

The Transition to a Cash Flow Income Tax

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I. INTRODUCTION

Recent world wide tax reforms reflect widespread concerns of governments over declining international competitiveness and growth of their national economies. Substantial cuts of tax rates in major industrial countries were intended to restore powerful incentives to save and invest at home and, thereby, to establish favorable conditions for more growth. In open economies and with financial capital very mobile internationally, a unilateral reduction of effective marginal tax rates on income from capital in one country would induce sizeable capital flows to eliminate return differentials. The popular discussion is sometimes plagued by confusion even over the direction of tax induced capital flows.

The theoretical discussion has shown that the effects of capital income taxes on international capital flows crucially depend on whether the residence or the source principle of interest taxation is in operation (see for example SINN 88A,B, SLEMROD 88, MUTTI/GRUBERT 85). The source principle leads arbitrage behavior to equate net interest rates whereas the residence principle installs a tendency for equalization of gross interest rates. International legal arrangements provided for the residence principle. Hence, analyses of the effects of tax policy on investment and savings in open economies must take account of the equalization of gross interest rates. As is intensely discussed in the paper, the effects of taxes on investment are determined by how they affect the pre tax rate of return on real investment for a given market interest rate. The effects on savings depend, on the other hand, on how taxes change the net return to savers for a given market interest rate. In a theoretical model like the present one, real investment and savings are determined independently in the face of internationally mobile financial capital.

Economists came forth with a multitude of theoretical and empirical models to analyse the effects of tax policy on international capital flows and growth. A broad theoretical literature centers on various alternatives for intertemporally neutral tax bases (see SINN 87, KING 87,77, BOADWAY/BRUCE 84, BOADWAY/BRUCE/MINTZ 83 among others). Theoretical studies of international and intertemporal effects of taxation are contained in FRENKEL/RAZIN 89,87, who employ a two period framework, and SINN 88B,87 who

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analyzes an infinite horizon model. By using more or less detailed simulation models, part of the literature tries to give an imagination of possible quantitative effects involved in tax reform under more realistic settings. Simulation models with intertemporal household and firm decision making but with rather simple tax structures are presented in FRENKEL/RAZIN 88, BOVENBERG 88,86, BRUNO/SACHS 85, MUTTI/GRUBERT 85 and LIPTON/SACHS 83. Recent models by GOULDER/SUMMERS 89 and GOULDER/EICHEN-GREEN 88 contain more details of the tax systems. In most of these simulation models consumption and savings follow from intertemporal maximization by an infinitely lived representative consumer.

The present paper is quite unique in that it contains a one good two country computable general equilibrium model with overlapping generations. The household sector is modeled along the lines of AUERBACH/KOTLIKOFF 87,83. The model can be solved for the adjustment paths to simultaneously investigate the short and long run effects of tax reforms. As compared to infinite horizon models, the overlapping generations structure leads to a complication in that it introduces the possibility of intergenerational redistribution. Even 'neutral' taxes that do not affect the marginal conditions for intertemporal decision making have real effects on the economy. Taxes generally redistribute resources among generations with different marginal propensities to consume.

The paper investigates with numerical simulations the effects from substituting the present system of capital taxation with a cash flow tax. The cash flow tax was shown to be neutral with respect to intertemporal decisions. The steady state comparisons show that this tax reform induces considerable increases in national wealth, real productive capital and welfare over the long run. However, the short run effects of the reform may be such that old generations loose. This is particularly disturbing since the presently living generations decide upon the initiation of tax reform. In such a case one would have to postulate a social welfare function that gives enough weight to the welfare gains of future generations for the policy to be acceptable. It is therefore important to consider various transitional arrangements that cushion the short run impacts of the reform. The paper shows that, in principle, it is possible to devise Pareto improving transition policies that also allow the initially living old generations to participate in the welfare increases.

The paper is organized as follows. Section 2 presents the theoretical model that is used for the simulations. Section 3 discusses the choice of behavioral and policy parameters in the base case. Section 4 presents the short and long run results from introducing the cash flow income tax. Section 5 concludes the paper with a summary of the main results.

II. THE MODEL

1. Consumption and Asset Accumulation

The world economy is assumed to consist of two countries, the 'home' country and the 'foreign' country. Household and production sectors face identical economic problems in both countries but may be different in taste and technological parameters. Household sectors are modeled along the lines of life cycle theory. Households supply labor inelastically during their working life, demand consumption goods and save for their retirement. For greater empirical relevance of the simulation model, the economic life span of a 'newly born' generation is assumed to extend over 55 years. This implies that at each date and country the household sector comprises 55 cohorts. Overlapping generations models require that one carefully distinguishes the different cohorts at each date in time. Let the cohorts be identified by their planning horizon or rest of life span. Then at date t , a generation with a planning horizon of v years is of age $55-v$, lives until $t+v$, and was born at date $t+v-55$. Consider generation v at date t in the home country. Old generations ($v < 10$) are retired and supply zero labor: $l_{v,t+s}=0$. Labor supply of younger generations ($v \geq 10$) at date $t+s$ is inelastically given by

$$l_{v,t+s} = \begin{cases} 1 & 0 \leq s < v-10 \\ 0 & v-10 \leq s \leq v \end{cases} \quad (1)$$

Financial wealth of generation v at date t , $f_{v,t}$, accumulates via savings

$$f_{v,t+1} - f_{v,t} = r f_{v,t} + (1 - t_l) w_t l_{v,t} - (1 + t_c) c_{v,t} \quad (2)$$

Symbols denote: r net real interest rate, w gross real wage rate, t_l wage tax rate, t_c consumption tax rate, $c_{v,t}$ consumption of generation v at date t . The consumption investment good is the natural numeraire in this one good world, hence its price is unity. In the absence of bequests, equation (2) is solved under the constraint $f_{v,t+v+1}=0$ to give the intertemporal budget constraint

$$H_{v,t} = (1 + r_t) f_{v,t} + \sum_{s=t}^{t+v} (1 - t_{l,s}) w_s l_{v,s} R_{t+1,s} \geq \sum_{s=t}^{t+v} (1 + t_{c,s}) c_{v,s} R_{t+1,s} \quad (3)$$

where

$$R_{t,s} = \prod_{u=t}^s \left(\frac{1}{1 + r_u} \right); \quad R_{t+1,t} \equiv 1$$

The equation states that the present value of consumption spending must be no more than total wealth $H_{v,t}$ which consists of financial plus human wealth. The newly born generation starts with zero financial wealth ($f_{54,t}=0$). The consumption pattern of any generation is determined through maximizing the time separable utility function

$$U_v (c_{v,t}, \dots, c_{v,t+v}) = \sum_{s=t}^{t+v} \frac{c_{v,s}^{1-1/\Gamma}}{1 - 1/\Gamma} \frac{1}{(1 + \rho)^{s-t}} \quad (4)$$

Setting up the Lagrangean for maximizing (4) subject to the constraint (3), one can derive from the first order conditions

$$c_{v,s+1} = \left[\frac{1 + t_{c_s}}{1 + t_{c_{s+1}}} \frac{1 + r_{s+1}}{1 + \rho} \right]^{\Gamma} c_{v,s} \quad (5)$$

Repeated use of equation (5) for substituting out $c_{v,s}$ for $s \geq t$ in the intertemporal budget constraint (3) and rearranging gives the ‘consumption function’ of generation v

$$c_{v,t} = \Psi_{v,t} H_{v,t} \quad (6)$$

where

$$\Psi_{v,t} = \left\{ (1 + t_{c_t})^{\Gamma} \sum_{s=t}^{t+v} [(1 + \rho)^{(t-s)\Gamma} ((1 + t_{c_s}) R_{t+1,s})^{1-\Gamma}] \right\}^{-1} \quad (7)$$

Aggregating over generations we have aggregate consumption and aggregate financial wealth at time t

$$L_t^s = \sum_{v=0}^{54} l_{v,t}, \quad C_t = \sum_{v=0}^{54} c_{v,t}, \quad F_t = \sum_{v=0}^{54} f_{v,t} \quad (8)$$

The household sector set up in the foreign country is perfectly symmetrical except that preference parameters, endowments, tax rates and prices may be different.

