley [1985]. Despite the growing interaction of international capital markets, all of the above authors conducted their analyses in a closed economy framework.

In this paper, using a steady-state growth model with continuously overlapping generations of life cycle savers and more realistic assumptions about the age-earnings profile, we extend the analysis to consider the question of tax reform in the context of a small open economy. With capital being perfectly mobile across national boundaries, the welfare impact of any tax reform will be influenced by the nature of international arrangements

concerning the taxation of foreign capital income that accompany the tax change. Accordingly, simulation results of tax changes and the evaluation of their welfare impact will be derived for three types of international tax arrangements.

Recently, Hartman [1985] showed that the "foreign tax revenue effect" implied by international capital ownwership could easily dominate other welfare effects of tax changes. However, in examining the case with perfectly elastic international capital flows, Hartman concluded that "one might need to know a great deal about the domestic capital market in order to determine even the direction of the bias produced by ignoring the openness of the economy". (Hartman [1985, p. 17]) In our model too, the tax revenue transfer effect between international jurisdictions will play a crucial role in determining the welfare advantage of a particular tax system over others, and its magnitude will depend primarily on the level of the domestic saving rate. We will also show that, in certain cases, the conclusions regarding the welfare effects of a tax change can be reversed simply by using different assumptions concerning the value of the interest rate elasticity of saving.

Section 2 of the paper describes the details of the model and the parametric assumptions. The three types of international arrangements concerning the taxation of foreign capital income are described in Section 3. Simulation results and welfare evaluation

of equal-yield income, wage and consumption tax systems for each of the three types of international fiscal arrangements are also presented in this section. A concluding section discusses the main findings of this study.

2 THE MODEL

Consumption demand and the supply of savings by domestic residents are determined by aggregating over a series of continuously overlapping generations the individual demand and supply functions derived from the intertemporal optimization of a multi-period life cycle model of savings behaviour. In this model, individual preferences for consumption in different periods are governed by an additive, isoelastic utility function. The discounted value of a representative individual's lifetime utility is:

$$(1) \quad U = \int_0^T \frac{C(t)^{\gamma}}{\gamma} e^{-\delta t} dt,$$

where $C(t)$ = consumption at age t,[1]

$1-\gamma$ = elasticity of the marginal utility function,

δ = utility discount rate, and

T = certain age of death.

Individual savings or asset accumulation is given by the following differential equation:

$$(2) \quad \dot{a}(t) = r(1-t_r)a(t) + (1-t_w)W(t) - \frac{C(t)}{1-t_c},$$

where $a(t)$ = individual assets at age t,

$\dot{a}(t)$ = change in assets or saving at age t,

$W(t)$ = wage at age t,

r = gross of tax rate of return on capital,

t_r = capital income tax rate,

t_w = wage tax rate, and

t_c = consumption tax rate.

In this model, two factors account for the evolution of the representative individual's labour income through time. One factor is age-specific. Its effects depend on the instantaneous age-earnings structure. The other factor is time-specific and stems from aggregate labour productivity growth.

It is assumed that individuals of the same age are homogeneous with respect to their labour services and hence receive the same wage. However, because of differences in education, training, experience, etc., workers in different cohorts (v) have different productivities and, accordingly, receive different wages following a hump-shaped age-earnings profile given by:

$$(3) \quad W(v) = W(0)e^{(bv+cv^2)}.$$

Due to aggregate labour productivity increases, W(v) grows exponentially by g per cent per period. Thus, ageing of workers combined with the above assumption on aggregate labour productivity increases give rise to the following wage-time profile for the representative individual:

$$(4) \quad W(t) = W(0)e^{(g+b+ct)t}.$$

Expression (4) can be rewritten as:

$$(5)\quad W(t) = \frac{\bar{W}(0)}{\Omega} e^{(g+b+ct)t},$$

$$\text{where } \Omega = \frac{n}{(1-e^{-nT'})} \int_0^{T'} e^{(b-n+ct)t} dt,$$

$\bar{W}(0)$ = average wage in period 0,

n = rate of population growth, and

T' = age of retirement.

With expression (5) describing the individual wage-time profile, the optimization problem of the representative individual consists in maximizing expression (1) subject to the equation of motion (2) and to the state variable a(t) taking initial and terminal values of zero. The above constraint on the state variable rules out bequest motives for saving in our model.

When aggregated over all generations of individuals, the results of the representative individual's intertemporal optimization problem can be used to derive the long-run consumption and saving functions for the domestic economy:

$$(6)\quad C = \frac{n(1-t_c)(1-t_w)\bar{W}L\Psi\{[\gamma r(1-t_r)-\delta]/(1-\gamma)\}(e^{\{[r(1-t_r)-\delta]/(1-\gamma)-n-g\}T}-1)}{(1-e^{-nT'})\Omega(e^{[\gamma r(1-t_r)-\delta]T/(1-\gamma)}-1)\{[r(1-t_r)-\delta]/(1-\gamma)-n-g\}},$$

and

$$(7)\quad S = \frac{(n+g)\bar{W}(1-t_w)L}{[r(1-t_r)-n-g]} \left\{\frac{n\Psi[\gamma r(1-t_r)-\delta]/(1-\gamma)(e^{\{[r(1-t_r)-\delta]/(1-\gamma)-n-g\}T}-1)}{(1-e^{-nT'})\Omega(e^{[\gamma r(1-t_r)-\delta]T/(1-\gamma)}-1)\{[r(1-t_r)-\delta]/(1-\gamma)-n-g\}} - 1\right\},$$

where $\Psi = \int_0^{T'} e^{[g+b-r(1-t_r)+ct]t} dt$, and

L = fixed labour supply.

The actual steps involved in the optimization problem of the representative individual and the derivation of the aggregate consumption and saving functions are described in Gauthier [1985].

The production side of the model is represented by an aggregate Harrod-neutral CES production function.[2] The derived demands for capital and labour inputs are obtained from the following marginal conditions for cost minimization:

$$(8) \quad r = \alpha[\alpha+(1-\alpha)(K/L)^{(1-\sigma)/\sigma}]^{1/(\sigma-1)}, \text{ and}$$

$$(9) \quad \bar{W} = (1-\alpha)[\alpha(K/L)^{(\sigma-1)/\sigma}+1-\alpha]^{1/(\sigma-1)},$$

where K = aggregate capital stock,

$0<\alpha<1$ is the distribution parameter, and

$0<\sigma<\infty$ is the elasticity of substitution between capital and labour.

The amount of productive capital available in the domestic economy is given by:

$$(10) \quad K = A + A^*,$$

where A = aggregate asset accumulation by domestic residents, and

A* = net foreign assets employed in the domestic economy.

It is assumed that individuals receive the full return on their savings at each period of time. This assumption permits to disregard the distinction between taxing capital income on an accrual or a realization basis.

Finally, perfect international capital mobility is assumed and the domestic economy is considered too small to influence prices on the international markets for capital, goods and services. This small open economy assumption implies that the balance of payments equilibrium condition simplifies to:

$$(11) \quad TB - r(1-t_r)A^* + I-S = 0,$$

where TB = trade balance, and

I = investment.

Given a rate of return on capital determined exogenously on world markets and the rate at which capital income is taxed, equations (7) to (11) plus the steady-state conditions that $S=(n+g)A$ and $I=(n+g)K$ can be solved to yield steady-state general equilibrium values for S, I, $\bar{W}$, net inflow of capital NF, and net exports

of goods and services NX^3. Gross domestic product (GDP) and aggregate consumption can then be evaluated by substituting the appropriate values into the production function and equation (6).

In solving the numerical model, it is assumed that individuals live 50-year economic lives with retirement at "age" 40, and that population and aggregate labour productivity grow by 1.5 per cent and 2 per cent per annum respectively. Values for b and c are set such that the instantaneous age-earnings profile is characterized by individuals in their 30th working year having the highest earnings of any age group; their earnings being 50 per cent higher than earnings of individuals who are just starting their working life. This implies the following parameter values: b=.027031 and c=-.0004505.

The choice of values for the parameters γ and δ is more problematic. It can be shown that $\gamma=1-1/\varepsilon$, where ε is the intertemporal elasticity of substitution in consumption. Estimates of ε found in the literature range from almost 0 to .75.[4] This implies an upper-bound value of -.33 for γ. There is no empirical evidence regarding δ.[5] Here, values for γ and δ are determined by calibrating the demand side of the model to particular benchmark solutions. Two benchmark cases are considered: a high and a low saving economy. In the "high saving economy" case, γ and δ are set such as to yield an aggregate long run saving rate out of disposable labour income equal to 15 per cent when the after-tax rate of interest is 4 per cent. Using equation (7), this can be

achieved by setting γ=-.396 (ε=.716) and δ=0. Although an infinite number of pairs of γ and δ would satisfy the above benchmark, the solution pair with δ=0 is preferred for two reasons. First, even though they are theoretically conceivable, negative utility discount rates are ruled out as being intuitively unappealing. Second, solutions with positive values for δ have values for γ (or ε) outside the range of empirical estimates mentioned above. The "low saving economy" case is characterized by an aggregate long run saving rate out of disposable labour income equal to 7.5 per cent when the after-tax rate of interest is 4 per cent. Keeping δ=0, equation (7) can be calibrated to the above saving rate by setting γ=-1.189 (ε=.457).[6]

Regarding parameters of the production function, the model will be solved with alternative values of 1 and .5 for σ. In both cases, α is set so that labour's share of GDP is .75 in the base case equilibrium with an income tax.

3 STEADY-STATE COMPARISONS OF TAX ALTERNATIVES UNDER DIFFERENT INTERNATIONAL TAX ARRANGEMENTS

In this section, the numerical model just described is used to examine the effects on steady-state general equilibria and welfare of alternatives to the taxation of capital income in a small open economy. The base case equilibrium used for comparisons of tax alternatives is one with an income tax system with tax rates of 20 per cent on labour income and 50 per cent on capital income.[7] It is assumed that the government runs a balanced budget. The analysis is conducted in a differential incidence framework. Having determined the base case equilibrium level of government revenues, the model is then solved for two equal-yield tax alternatives: a wage tax and a consumption tax.