2. Production

A realistic representation of the system of capital income taxes requires a quite detailed modeling of real and financial decisions of the production sector. Allowing for the introduction of an alternative cash flow tax further complicates the exposition. Start with the definition of gross earnings or cash flow¹ CF

$$CF = P(K, L) - wL - iD^f \quad (9)$$

In (9), K and L denote capital and labor inputs to the neoclassical production technology $P(\cdot)$ with labor measured in efficiency units. Technological progress is assumed to be labor augmenting at a constant rate g_r . Outstanding debt of the firm D^f is to be served at the market rate of interest i . The technology of the firm is assumed to be of the linear homogeneous CES—type with σ being the elasticity of substitution, α a share parameter and Φ a shift parameter.

$$P(K_s, L_s) = \Phi \left\{ \alpha K_s^{(\sigma-1)/\sigma} + (1 - \alpha)[(1 + g_r)^s L_s]^{(\sigma-1)/\sigma} \right\}^{\sigma-1/\sigma} \quad (10)$$

The system of capital income taxation is described by tax rates t_e on retained profits, t_a on dividends or distributed profits, t_b on interest income, t_w on capital gains, and tax parameters t_1, t_2, t_3 . Taxes on retained profits are

$$TE = t_e (P - wL - t_k K - t_3 i D^f - t_1 I - \delta^T K^T - DIV) - t_2 I \quad (11)$$

In (11), dividends are DIV and K^T denotes the depreciable capital stock for tax purposes which evolves according to

$$K_{t+1}^T - K_t^T = (1 - t_1) I_t - \delta^T K_t^T \quad (12)$$

1. For the sake of notational simplicity, some of the following equations lack time indices.

A given combination of tax parameters and tax rates characterizes the tax system. Firms may immediately write off a share t_1 of investment expenditures against the tax base. A fraction $(1-t_1)$ of investment outlays adds to the depreciable capital stock and increases allowable tax depreciation $\delta^T K^T$ next year. A fraction t_2 may be offset directly against the tax liability in the form of an investment tax credit or investment premium. In the case of $t_3=1$, interest payments on firm debt may be deducted from the tax base, in the opposite case of $t_3=0$ interest is not deductible.

To make tax payments determinate one needs to specify the financial behavior of firms. Following GOULDER/SUMMERS 89 it is assumed that firms maintain a constant debt-capital ratio b through time and correspondingly new debt issues BN are a constant fraction of net investment. Firms pay dividends equal to a constant fraction a of after-tax profits net of economic depreciation. Capital depreciates at the true rate of economic depreciation δ^R whereas for tax purposes a rate δ^T applies.

$$\begin{aligned} DIV &= a(CF - \delta^R K - TE - t_k K) \\ D^f &= b K \\ BN &= b(I - \delta^R K) \end{aligned} \quad (13)$$

To induce investors to hold equities in a firm, the firm must generate returns equal to the returns on alternative assets. The net of tax return on alternative assets being $(1-t_b)i_t$, the arbitrage condition is

$$(1-t_b)i_t = \frac{(1-t_a)DIV_t + (1-t_w)(V_{t+1} - V_t - VN_t)}{V_t} \equiv r_t \quad (14)$$

Firm value is V_t and $V_{t+1} - V_t - VN_t$ denotes the capital gains on shares outstanding at time t . The firm must generate dividends and capital gains per share after taxes equal to the required net rate of return. Solving the difference equation (14) and imposing a suitable existence condition² yields the valuation of the firm by its owner and the objective functional for the real decisions of firms.

$$\begin{aligned} \max_{\{L_s, I_s\}} V_t &= \sum_{s=t}^{\infty} \left(\frac{1-t_a}{1-t_w} DIV_s - VN_s \right) R_{t,s}^f \quad s.t. \\ K_{s+1} - K_s &= I_s - \delta^R K_s; \quad K_t = K^0; \quad \lim_{T \rightarrow \infty} K_T > 0 \end{aligned} \quad (15)$$

2. The condition is fulfilled if the discount rate is higher in the long run than the growth rate of V_t $\lim_{T \rightarrow \infty} V_{T+1} R_{t,T}^f = 0$

The discount factor is defined as

$$R_{t,s}^f = \prod_{u=t}^s \left(1 + \frac{1-t_b}{1-t_w} i_u\right)^{-1}$$

According to the dynamic theory of firm behavior, optimal factor demands and output of the representative firm follow from value maximization. The value of the firm is the present value of future net payments of the firm to its owners. The solution of the dynamic maximization problem requires that (15) be expressed in terms of the control and state variables. This part is relegated to the appendix. Part of the firm value in (15) stems from tax savings out of future depreciation allowances which depend on past investments previous to time t and on future investments at time $s \geq t$. Maximization of (15) requires to choose an optimal path for future investments only. Hence it is necessary to distinguish the present value of depreciation allowances B_t on old capital from that on yet to be invested new capital.

$$B_t = z_t K_t^T; \quad z_t = \sum_{s=t}^{\infty} \Omega_s t_{e_s} \delta^T (1 - \delta^T)^{s-t} R_{t,s}^f;$$

$$\Omega = [a(1-t_a) + (1-a)(1-t_w)] / [(1-t_w)(1-at_e)] \quad (16)$$

In (16), Ω is a tax factor, z_t is the present value of tax savings arising from a unit of newly installed capital and B_t is the present value of tax savings arising from the total tax depreciable capital stock accumulated out of past investments up to date t . Having isolated B_t , the maximand in (15) is $V_t - B_t$. The problem is solved by methods of dynamic optimization³. After setting up an appropriate Lagrange-function, one derives the necessary conditions in (17):

$$(a) \quad w_s = \partial P / \partial L_s$$

$$(b) \quad q_{s+1} = 1 - b - (1-t_1) z_{s+1} - \Omega (t_2 + t_1 t_e)$$

3. See KAMIEN/SCHWARTZ 81 and FEICHTINGER/HARTL 86 for dynamic optimization methods and KEUSCHNIGG 90 for the details of the present solution.

$$(c) \quad i_s = \frac{\Omega(1 - t_e) \left(\frac{\partial P}{\partial K_s} - t_k \right) + \delta^R (1 - b - \Omega) + q_{s+1} (1 - \delta^R) - q_s}{\frac{1 - t_b}{1 - t_w} q_s + \Omega b (1 - t_e)} \quad (17)$$

The wage rate is equated to the marginal product of labor. According to (17b) firms invest until the marginal benefit q of an additional unit of capital (the current value multiplier, or Tobin's marginal 'q') equals the marginal cost of acquisition. Since the consumption—investment good is the numeraire, the price of the capital good is one, but the acquisition cost is reduced by the tax savings that become available with additional investment.