It is assumed that the "rest of the world" also taxes capital income at a rate t_r^* of 50 per cent and that it will continue levying a tax on capital income at that same rate when alternatives to the taxation of capital income are considered for the domestic economy. In the base case equilibrium, each country taxes worldwide capital income of residents and domestic income of non-residents, and foreign tax credit systems are in place in each country.[8] Thus, under the income tax system, the domestic economy faces an infinite supply of funds at the world fixed gross rate of return r^*. In this paper, a value of 8 per cent is assumed for r^*.

The simulation results for the domestic economy of collecting the same amount of revenues from different tax bases will depend critically on the nature of the international arrangements concerning the taxation of foreign capital income. Three possible cases are simulated. In the figures accompanying the following description of these three types of international tax arrangements, the dotted line represents the supply of saving by domestic residents while the full line represents the supply of domestic and foreign funds available for productive uses by the domestic economy given the type of international tax arrangement.

Case 1: Residence-source

Under the two alternative tax bases, capital income of foreigners is no longer taxed by the domestic government. It is taxed back in the foreigner's country according to the residence principle. However, foreign capital income of domestic residents is still taxed at source and those taxes are not credited by the domestic government.

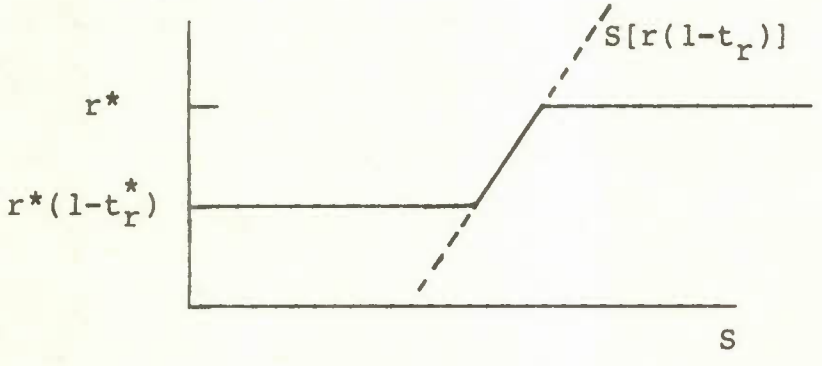

Figure 1

The equilibrium rate of return will lie between r^* and $r^*(1-t_r^*)$ as domestic investors have access to an infinite supply of foreign funds at r^* and domestic savers are guaranteed a rate of return of $r^*(1-t_r^*)$ on world markets.

Case 2: Residence - (residence)

As in Case 1, capital income of foreigners is no longer taxed by the domestic government in the two alternative tax systems; it is taxed back in the foreigner's country. Concurrently, foreign governments adopt a reciprocal treatment towards foreign capital income of domestic residents, i.e., foreign capital income of domestic residents is also no longer taxed at source by foreign governments.

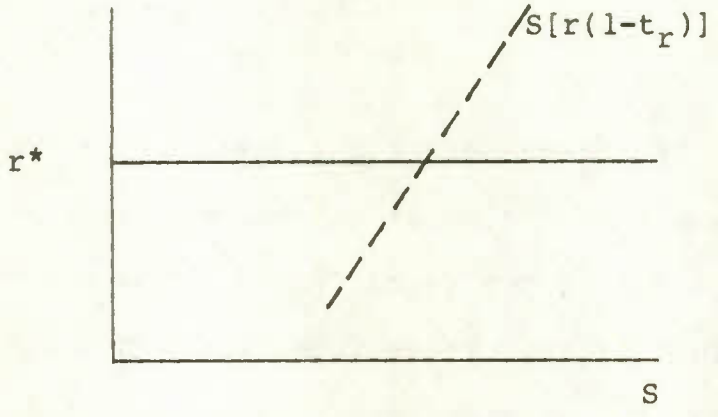

Figure 2

This type of tax arrangement produces a unique equilibrium rate of return equal to r^*.

Case 3: Source - source

Under either the wage or consumption tax bases, the domestic government continues levying a 50 per cent tax on capital income of foreigners (which is credited by the foreign government). At the same time, foreign capital income of domestic residents is still taxed at source and those taxes are not credited by the domestic government.

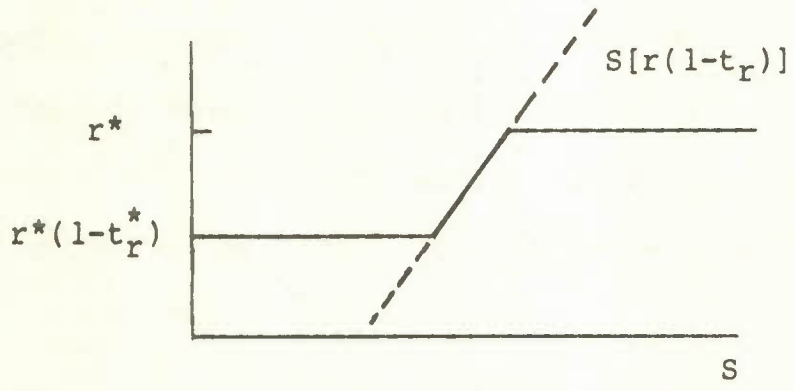

Figure 3

Case 3 yields the same shape for the supply of funds available for productive uses by the domestic economy and the same range for the equilibrium rate of return as Case 1. However, the general equilibrium solutions may differ from Case 1 to Case 3 as part of the tax revenues may be levied on foreign capital in the latter case.

In each of the three cases described above, equilibrium will occur where the domestic investment schedule derived from

equation (8) intersects the supply of domestic and foreign funds available for productive uses represented by the full line in Figures 1 to 3. It should be noted that although the "low-saving" and the "high saving" versions of the domestic economy are represented in this paper as net importers of capital in the base case equilibria with an income tax system, the domestic economy's capital account may close or open itself under the two alternative tax systems depending on whether the equilibrium occurs or not on a section of the domestic (dotted line) supply of saving.

Simulation Results

Wage tax and consumption tax simulations will differ because of the two tax systems' different effects on aggregate saving. These effects can be illustrated as follows. A higher net rate of return to savers following the removal of the tax on capital income induces a higher level of domestic saving, provided the aggregate saving function is not totally interest inelastic. However, to this movement along the saving schedule must be added a shift of the saving schedule itself. Given the government revenue requirements, a higher tax rate on labour income or taxation of consumption is needed to offset the loss of tax revenues previously levied on capital income. According to equation (7), a higher value for t_w will cause an inward shift of the aggregate saving schedule. However, a tax on consumption is neutral with

respect to saving as t_c does not appear in equation (7).[9] The saving schedule will nevertheless shift outward as t_w is reduced from 20 per cent under the income tax system to zero under the consumption tax system. Thus, for equal-yield alternatives to the income tax system, the additional amount of saving induced by the removal of the tax on capital income will be greater under the consumption tax system than under the wage tax system.

Steady-state equilibrium solutions of the model under the base case income tax system and the two alternative tax bases for the three types of international tax arrangements considered are presented in Tables 1 to 4.

Table 1 presents simulation results for the "low saving" economy with Cobb-Douglas production technology. In the base case equilibrium with an income tax system, 5.3 per cent of GNP is saved by the domestic economy's residents and the net inflow of capital (NF) amounts to 7.5 per cent of GNE. Given the high level of capital imports, more than one fourth of the domestic government's revenue requirements (π) is being raised on capital income of foreigners. Although the saving rate out of disposable income increases from 6.9 to 12 per cent under the wage tax system, this is insufficient to finance all the investment demand and the domestic economy remains a net importer of capital on the world market. For that reason, Cases 1 and 2 produce identical results. With an unchanged rate of return at 8 per cent, GDP/L is

Table 1

Steady-State Comparisons of Tax Alternatives
Low Saving Economy; σ=1

	Income tax	Wage Tax			Consumption Tax		
		Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
r	.08	.08	.08	.08	.075	.08	.075
$r(1-t_r)$	.04	.08	.08	.08	.075	.08	.075
$\bar{W}$	1.097	1.097	1.097	1.097	1.118	1.097	1.118
$\bar{W}(1-t_w)$	.877	.694	.694	.737	1.118	1.097	1.118
GDP/L	1.462	1.462	1.462	1.462	1.491	1.462	1.491
GNE/L	1.247	1.360	1.360	1.377	1.491	1.513	1.491
C/L	.887	.843	.843	.895	.916	.929	.916
C/GNE	.711	.620	.620	.650	.614	.614	.614
I/GNE	.128	.118	.118	.116	.116	.106	.116
TB/GNE	.011	.042	.042	.004	0	-.019	0
NX/GNE	-.162	-.033	-.033	-.058	0	.015	0
K/GDP	3.125	3.125	3.125	3.125	3.312	3.125	3.312
NF/GNE	.075	.033	.033	.027	0	-.015	0
S/GNP	.053	.085	.085	.089	.116	.120	.116
S/Yd	.069	.120	.120	.120	.159	.164	.159
$\bar{W}$L/GDP	.75	.75	.75	.75	.75	.75	.75
t_w	.2	.367	.367	.328	0	0	0
t_r	.5	0	0	0	0	0	0
t_c	0	0	0	0	.305	.302	.305
FT/π	.268	0	0	.106	0	0	0
Welfare change (as % of lifetime income)		-14.030	-14.030	-8.056	-4.010	-4.324	-4.010

Assumptions: T=50, T'=40, δ=0, n=.015, g=.02, γ=-1.189, (ε=.457), α=.25, σ=1. b and c are chosen such that people in their 30th working year have the highest earnings on a cross-section basis; their earnings being 50 per cent higher than earnings of people just starting their working life.

unaffected but GNE/L rises as reduced interest payments to foreigners improve the goods and services account of the balance of payments. The increase in GNE/L is more pronounced in Case 3 where the imposition of a withholding tax on capital income of foreigners, which finances 10.6 per cent of the government's revenue requirements, permits the taxation of labour income at a lower rate than in Cases 1 and 2. The higher after-tax wages that result lead to more savings and to smaller net imports of capital.

Under the equal-yield consumption tax, all foreign investment is crowded-out by the additional saving generated. In Cases 1 and 3, which yield the same results, the excess supply of domestic saving puts downward pressure on the rate of return. The new capital market equilibrium is achieved at a rate of return of 7.5 per cent with an increase in the capital/labour ratio of 8.1 per cent over the base case equilibrium. This capital deepening results in higher output and wages. In Case 2, the excess supply of domestic saving, which accounts for 1.5 per cent of GNE, is invested abroad free of taxes at the fixed world rate of return. Compared to the base case equilibrium, the levels of investment, wages, and GDP remain unchanged, but GNE/L increases due to the surplus in net exports of goods and services and the rise in C/L.