Marginal q is the increase in equity value due to the investment of an additional unit of capital. Solving the difference equation for q in (17c) shows how investors evaluate an incremental unit of capital. A unit of newly installed capital will generate in the future a stream of marginal products. Since capital depreciates, this income stream decreases at the rate δ^R . Marginal q is equal to the present value of this incremental income stream net of taxes that goes to the investor. The discount factor is equal to the tax corrected interest rate plus the economic depreciation rate. Hence, (17b) represents the simple criterion that the present value of incremental future income must exceed the effective acquisition costs of new capital goods for investment to be profitable.

Assuming linear homogeneity of the production function, one can establish a relation between marginal q and the asset price $Q = V/K$ of a share in the firm⁴: $q_s = Q_s - B_s/K_s$.

3. Government Behavior

Government provides for collective consumption, pays interest on the stock of public debt and collects revenues from the taxation of labor and capital income and of consumption. Tax revenues TR are

$$TR = TE + t_a DIV + t_{bi} (D^f + D^g + Z) + t_w (\Delta V - VN) + t_k K + t_l wL^S + t_c C \quad (18)$$

The tax revenue from retained earnings is TE in (11). L^S and C denote aggregate labor supply and consumption as defined in (8).

The government accumulates debt by running a deficit

$$D_{s+1}^g - D_s^g = G_s + i_s D_s^g - TR_s \quad (19)$$

4. See HAYASHI 82, and KEUSCHNIGG 90 for a detailed derivation in the present context.

The accumulation of public debt is constrained intertemporally. Solve (19) to get

$$D_t^g = \sum_{s=t}^{\infty} (TR_s - G_s) \prod_{u=t}^s \left(\frac{1}{1 + i_u} \right) \quad (20)$$

provided that an appropriate terminal condition holds which requires that public debt does not grow faster than at rate r . Future tax and expenditure policies must be such that the principal and interest payments on current and newly accumulated future debt must be eventually served by future surpluses. The intertemporal budget constraint rules out permanent tax reductions or expenditure increases. A budget imbalance in the present inevitably requires a compensating action in the future. In a model with perfect foresight, private agents anticipate the countervailing actions of government in the future and adapt consumption and savings, although anticipation of future policies is not perfect because of finite planning horizons of private households.

4. Balance-of-Payments Accounts

The balance of trade surplus B_t is the excess of domestic product Y_t over domestic absorption $C_t + G_t + I_t$. In a one good world, we have

$$B_t = Y_t - C_t - G_t - I_t = -B_t^* \quad (21)$$

By definition, the trade surplus of the foreign country must be the negative of the home country's surplus, $B_t^* \equiv -B_t$. From now on, an asterisk denotes variables of the foreign country. The current account surplus CA_t is the excess of national product, which is the sum of domestic product and net foreign source income, over domestic absorption.

$$CA_t = Y_t + i_t Z_t - C_t - G_t - I_t = B_t + i_t Z_t \quad (22)$$

Foreign source income stems from the return on Z_t which denotes the home country's net foreign wealth, and by symmetry $Z_t^* \equiv -Z_t$ and $CA_t^* \equiv -CA_t$. It is assumed that the residents of each country acquire only foreign bonds but not foreign equity capital. There is no direct foreign investment in the model. If interest income is taxed according to the *residence principle* of taxation, arbitrage dictates that foreign and domestic bonds earn an interest equal to the world interest rate i_t . If there is differential interest taxation, the

residence principle generates differences in net rates of return on domestic and foreign assets.⁵

The current account determines the accumulation of foreign wealth Z_t ,

$$Z_{t+1} - Z_t = B_t + i_t Z_t \quad (23)$$

Solving (23) for Z_t gives the intertemporal constraint on the accumulation of net foreign wealth

$$Z_t = \sum_{s=t}^{\infty} -B_s \prod_{u=t}^s \left(\frac{1}{1+i_u} \right) \quad (24)$$

The intertemporal constraint in (24) means that a country with net foreign wealth must incur future trade deficits with a present value equal to current wealth. The discount rate is the world interest rate i . The intertemporal constraint is satisfied if net foreign wealth does not continuously grow faster than at rate i .

To show the savings investment identity in the present open economy model, one aggregates the wealth accumulation equation (2) and uses the arbitrage equation (14) as well as the identity $F = V + D^f + D^g + Z$ to derive $\Delta F = S + (\Delta V - VN)$ where aggregate savings S are defined as

$$S = r(D^g + D^f + Z) + (1 - t_a) DIV - t_w(\Delta V - VN) + (1 - t_l) w L^s - (1 + t_c) C \quad (25)$$

From the financial identity of the firm in (A1), one has $I^n = I - \delta^R K = RET + BN + VN$ with $RET = CF - \delta^R K - TE - t_k K - DIV$. Out of savings, households acquire new equity and new bonds, $S = VN + BN + DEF + CA$, where DEF denotes the government deficit. Using the definition for net investment finance, this leads to the open economy savings investment identity

$$S + RET = I^n + DEF + CA \quad (26)$$

5. Arbitrage dictates that all assets, domestic and foreign bonds and domestic equity capital, must earn identical returns net of taxes. For the home country, arbitrage implies $r = (1 - t_b)i = (1 - t_b)i^*$. For the foreign country, the arbitrage condition reads $r^* = (1 - t_b^*)i^* = (1 - t_b^*)i$. See also equation (14). Both conditions imply $i = i^*$, but net of tax returns on equities and bonds differ in the case of differential interest taxation.

5. Market Clearing Conditions and Equilibrium

Equilibrium requires that the following market clearing equations hold for each date t

$$\begin{aligned} L_t^s &= L_t \\ L_t^{*s} &= L_t^* \\ F_{t+1} + F_{t+1}^* &= V_{t+1} + V_{t+1}^* + D_{t+1} + D_{t+1}^* \\ B_t + B_t^* &= 0 \end{aligned} \tag{27}$$

Labor markets in each country clear separately as labor is assumed to be internationally immobile. World capital market clearing in (27) is obtained by summing desired home and foreign asset holdings $F_{t+1} = V_{t+1} + D_{t+1} + Z_{t+1}$ and $F_{t+1}^* = V_{t+1}^* + D_{t+1}^* - Z_{t+1}$, where D_{t+1} denotes the sum of firm and government debt. The concept of a perfect foresight general equilibrium is applied for solving the model. In the long run or steady state equilibrium, the world economy exhibits balanced growth at the rate g_r .

III. CALIBRATION OF MODEL

To compute equilibrium solutions of the model, I employ essentially the methodology of AUERBACH/KOTLIKOFF 87,83. The present model, however, is a two country model and contains much more details on capital income taxes. The two country structure and the presence of tax depreciation, for instance, dictate some modifications of the algorithm.