Except for Cases 1 and 2 of the wage tax system, the simulation results for the wage and consumption tax systems show increases

in the levels of aggregate consumption. It cannot be concluded, however, that higher aggregate consumption necessarily implies a welfare improvement. Under the two alternative tax systems individuals choose to reduce their consumption in early periods of their lives in order to augment it proportionately more in later periods. This trade-off may produce a higher steady-state equilibrium value for C/L and still not constitute a welfare improvement for individuals. This could occur, for example, if individuals were net borrowers in the early periods of their lives.

According to the utility function (1), individuals essentially derive utility from the level and time pattern of consumption they can achieve throughout their lives. The adjustment of the individual consumption stream under the two alternative tax systems can be analyzed in terms of a price effect and three wealth effects. First, the higher net rates of return to savers under the wage and consumption tax systems improve the intertemporal terms of trade by lowering the implicit price of future consumption. This price effect benefits individuals who are net lenders throughout their working lives. However, the welfare implications of this price effect are ambiguous for individuals who are net borrowers in early years, and it will depend on the magnitude of the intertemporal elasticity of substitution with regard to consumption. A welfare loss may result if this elasticity is low. Second, a negative net wealth effect results from the increase in either the wage tax rate or the consumption tax rate. The former reduces the disposable income of individuals during their working

lives, whereas the latter raises the gross price of consumption goods in every period. The effect is generally weaker in the consumption tax alternative since the tax liabilities are spread over a longer period including retirement years.[10] Third, an additional negative net wealth effect follows from increased taxation of domestic residents to compensate for the loss in tax revenues that were previously levied on capital income of foreigners. Finally, when equilibrium occurs at a rate of return lower than r^*, as in Cases 1 and 3 under the consumption tax system, the increased demand for labour accompanying the capital deepening leads to higher gross wages. This is equivalent to a positive gross wealth effect.

The steady-state welfare consequences for the representative individual of replacing the income tax by a wage tax or a consumption tax can be evaluated by measuring the wealth equivalent to the change in lifetime utility resulting from the combined price and wealth effects just described. The wealth equivalent variations as a percentage of the base case lifetime income appear in the last row of Tables 1 to 4. For the "low saving" economy with Cobb-Douglas production technology, figures in Table 1 reveal that in Cases 1 and 2 the wage tax alternative would be equivalent to a 14 per cent reduction in the lifetime income of the representative individual. The large tax revenue transfer to foreigners (26.8 per cent of government revenue requirements) is the main cause of this. In Case 3, where a

withholding tax of 50 per cent applies to capital income of foreigners, the welfare loss is reduced to 8 per cent of lifetime income. Under the consumption tax system, the postponement of taxes and the capital deepening effect offset somewhat the tax revenue transfer effect, but there still results a welfare loss of 4 per cent of lifetime income for the representative individual.

The simulation result for the "high saving" economy with Cobb-Douglas production technology are presented in Table 2. The base case equilibrium yields a saving/GNP ratio of 9.4 per cent. With lower net imports of capital that amount to 2 per cent of GNE, only 8 per cent of government revenue is derived from taxes on the capital income of foreigners. Foreign investment is completely crowded-out by additional domestic saving under both alternative tax systems. The fiscal base of the withholding tax on capital income of foreigners vanishes and Case 3 produces results identical to those in Case 1. For these two cases, the equilibrium under the wage tax system is attained at a rate of return of 6.5 per cent with increased capital stock, wages and output. After-tax wages are, however, lower than in the base case due to the higher tax rate on labour income needed to replace government revenues that were previously obtained from the taxation of capital income, and to compensate for the revenues lost through the tax transfer to foreigners. Despite the improvement in the intertemporal terms of trade and the capital deepening effect, the diminution in disposable labour income is large enough to create a welfare loss that amounts to .58 per cent

Table 2

Steady-State Comparisons of Tax Alternatives
High Saving Economy; σ=1

	Income tax	Wage Tax			Consumption Tax		
		Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
r	.08	.065	.08	.065	.054	.08	.054
$r(1-t_r)$	.04	.065	.08	.065	.054	.08	.054
$\bar{W}$	1.097	1.173	1.097	1.173	1.247	1.097	1.247
$\bar{W}(1-t_w)$	.877	.770	.694	.770	1.247	1.097	1.247
GDP/L	1.462	1.563	1.462	1.563	1.663	1.462	1.663
GNE/L	1.397	1.563	1.669	1.563	1.663	2.001	1.663
C/L	.896	.952	1.017	.952	.993	1.203	.993
C/GNE	.641	.609	.609	.609	.597	.601	.597
I/GNE	.114	.134	.096	.134	.161	.080	.161
TB/GNE	.003	0	-.070	0	0	-.152	0
NX/GNE	-.043	0	.054	0	0	.118	0
K/GDP	3.125	3.821	3.125	3.821	4.596	3.125	4.596
NF/GNE	.020	0	-.054	0	0	-.118	0
S/GNP	.094	.134	.150	.134	.161	.198	.161
S/Yd	.128	.180	.198	.180	.212	.247	.212
$\bar{W}$L/GDP	.75	.75	.75	.75	.75	.75	.75
t_w	.2	.343	.367	.343	0	0	0
t_r	.5	0	0	0	0	0	0
t_c	0	0	0	0	.288	.250	.288
FT/π	.081	0	0	0	0	0	0
Welfare change (as % of lifetime income)		-.577	-2.100	-.577	7.689	14.749	7.689

Assumptions: T=50, T'=40, δ=0, n=.015, g=.02, γ=-.396, (ε=.716), α=.25, σ=1. b and c are chosen such that people in their 30th working year have the highest earnings on a cross-section basis; their earnings being 50 per cent higher than earnings of people just starting their working life.

of the representative individual's lifetime income. In the consumption tax alternative, the additional savings generated depress the equilibrium rate of return further to a value of 5.4 per cent. Compared with the solution in the wage tax system, there is less amelioration in the intertemporal terms of trade, and with a lower discount factor the present value of taxes turns out to be higher.[11] On the other hand, the capital deepening effect is stronger and, consequently, so are the accompanying increases in wages and output. Wages and GDP/L are both 13.7 per cent higher than in the base case, while per capita GNE augments by 19 per cent. These changes make the consumption tax alternative a welfare increasing proposition to the representative individual who would gain the equivalent of a 7.7 per cent increase in his lifetime income.

Interestingly enough, the largest variations in welfare occur in Case 2 where countries enter in a bilateral agreement to not tax capital income of foreigners. If the domestic economy were to adopt a wage tax system, that type of international fiscal arrangement would produce the worst outcome, i.e., a welfare loss of 2.1 per cent of lifetime income for the representative individual. The benefits from the reduction in the implicit price of future consumption are greater in Case 2, but these are outweighed, and to a greater extent than in Cases 1 and 3, by lower after-tax wages. After-tax wages are lower in Case 2 not only because gross wages stay unchanged from their base case

level, whereas they increase in Cases 1 and 3 due to the capital deepening effect, but also because they are taxed at a higher rate given that the same amount of government revenue has to be raised from a smaller fiscal base. The story is quite different under the consumption tax system. The benefits from higher returns to saving in Case 2 are much larger than the gains brought about by higher labour productivity in Cases 1 and 3. Furthermore, consumption is taxed less heavily in Case 2 than in Cases 1 and 3 since the fiscal base (aggregate consumption) is much larger in Case 2. The implementation of a consumption tax system with the international tax arrangements of Case 2 would lead to a welfare gain for the representative individual almost twice the size of the gains that could be achieved in Cases 1 and 3.

The extent of factor substitution in production does not alter the interpretation of results in comparing the alternative tax systems under the different types of international fiscal arrangements. Simulation results for the "low saving" and the "high saving" economies with an elasticity of substitution in production between capital and labour equal to .5 are presented in Tables 3 and 4 respectively. These results show that, except for the cases where the equilibrium rate of return remains at r^*,[12] only relative magnitudes of changes in the variables are affected. With more factor substitution, the solutions under the two alternative tax systems yield larger relative increases in the amount of capital and output, while the relative increases in

Table 3

Steady-State Comparisons of Tax Alternatives
Low Saving Economy; σ=.5

	Income tax	Wage Tax			Consumption Tax		
		Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
r	.08	.08	.08	.08	.074	.08	.074
$r(1-t_r)$	.04	.08	.08	.08	.074	.08	.074
$\bar{W}$	2.571	2.571	2.571	2.571	2.641	2.571	2.641
$\bar{W}(1-t_w)$	2.057	1.629	1.629	1.729	2.641	2.571	2.641
GDP/L	3.429	3.429	3.429	3.429	3.475	3.429	3.475
GNE/L	2.924	3.190	3.190	3.228	3.475	3.548	3.475
C/L	2.079	1.977	1.977	2.098	2.136	2.178	2.136
C/GNE	.711	.620	.620	.650	.615	.614	.615
I/GNE	.128	.118	.118	.116	.114	.106	.114
TB/GNE	.011	.042	.042	.004	0	-.019	0
NX/GNE	-.162	-.033	-.033	-.058	0	.015	0
K/GDP	3.125	3.125	3.125	3.125	3.257	3.125	3.257
NF/GNE	.075	.033	.033	.027	0	-.015	0
S/GNP	.053	.085	.085	.089	.114	.120	.114
S/Yd	.069	.120	.120	.120	.156	.164	.156
$\bar{W}$L/GDP	.75	.75	.75	.75	.760	.75	.760
t_w	.2	.367	.367	.328	0	0	0
t_r	.5	0	0	0	0	0	0
t_c	0	0	0	0	.306	.302	.306
FT/π	.268	0	0	.106	0	0	0
Welfare change (as % of lifetime income)		-14.030	-14.030	-8.056	-3.907	-4.324	-3.907

Assumptions: T=50, T'=40, δ=0, n=.015, g=.02, γ=-1.189, (ε=.457), α=.781, σ=.5. b and c are chosen such that people in their 30th working year have the highest earnings on a cross-section basis; their earnings being 50 per cent higher than earnings of people just starting their working life.