Computation of model solutions requires numerical values of behavioral parameters. Since it is generally not possible to simultaneously estimate parameters for this type of model, one must rely on outside information in the econometrics literature to assign values to parameters. For some parameters, however, the consensus in the econometrics literature is not particularly reassuring. And there is scant evidence for the numerical values of other parameters such as the rate of time preference. Since the solution of the model depends on the specific constellation of parameter values, one must emphasize sensitivity analysis to shed light on the robustness of the results.

Table 1 reports values for the behavioral parameters and exogenous variables and also characterizes the initial steady state equilibrium of the base scenario. The numerical magnitudes in table 1 apply to both countries. Since calibration is perfectly symmetric, there is no reason for any exchange between the two countries in the base case and the current account and the net foreign wealth position are zero initially. The intertemporal elasticity of substitution is assigned a value of $\Gamma = .5$ in each country. Recent empirical analysis of private consumption behavior has unfortunately produced estimates of Γ ranging from near zero to unity. Hence, Γ will be an important candidate for sensitivity analysis. The rate of time preference is chosen to be $\rho = .015$.

On the production side, the elasticity of substitution between labor and capital is set equal to $\sigma = .95$ in both countries. Firms finance 40% of net investment by issuing debt ($b=.4$), equity finance covers the rest. To what extent the representative firm resorts to retained earnings and share issues as the marginal source of equity finance depends on the dividend payout ratio a . A value of $a=.85$ means that dividends are 85% of accounting profits net of taxes on the capital stock and net of the corporate tax on retained earnings⁶. Such a high payout ratio is necessary to prevent negative share issues and still implies that most of equity finance comes from retained earnings. An unattractive feature of this kind of exogenously determined financial behavior is that firms never substitute between different sources of marginal finance to exploit opportunities for tax arbitrage. What is needed is a model of financial decisions that precludes corner solutions, but in keeping with empirical observation guarantees an *interior* solution where the firm relies on all of the marginal sources of finance. In the absence of an economic mechanism that prevents, for example, 100% debt finance, one must rely on exogenously determined financial parameters.

The economic aspects of capital income taxation are best summarized by the concepts of average and marginal effective tax rates. In a closed economy the total tax wedge $r^s - r$ is relevant for the growth effects of the tax system where $r^s = \partial P / \partial K - \delta^R$ is the gross rate of return. Investment and national savings change identically. In open economies with international capital movements, however, national savings and investment are in general not identical. With the *residence principle* of interest taxation in operation the world market rate of interest i is equated among countries. The interest rate is determined

Table 1: Characterization of Initial Steady State

Parameter Values				Initial Steady State	
g_r	0.03	t_c	0.1	K/L	5.0363
Φ	1.8	t_k	0.001	i	0.0868
α	0.3	t_w	0.01	τ'_a	0.0555
σ	0.95	t_b	0.15	$\bar{\tau}$	0.3418
a	0.85	t_a	0.4	Q	0.4443
b	0.4	t_e	0.56	S/Y	0.0450
δ^R	0.07	δ^T	0.1	RET/Y	0.0149
Γ	0.5	t_1	0.1	I^a/Y	0.0524
ρ	0.015	t_2	0	DEF/Y	0.0075
G/Y	0.25	t_3	1	CA/Y	0
D^g/Y	0.25	t_l	0.2234		

6. See equation (13).

internationally and would be effectively exogenous for a small open economy. The rate of investment depends on the gross rate r^g whereas national savings is driven by the net rate r , and any difference between savings and investment is felt in the current account. With the interest rate determined internationally, one must decompose the total tax wedge into an A-wedge r^g-i relevant for the effects of the tax system on investment, and into a B-wedge $i-r$ with implications for national savings. The corresponding marginal effective tax rates $\tau'_a = (r^g - i)/i$ and $\tau'_b = (i - r)/i = t_b$ capture the different incentives for investment and savings of the tax system. The overall measure of the marginal effective tax rate $\tau'_a + \tau'_b = (r^g - i)/i$ yields 20.5% in the base case but is mainly due to interest income taxation at the personal level $\tau'_b = t_b = .15$. The average tax rate on equity income including personal taxes in per cent of gross profits⁷ is $\tau = .34$ in the base scenario.

IV. INTRODUCTION OF THE CASH FLOW INCOME TAX

1. Steady State Comparisons

The cash flow income tax is a much discussed proposal for neutral capital income taxation. Recently, SINN 87 and KING 87 among others praised its advantages in avoiding intertemporal distortions in savings and investment decisions. Within the present model, a cash flow tax requires that $t_1=1$, $t_2=t_3=0$, $\delta^T=0$, $t_b=t_w=t_k=0$ and $t_e=t_a=t_{CF}$. This tax is on net cash flow from real economic activities of firms. Investment expenditures are immediately expensed. The tax base is sales less purchases of all real goods and services required in the production process, including expenditures on capital goods. The tax disallows any deduction for financing of investment. Since interest expenditures do not qualify as a deduction from the corporate tax base, interest income of households has to be tax exempt ($t_b=0$). Distributed profits bear the same tax burden as retained profits, and capital gains are tax exempt. The cash flow tax is radical but more easily administered than other neutral designs of a capital income tax. There is no need, for example, to calculate true economic depreciation and accrued capital gains. Its neutrality with respect to investment and savings decisions is easily recognized since evaluation of the marginal conditions (17b,c) with a cash flow tax reveals that gross, market and net rates of return become identical: $\partial P / \partial K - \delta^K = i = r$. Effective marginal tax rates are zero. The neutrality arises from the fact that the tax reduces effective acquisition costs of new capital to the firm and the present value of marginal future returns to investment by the same propor-

7. $\bar{\tau} = [TE + t_k K + t_a DIV + t_w (\Delta V - VN)] / [P - wL - \delta^K K - iD]$.

tion.⁸ The government behaves as if it were a non voting partner in the firm who participates equiproportionally in benefits and costs of investment.

A critical issue in devising the simulation experiments is how the governments adjust to satisfy their budget constraints. Since the paper is concerned with structural reforms of capital income taxes we seek to find that long run cash flow tax rate t_{CF} which allows other tax rates (on labor income and consumption) to remain unchanged in the home country. The size of this 'revenue neutral' rate t_{CF} depends also on the assumptions concerning debt and expenditure policy. The initial steady state has expenditure and debt to income (GNP) ratios of 25% in size. The governments are assumed to keep their debt income ratios constant but let their expenditure levels increase with the predetermined long run rate g_r from initial levels. One might argue that it is the appropriate policy assumption to keep G/Y constant. I assume instead that governments do not change their provision of public goods due to tax induced income changes but choose their consumption in accordance with the more fundamental long run increases in income due to productivity growth only.⁹ With such a specification the expenditure income ratio slightly declines in response to tax induced income growth.

The foreign country is assumed to react passively to capital income tax reform in the home country and to adjust its wage tax rate t_i^* in order to support its budget (See line 6 in *table 2*). If the home country has some influence on the world interest rate one might ask about possible policy responses of the foreign country. To keep the analysis within limits I presently do not investigate the important issues involved in tax harmonization versus competition.¹⁰

To highlight the importance of international capital mobility in the analysis of tax reform, *table 2* distinguishes three cases. The last column contains the effects on a small open economy which has effectively no influence on the world interest rate. In this pure absorption model, the only channel by which one country can influence any other is via the world interest rate. The small open economy case is achieved by choosing the foreign population to be a hundred times larger. In the intermediate case the two countries are of equal size. *Table 2* reports the effects on both countries in columns four and five. In the closed economy case (column 3) exactly identical policies are enacted in both countries. There is no reason for capital movements to occur, and the model mimics the behavior of a closed economy.