Table 4

Steady-State Comparisons of Tax Alternatives
High Saving Economy; σ=.5

	Income tax	Wage Tax			Consumption Tax		
		Case 1	Case 2	Case 3	Case 1	Case 2	Case 3
r	.08	.060	.08	.060	.046	.08	.046
$r(1-t_r)$	.04	.060	.08	.060	.046	.08	.046
$\bar{W}$	2.571	2.805	2.571	2.805	2.997	2.571	2.997
$\bar{W}(1-t_w)$	2.057	1.863	1.629	1.863	2.997	2.571	2.997
GDP/L	3.429	3.581	3.429	3.581	3.701	3.429	3.701
GNE/L	3.277	3.581	3.915	3.581	3.701	4.693	3.701
C/L	2.101	2.186	2.384	2.186	2.227	2.822	2.227
C/GNE	.641	.610	.609	.610	.602	.601	.602
I/GNE	.114	.126	.096	.126	.144	.080	.144
TB/GNE	.003	0	-.070	0	0	-.152	0
NX/GNE	-.043	0	.054	0	0	.118	0
K/GDP	3.125	3.607	3.125	3.607	4.104	3.125	4.104
NF/GNE	.020	0	-.054	0	0	-.118	0
S/GNP	.094	.126	.150	.126	.144	.198	.144
S/Yd	.128	.171	.198	.171	.193	.247	.193
$\bar{W}$L/GDP	.75	.783	.75	.783	.810	.75	.810
t_w	.2	.336	.367	.336	0	0	0
t_r	.5	0	0	0	0	0	0
t_c	0	0	0	0	.297	.250	.297
FT/π	.081	0	0	0	0	0	0
Welfare change (as % of lifetime income)		-.496	-2.100	-.496	5.028	14.749	5.028

Assumptions: T=50, T'=40, δ=0, n=.015, g=.02, γ=-.396, (ε=.716), α=.781, σ=.5. b and c are chosen such that people in their 30th working year have the highest earnings on a cross-section basis; their earnings being 50 per cent higher than earnings of people just starting their working life.

wages are smaller than in the case with σ equal to .5. Naturally, while labour's share of output is fixed at 75 per cent in the Cobb-Douglas case, a value of .5 for σ yields larger labour shares of output when the rate of return declines below its base case equilibrium level. Welfare changes for the representative individual are roughly the same except for the "high saving" economy in Cases 1 and 3 under a consumption tax system. With Cobb-Douglas production technology the welfare gain is equivalent to 7.7 per cent of the representative individual's lifetime income, while with σ=.5 the gain is reduced to 5 per cent of lifetime income.

The Importance of the Saving Elasticity

So far, the analysis has been conducted without reference to a parameter of crucial importance: the elasticity of saving with respect to the rate of interest. Simulation results and the evaluation of welfare changes are likely to be affected by the sensitivity of saving to changes in the rate of interest. From standard consumer's surplus analysis, the higher the saving elasticity is, the greater are the benefits to savers when the tax on capital income is removed. A high elasticity of saving also increases the likelihood of a capital deepening effect with corresponding increases in wages in Cases 1 and 3. Hence, with a higher saving elasticity the representative individual in the "low saving" economy could find the alternatives to the income tax

system welfare increasing options. Likewise, perhaps the representative individual in the "high saving" economy would be better off under an income tax system if the saving elasticity were lower.

From expression (7), the long-run elasticity of saving with respect to the net-of-tax interest rate can be derived. It is equal to:

$$(12)\quad \eta = \frac{r(1-t_r)n}{n\Psi BG - (1-e^{-nT'})\Omega DF}\left\{\frac{\Psi}{1-\gamma}\left[BG\left[T-\frac{1}{F}-\gamma T\left(\frac{D+1}{D}\right)\right]+BT+G\gamma\right]+BG\phi\right\}$$

$$- \frac{r(1-t_r)}{[r(1-t_r)-n-g]},$$

where $B = [\gamma r(1-t_r) - \delta]/(1-\gamma)$

$D = e^{BT}-1$

$F = [r(1-t_r)-\delta]/(1-\gamma)-n-g$

$G = e^{FT}-1$, and

$$\phi = \frac{\partial \Psi}{\partial r(1-t_r)} = \{[g+b-r(1-t_r)]\Psi - e^{[g+b-r(1-t_r)+cT']T'}+1\}/2c.$$

When evaluated with variables at their base case equilibrium values, expression (12) produces saving elasticities of 1.078 for the "low saving" economy and of 1.114 for the "high saving" economy. These figures accord with the empirical estimates of Beach, Boadway, and Bruce [1986] for Canada. Using equations (7)

and (12) the demand side of the model can be recalibrated to yield the same base case equilibrium saving rates but with different interest rate elasticities. The calibration is performed by solving equations (7) and (12) for γ (or ε) and δ to yield desired values of the saving rate and its interest rate elasticity.

For the "low saving" economy, a Summers-type saving elasticity of 2.1 obtained with ε=.731 and δ.015 is sufficiently high to make the consumption tax system a desirable alternative for the representative individual. While the welfare costs of adopting a wage tax system are reduced, they still amount to close to 10 per cent of lifetime income. However, for the "high saving" economy the consumption tax system still yields welfare gains of more than 4 per cent of lifetime income when a Boskin-type elasticity of .4 with ε=.358 and δ=-.04 is used. The welfare costs of the wage tax system using the above values increase to 7 per cent of lifetime income. Contrary to the "low saving" economy case, it seems that the conclusions regarding the welfare consequences of a consumption tax for the "high saving" economy cannot be reversed since lowering η further would necessitate the use of a still lower value for δ which is already implausibly low at minus 4 per cent. Estimates of welfare changes based on the above experiment for the consumption tax appear in Table 5.

Table 5

Steady-State Welfare Consequences of a Consumption Tax System: Sensitivity of Results to Alternative Assumptions about the Saving Elasticity

		Welfare Change as Per Cent of Lifetime Income		
		Case 1	Case 2	Case 3
"Low Saving" Economy				
(γ = -.368, ε = .731, δ = .015, η = 2.107)	σ = 1	1.297	3.646	1.297
	σ = .5	.490	3.646	.490
"High Saving" Economy				
(γ = -1.792, ε = .358, δ = -.04, η = .410)	σ = 1	4.659	4.420	4.659
	σ = .5	4.110	4.420	4.110

Note: Figures in the table measure the welfare changes for the representative individual of being taxed according to a consumption tax system as opposed to the income tax system defined in this paper. σ is the elasticity of substitution in production between capital and labour.

4 CONCLUSIONS

In the context of a life cycle growth model, the general equilibrium welfare consequences of alternatives to the taxation of capital income in a small open economy were shown to depend on the extent of foreign financing of domestic investment and the nature of the international arrangements concerning the taxation of foreign capital income. For an economy that is a net importer of capital, a tax revenue transfer to foreigners occurs when the tax on capital income is removed. Tax revenues are lost even when a withholding tax of the same rate is levied on capital income of foreigners, since capital imports are reduced in the process leaving a smaller fiscal base to which the withholding tax applies.

The substitution of wage or consumption taxes for an income tax removes intertemporal distortions in the choice between present and future consumption and, in certain instances, results in a higher stock of productive capital and increased wages. However, the lower the economy's propensity to save is, the more likely it is that the above beneficial effects will be outweighed by the tax revenue transfer effect. In the "low saving" economy depicted in this paper, the representative individual would be better off under an income tax system that, by taking advantage of the foreign tax credit system, shifts a good part of the tax burden to

foreign governments. Although the tax revenue transfer effect still operates for a capital importing economy with a higher propensity to save, its negative effect on the welfare of the representative individual is smaller than the positive effects of the improvement in intertemporal terms of trade and the capital deepening when a consumption tax is substituted for the income tax.

These results are sensitive not only to the economy's propensity to save which determines the extent of capital importations, but also to the economy's interest rate elasticity of saving. It was shown that using different assumptions about the saving elasticity, some of the above conclusions could be reversed. This last result constitutes one more item to an already long list of reasons why economists should reach an agreement on the size of the interest rate elasticity of saving.

Notes

1 The variable "t" refers to the economic life of individuals, where age zero represents the start of their working life.

2 For simplicity, the model assumes no depreciation of capital.

3 Following the definitions of national income and expenditure accounts used in Canada, net exports of goods and services are defined as $NX=TB-rA^*$. Net foreign tax revenues rt_rA^* are considered as transfer payments from the non-resident sector to the government sector and are not included in GNE.

4 Weber [1970, 1975], Friend and Blume [1975], Ghez and Becker [1975], Grossman and Shiller [1981], Hall [1981], and Summers [1981b] provide estimates of ε.

5 Although Olson and Bailey [1981] develop a case for a positive rate of time preference, they do so in the context of an infinite time horizon. With respect to a finite planning horizon they assert that "It is indeed fortunate that time preference within planning horizons of a lifetime or less in length is not the key issue [it may not be in their paper, but it is in this life cycle model], for it is almost impossible to find out what time preference over the life cycle might be." (p. 15)

6 Although a zero value for δ implies equal present valuation of "utils" originating at different moments in time, Böhm-Bawerk's first cause of preference for present over future consumption is still maintained given the diminishing marginal utility exhibited by the utility function. See Olson and Bailey [1981] for a discussion of Böhm-Bawerk's two principal causes of the preferences for present over future consumption.

7 The 50 per cent tax rate on capital income is assumed to represent the combined effects of corporate, property and individual capital income taxes.

8 With identical tax rates on capital income and foreign tax credit systems in each country, the base case tax system is equivalent to taxing capital income according to the source principle (i.e., in the country where capital is located).

9 The neutrality of the consumption tax with respect to saving is due to the assumed homotheticity of the utility function, which implies unitary expenditures elasticities.

10 The present value of lifetime consumption taxes could, however, turn out to be larger than the present value of lifetime wage taxes. This would be the case if the equilibrium rate of return used as the discounting factor was much lower in the consumption tax system.

11 The present value of taxes for the representative individual is equal to $t_w \bar{W}\bar{\Psi}/\Omega$ for a wage tax and to $t_c \bar{W}\bar{\Psi}/\Omega$ for a consumption tax. When evaluated for Cases 1 and 3 under the "high saving" economy scenario, these expressions yield present values of 7.1 for the wage tax system and 7.6 for the consumption tax system.

12 With an unchanged equilibrium rate of return, σ acts only as a scaling parameter on the variables of the model.

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