The open economy case is most easily interpreted. The world market interest rate is internationally determined and thus effectively exogenous from the point of view of the small country. The residence principle of interest taxation dichotomizes the effects of tax

8. To see this, evaluate (17a,b) in an equilibrium with the cash flow tax and arrive at a condition $(1-t_{CF})mpk/(i+\delta^R) = (1-t_{CF})$ or at the equivalent expression $(1-t_{CF})(mpk-\delta^R) = (1-t_{CF})i$.

9. In the case of a constant G/Y a negative result emerges: the incentive effects of the cash flow tax induce income growth and corresponding increases in G . The financing requirements of the government budget constraint necessitate such large 'revenue neutral' increases in t_{CF} that asset prices become negative.

10. See, for example, SORENSEN 89, SINN 90, RAZIN/SADKA 89.

policy on investment and savings. Since labor supply is exogenous, the production sector is affected in a particularly simple manner. With a given market interest rate, tax policy's effects on investment derive solely from changes in the pre tax rate of return which was $r^s = (1 + \tau'_a)i$ in the initial situation. Since the implementation of the cash flow tax eliminates the effective marginal tax rate τ'_a the gross return of capital decreases to the market interest rate. The lower gross return entails an increase in the long run capital labor ratio

Table 2: Steady State Effects of Cash Flow Tax

Var.	Base Case	Final Steady State			
		closed	equally sized		open
1. i	0.0868	0.0693	0.0774	0.0774	0.0866
2. K/L^e	5.0363	6.1315	5.6900	5.5031	5.2512
3. w	2.0681	2.1922	2.1443	2.1232	2.0939
4. $\bar{\tau}$	0.3418	0.3506	0.3867	0.3277	0.4184
5. q	0.1624	0.2289	0.2211	0.1445	0.2159
6. t_{CF}		0.3711	0.3789	$t_1^* = 0.2279$	0.3841
7. S/L^e	0.1298	0.1705	0.1991	0.1031	0.2319
8. RET/L^e	0.0429	0.0363	0.0359	0.0422	0.0353
9. DEF/L^e	0.0216	0.0228	0.0232	0.0214	0.0237
10. I^*/L^e	0.1511	0.1839	0.1707	0.1651	0.1575
11. CA/L^e	0	0	0.0412	-0.0412	0.0859
12. EV in %		4.5957	4.8428	-0.2714	5.4994

which in turn translates into corresponding increases in steady state capital stock, investment, domestic product, and gross wages. Effective acquisition costs of new capital are $1 - t_{CF}$ where t_{CF} is the tax savings due to immediate expensing of investment from the tax base. Hence, marginal costs of investment to the equity owner are $q_{CF} = 1 - t_{CF} - b$. Since the cash flow tax eliminates all benefits from depreciation of old capital ($t_1 = 1$, $K^T = 0$, $B^T = 0$), the average asset price Q and marginal q are equal. The asset price devalues from $Q = 0.44$ initially to its new price $Q = q = 0.22$. In the absence of any adjustment costs to investment and without any transitional arrangements this devaluation is immediate and hurts the equity owners in the period of the tax policy's initiation. The amount of devaluation depends on the size of the new cash flow tax rate, given that financial behavior of the firm does not change. The revenue neutral statutory cash flow tax rate is 38% in

the final steady state and is thus slightly lower than both the initial tax rates on retained earnings and on dividends¹¹. The average tax rate on equity income τ is affected by changes in the definitions of tax bases, by the size of the cash flow tax rate, and via the effects of growth on the size of tax bases. In sum, the average equity tax rate is higher after the introduction of the cash flow tax.

With a fixed world interest rate in the open economy case in table 2, the elimination of the interest income tax as part of the cash flow tax reform increases the net return to domestic households and induces an increase in savings via the substitution effect. In a multiperiod life cycle model, an increased net interest rate also entails a wealth effect. Since future labor income is discounted at a higher rate, human wealth and correspondingly present consumption decreases. This is why SUMMERS 81 found such a high interest elasticity of savings. On the other hand, higher current wage income of the working generations and higher interest income of the owners of capital further increase savings. In sum, table 2 reports a substantial increase in domestic savings. Since government debt is tied to the increases in national income by a constant debt income ratio, the new domestic steady state deficit is slightly higher, too. As private sector savings expand much more than investment and government deficits, the home country runs an equilibrium current account surplus and exports capital. In fact, as is seen from table 2, capital exports are about one third of private sector savings! The current account surplus feeds net foreign wealth accumulation of the home country. Since the market interest rate exceeds the growth rate in the steady state, the home country runs deficits in the trade balance. The last line in table 2 indicates that future generations of the home country will benefit from the introduction of the cash flow tax. To be more precisely, a representative generation born in the new steady state in the home country experiences a welfare gain equivalent to a 5.5% increase in life time resources. The welfare evaluation for current generations must await the discussion of transition paths in the next section.

In the case of two equally sized countries, fiscal policy in the home country affects the foreign country via its effects on the world interest rate. Notice that in the base equilibrium the marginal effective tax rate τ'_a is small relative to τ'_b . Given the relatively high interest elasticity of savings in OLG models and the relatively large increase in the net rate of return to domestic savers, domestic savings are expected to expand by relatively more than investment. Hence, the home country exports capital which is felt in a current account surplus of the home country. To bring the world capital market into equilibrium, the foreign country will have to invest more and save less than in the initial situation. Given the tax policy in the home country, equilibrium is brought about by a decline in the world interest rate. The decline in the market interest rate reinforces the growth effect of the cash flow tax as compared to the open economy case since the social rate of return to investment declines by more than the effective tax rate τ'_a . Correspondingly, the decline

11. Note, however, the dependence of the revenue neutral rate t_{CF} on the assumption concerning government spending. See footnote 9.

in the interest rate and the increase in the capital labor ratio has to be highest in the closed economy case as table 2 confirms. With a lower market interest rate, savings cannot increase as much as in the small open economy case and capital exports are smaller, too. In a closed economy, the interest rate has to fall to such an extent that domestic savings are brought in line with domestic investment. Notice that in table 2 the market interest rate in the closed economy final steady state is *lower* than the net rate of return in the initial state $r_{JSS} = .0868 * (1 - .15) = .07378 > r_{FSS} = .0693$. This is to undo the effect of higher wages in the closed economy on savings. I conclude that the steady state mechanics of the model is dominated by the high interest elasticity of savings due to the wealth effect of interest changes and by the fact that the B—wedge is large relative to the A—wedge in the initial situation.

2. Sensitivity Analysis

The results from simulation models depend on the numerical values assigned to behavioral parameters. Thus, it is important to check for the sensitivity of results to parameter perturbations. In clarifying the general equilibrium effects of the cash flow tax reform on national savings, investment and international capital movements, the parameters of particular interest are those that determine the interest elasticities of the savings and investment schedules.

Table 3 reports results from steady state comparisons under different combinations of Γ , the intertemporal elasticity of substitution in consumption, and σ , the elasticity of substitution between capital and labor in production. The numbers in table 3 relate to the home country only, the foreign country is in all cases of equal size and perfectly symmetric. National savings S is the sum of aggregate household savings plus retentions minus government deficits and is expressed like net investment I'' in labor efficiency units which are constant across all cases because of exogenous labor supply and technological progress. Hence, the changes in these ratios also can be interpreted as changes in levels.

The different combinations of the technology and preference parameters lead to considerable variations in steady state interest rates and investment and savings ratios. In all cases of table 3, the tax reform considered leads to a fall in the world interest rate from its initial value. Steady state savings change in all cases by more than steady state investment levels which implies that the tax reform induces capital exports. This is most likely due to the high interest elasticity of savings in overlapping generations models as reported by SUMMERS 81 and to the fact that in the initial situation the effective tax rate τ'_b is large relative to τ'_a . Therefore households experience a large increase in net interest rates even if the market interest rate stays constant. Hence, I conclude that the introduction of a cash flow tax most likely leads to a lower world interest rate and to capital exports in the long run.

However, I did find a rather special parameterization that reverses this conclusion. Setting the tax rates on interest income to zero initially and choosing $\Gamma = .4$, $\Gamma^* = .6$, $\sigma = 1.5$,

$\sigma^* = .5$ gives effective tax rates $\tau_b^* = 0$, $\tau_b^* = .15$, $\tau_a^* = .16$, and $\tau_a^* = .06$ initially. Note that this parameterization is extremely asymmetric and implies that the home country is a large debtor nation in the initial state. Given this parameterization, the introduction leads to a higher world interest rate and to capital imports.

Table 3: Sensitivity in Open Economy

symmetric parameters	interest i		Initial		Final	
	ISS	FSS	S/L^e	I^n/L^e	S/L^e	I^n/L^e
$\Gamma = .2 \quad \sigma = .5$	20.6	18.3	4.45	4.45	6.41	4.97
$\Gamma = .5 \quad \sigma = .5$	6.74	5.90	7.13	7.13	10.2	7.48
$\Gamma = .8 \quad \sigma = .5$	4.52	3.71	7.95	7.95	13.2	8.34
$\Gamma = .2 \quad \sigma = .95$	23.1	21.0	5.87	5.87	8.75	7.25
$\Gamma = .5 \quad \sigma = .95$	8.68	7.74	15.1	15.1	21.2	17.1
$\Gamma = .8 \quad \sigma = .95$	5.94	5.17	19.9	19.9	28.3	22.0
$\Gamma = .2 \quad \sigma = 1.5$	25.9	24.5	7.37	7.37	11.6	10.3
$\Gamma = .5 \quad \sigma = 1.5$	12.3	11.5	33.7	33.7	50.7	44.3
$\Gamma = .8 \quad \sigma = 1.5$	9.29	8.61	59.6	59.6	88.9	76.6

3. Transition Paths and Short Run Effects

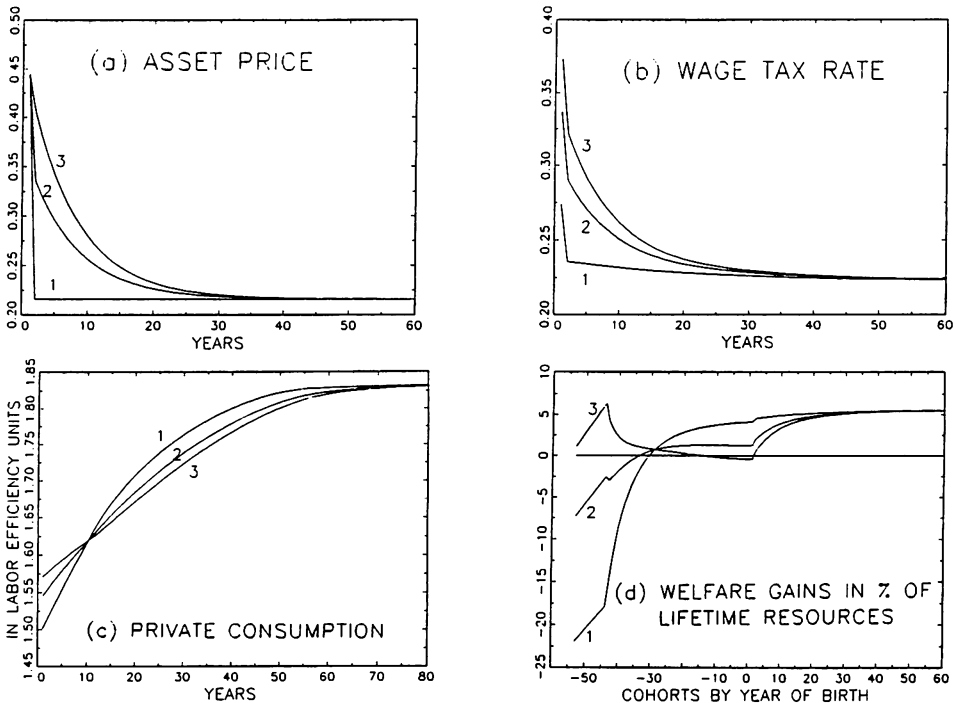
The introduction of a cash flow tax is a large and radical tax reform. A multitude of transitional policies are possible that lead all to identical long run consequences but differ in their short run effects. It is an advantage of simulation models that they allow to trace adjustment paths to long run equilibria. In *figures 1* and *2*, four transitional policies for implementing the same long run tax system are considered.

Policy 1 entails that the interest on the stock of debt is abruptly excluded from the tax base and that the previously accumulated tax depreciable capital stock of firms is immediately written off. As in all cases of *figure 1*, the wage tax rate is adjusted to support the government budget constraint. In the model economy, the reform provokes large revaluations of corporate wealth. The reduction in effective acquisition costs for new

capital and the complete devaluation of the tax depreciable capital stock reduce share prices from .44 to .22 in one stroke.¹² Thus, the reform taxes away equity wealth of the initially living old generations whereas young and future generations gain from the induced wage increases. *Figure 1d* documents the generational welfare effects and depicts policy 1 as redistributing resources from the old to young and future generations.¹³

The first policy's unattractive consequences for intergenerational distribution raise concerns about appropriate transitional arrangements to phase in the reform. A natural policy for a smoother transition path would allow the depreciation of previously accumulated capital to be continued and allow complete depreciation on new investments. Hence, total tax depreciation increases in the initial years of the reform and partly compensates for the increased tax base due to the loss of interest deductions on debt. This is labelled policy 2. The average tax rate on capital income of equity owners first falls and increases only after several years. Hence, the initial increase in the wage tax rate must be larger to support the government budget constraint (*figure 1b*). The devaluation of asset prices and

Figure 1: Transitional Policies



12. In a model with adjustments costs in investment the devaluation of asset prices would be more gradual even with immediate changes in the tax code.

13. Welfare changes are measured in terms of the equivalent variations per cohort which indicate the amount of additional lifetime resources necessary for the consumer to attain the utility in the new situation at initial prices. Only the rest of life time is considered in calculating the welfare changes of initially living old generations.

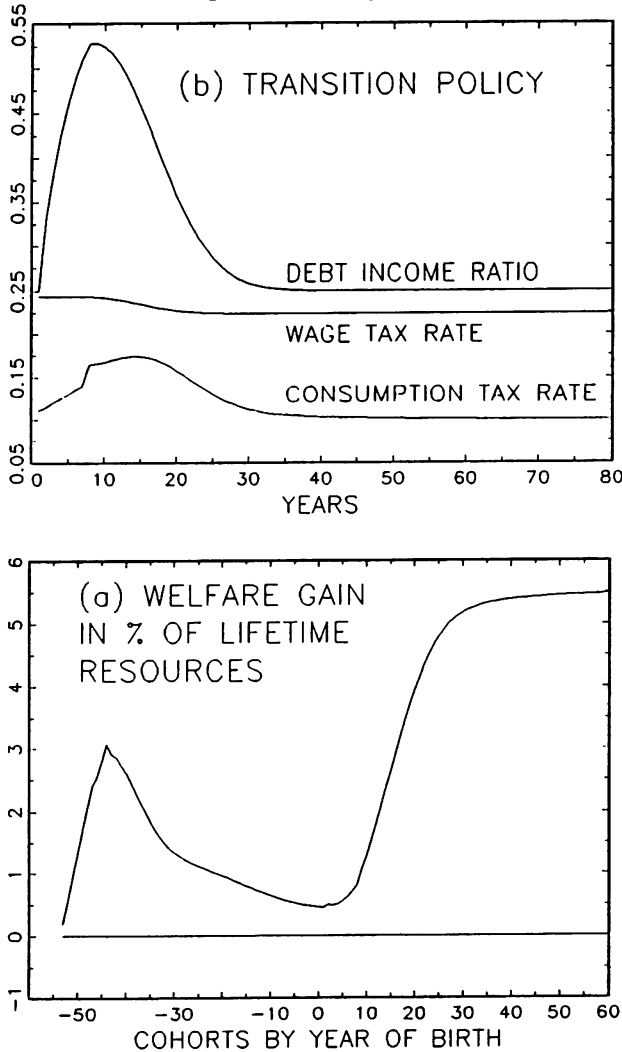
the decrease in the average return on equities is less rapid which is to the advantage of the initially living old generations who have accumulated corporate equity capital along with other assets. Policy 2 keeps the welfare losses of initially living old generations within limits but reduces the welfare gains of the young since it necessitates a higher initial wage tax rate to make up the revenue losses in the government budget.

Still another alternative for a more gradual phase in of the cash flow tax is policy 3 which allows for continued depreciation of old capital and old corporate debt. This is achieved by adding the initial level of corporate debt to the tax depreciable capital stock which is then gradually depreciated to zero at the geometric rate δ^T . The depreciation of old debt may be seen as an arrangement to make the elimination of interest deductions more gradual. Revenue losses from equity taxation are higher initially and necessitate an even more pronounced increase of the wage tax rate. Since equity values and the average return on equities decrease less initially, the prospects for old generations are better. *Figure 1d* shows that the old gain but the young loose under such a policy. Also note from *figure 1c* that the intergenerational redistribution of resources from the young to the old shifts aggregate private consumption of the home country from the future to the present.

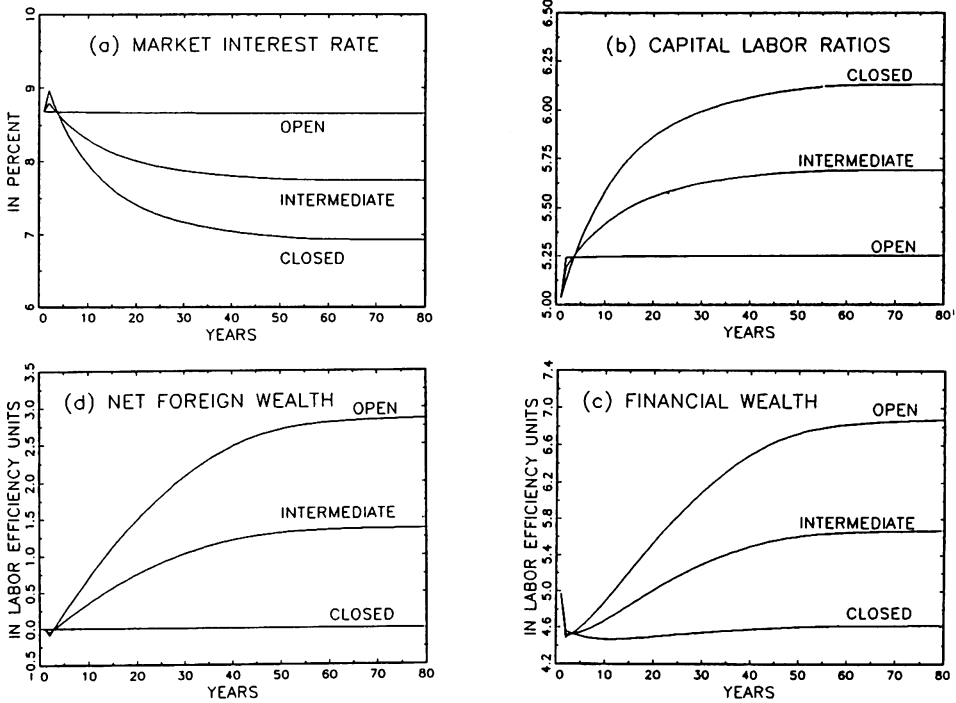
So far, any judgment about the attractiveness of introducing the cash flow income tax on the basis of generational welfare consequences as depicted in *figure 1d* would involve some intergenerational welfare comparisons. Are there any possibilities for Pareto improvement? *Figures 2* indicate such possibilities in the present context. The idea is to avoid any large increases in wage taxes. Wage taxes have to be paid early in life, translate into high present value tax liabilities and correspondingly reduce household total wealth by more than consumption taxes which yield equal revenues to the government in terms of present value. On the other hand, consumption taxes must be raised slowly since any immediate increase would deprive existing old generations of purchasing power and put them on a disadvantage. Hence, government debt must be allowed to accumulate initially. Specifically, the policy behind *figure 2* is to levy a 2% surcharge on wages over eight years. The wage tax rate is then reduced gradually to its initial level until year 20. The consumption tax rate is increased linearly from 11% in the first year to 14% in year 7. Government debt accumulates. In year 8 a debt reduction policy is started that brings back gradually the debt income ratio to its steady state value of .25 by the year 38, and the consumption tax rate adjusts to support this policy. *Figure 2* shows this policy to be Pareto improving. The economy eventually arrives at the same steady state characteristics as in the other cases of transitional arrangements. No cohort specific taxes are needed to achieve this Pareto improvement. Although the policy is a quite special construction and by no means unique, the example indicates that given the initial intertemporal distortions the cash flow tax generates some potential for Pareto improvement within the present model. Note also that the example in *figure 2* pertains to the small open economy case. In the intermediate case of two equally sized countries or in a closed economy, different policies might be required to generate Pareto improvement if it is possible at all.

Figures 3 show the effects of the introduction of the cash flow tax under different assumptions concerning the international environment. If the home country is small

Figure 2: Pareto Improvement



relative to the world economy, tax reform will leave the market rate of interest unaffected. The growth effects are rather moderate in this case as the A-wedge is relatively small in the initial situation and the pre tax rate of return on capital declines only by this minor amount. Since the net rate of return to savers increases by the full amount of the interest tax, the increase in financial wealth accumulation is most pronounced in the open economy case. The differences in the demand for assets by domestic households and the supply of assets from the domestic production sector and government is invested in

Figure 3: Effects in Open and Closed Economies

foreign bonds. In the opposite case of a closed economy, the decline in the market interest rate which is necessary to bring the capital market into equilibrium reinforces the growth effect and depresses household wealth accumulation as compared to the open economy case.

V. CONCLUDING REMARKS

In analyzing the international and intertemporal effects of a cash flow tax reform with a dynamic simulation model with overlapping generations, the paper arrived at several important results. *First*, with quite realistic assumptions on marginal tax rates and in an open economy, the introduction of a cash flow tax is expected to induce moderate growth effects but quite large effects on the accumulation of domestic household wealth. The results seem to be dominated by the high sensitivity of household savings with respect to changes in net interest rates. *Second*, the decline of the equilibrium interest rate in a closed economy reinforces the growth effect of the reform but depresses household wealth accumulation as compared to the open economy case. *Third*, the result that the world interest rate will decline and that capital is exported as a consequence of the tax reform

seems to be quite robust to changes over a wide range of parameters. Only in extreme non symmetric parameterizations was it possible to arrive at a higher world interest rate. *Fourth*, the design of transitional policies is of critical importance in determining the intergenerational welfare effects of the reform. While it is possible to mitigate the tax capitalization effects of the reform by allowing the old tax depreciable capital stock and old debt to be written off gradually, these arrangements also lead to higher revenue losses in the short run. The intergenerational welfare effects depend crucially on which compensating policies are chosen to satisfy the budget requirements of the government. The paper showed that Pareto improvement is possible within the proposed model by a combined use of debt policy and consumption and wage taxes without influencing the long run state of the economy.

The results obtained so far must be interpreted with some caution because of several strong assumptions underlying the model. Agents are assumed to optimize over long time horizons and do not face any liquidity constraints. Such intertemporal models generally find it difficult to explain the close empirical relationship between consumption and income and imply an unrealistically high interest elasticity of savings. Also, we observed rapid adjustment in the short run due to the absence of any adjustment costs in investment. Including adjustment costs would have mitigated the tax capitalization effects, led to a slower revaluation of asset prices and to less dramatic welfare effects in the short run (see *figure 1*). Furthermore, labor is supplied exogenously. The proposed policies involved some increases in wage tax rates to account for the revenue losses in the initial years, but the model could not capture the efficiency costs in the form of a more serious distortion between labor and leisure. To properly examine the welfare effects of shifting from a tax that distorts both intertemporal consumption and labor supply decisions to one that distorts only the labor leisure margin, the model should ideally allow for endogenous labor supply. Finally, both countries produce the same good. As BOVENBERG 89 has shown, tax changes will result in more price adjustment and less real allocational effects if it becomes more difficult to substitute between different types of goods. Incorporating each of these more realistic features involves, however, a major new modeling effort which is left for future research.

APPENDIX

The appendix shows how the objective function in (15) is expressed in terms of state and control variables. According to the dynamic theory of firm behavior, optimal factor demands and output of the representative firm follow from maximizing the present value of future net cash payments to the owners. Net payments to the owners derive from the fundamental financial identity of the firm which requires that at any time revenues equal disbursements.

$$DIV + I + TE + t_k K = CF + BN + VN \quad (A1)$$

Disbursements are dividends, gross investment outlays, and tax payments. The firm receives new equity issues, new bond issues, and gross earnings. Use equations (A1) and (13) to derive

$$VN = \frac{a-1}{a} DIV + (1-b) (I - \delta^R K) \quad (A2)$$

From (13), (9) and (11) we determine dividend payments

$$DIV = \frac{a}{1-at_e} \{ (1-t_e) (P - wL - t_k K) - (1-t_3 t_e) iD^f + (t_2 + t_1 t_e) I - \delta^R K + t_e \delta^T K^T \} \quad (A3)$$

Substitute (A2) and (A3) in (15) to get an expression for firm value in terms of the decision variables. The bracket in (15) emerges as

$$\left[\frac{1-t_a}{1-t_w} DIV - VN \right] = \Omega (1-t_e) (P - wL - t_k K) - K [\Omega i b (1-t_3 t_e) - \delta^R (1-b-\Omega)] - I [1-b-\Omega (t_2 + t_1 t_e)] + \Omega t_e \delta^T K^T \quad (A4)$$

The tax factor Ω is defined in (16). Now make use of equation (A5) which is derived in more detail in KEUSCHNIGG 90.

$$\sum_{s=t}^{\infty} \Omega_s t_{e,s} \delta^T K_s^T R_{s,t}^f = B_t + \sum_{s=t}^{\infty} (1-t_1) I_s z_{s+1} R_{t,s}^f \quad (A5)$$

The definitions of z_t and B_t are in (16). Substitute (A4) into (15) and use (A5) to derive the maximand

$$\max_{\{L_s, I_s\}} V_t - B_t = \sum_{s=t}^{\infty} \chi_s R_{t,s}^f \quad (A6)$$

subject to the conditions in (15) and the definition of χ

$$\chi_s = \Omega (1 - t_e) (P - w L - t_k K) -$$

$$K [\Omega i b (1 - t_3 t_e) - \delta^R (1 - b - \Omega)] - I [1 - b - (1 - t_1) z_{s+1} - \Omega(t_2 + T_1 t_e)]$$

The necessary conditions in (17) emerge from the problem in (A6). We also can write the value of the objective function as $V-B=qK$ where q is the current value multiplier of the state variable K .

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SUMMARY

The paper presents a one good two country computable general equilibrium model with overlapping generations to evaluate intertemporal and international effects from tax reform. Model treatment of household and firm behavior is firmly rooted in the microeconomic theory of intertemporal choice. The paper considers the effects from the implementation of a cash flow income tax which was shown to be neutral with respect to intertemporal decisions. The paper compares the effects in closed and open economies. In solving for transition paths to new intertemporal equilibria, I also discuss the generational welfare consequences of various arrangements that affect the transition paths.

ZUSAMMENFASSUNG

Dieser Beitrag stellt ein angewandtes intertemporales Gleichgewichtsmodell mit überlappenden Generationen, zwei Ländern und einem Gut vor, mit welchem intertemporale und internationale Effekte von Steuerreformen berechnet werden können. Das Verhalten der Haushalte und Unternehmen gründet auf der mikroökonomischen Theorie optimaler intertemporaler Konsum- und Produktionsentscheidungen. Im Besonderen wird der Übergang zu einem System der Cash Flow Besteuerung simuliert, wobei die Auswirkungen in offenen und geschlossenen Wirtschaften einander gegenübergestellt werden. Ausserdem werden die generationenspezifischen Wohlfahrtseffekte verschiedener Übergangsszenarios ermittelt, was die Berechnung der vollständigen Anpassungspfade zwischen den stationären Wachstumsgleichgewichten voraussetzt.