The Home Country Optimal Taxation on Foreign Investment in a Growing Economy*

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1. Introduction

The pros and cons of foreign investment, especially its impact on the domestic U. S. economy, have provoked much discussion during the last decade. Labor unions contend that foreign direct investment — the way that multinational corporations usually invest abroad — deprives U.S. workers of jobs by transfering production to countries where labor is cheap. But businessmen argue that foreign investment contributes to higher employment and a positive U.S. balance of payments by stimulating exports and by enhancing capital formation through profit repatriation for domestic investments. Advocates of foreign investment support a favorable tax treatment of foreign investment income. But labor unions question the wisdom of heavy foreign investment and support a less lenient tax policy to reduce capital outflow.

Most analyses of the impact of foreign investment tax on the functional distribution of income or on the level of capital outflow have assumed that there is a fixed amount of aggregate captal to divide between investment at home and abroad. Most of them recommended taxing investment income more heavily than domestic investment income in order to reduce capital outflow and thus to increase domestic capital stock and the share of labor based on one sector or two sector general equilibrium model (Brownlee (1979), Feldstein and Hartman (1979), Frank and Freeman (1978), Hartman (1980), Hufbauer, et al (1975), and Musgrave (1975)).

As a representative of short-run models, let us introduce the Feldstein-Hartman model briefly. In their model, there are three different technologies F (K, L), F^s (K^s, L^s), and F^* (K^*, L^*) which represent a representative home country firm, its foreign subsidiary and a representative host country firm, respectvely. Since the home country total capital is

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assumed exogenously given ($\overline{K}$), the domestic capital (K) is endogenously determined by the difference between the exogeneously given total national capital and the amount of capital transferred abroad to foreign subsidiaries (K^s); i. e., $K=\overline{K}-K^s$. The model consists of an equilibrium condition that the marginal after tax profitability of foreign investment be equal to that of domestic investment, a labor market equilibrium condition in the host country, and the home country objective function:

$$(1-t)F_k = [(1-t_s)(1-t_s^*)+\gamma t_s^*]F_k^s \tag{1}$$

$$E_L^*(K^*, L^*-\overline{L}^s) = F_L^s(K^s, L^s) \tag{2}$$

$$N = F(\overline{K}-K^s, L) + (1-t_s^*)(F^s - W^* L^s)$$

$$\text{where}\quad F_K = \frac{\partial F}{\partial K},\quad F_K^s = \frac{\partial F^s}{\partial K},\quad F_L^* = \frac{\partial F^*}{\partial L},\quad \text{and}\quad F_L^s = \frac{\partial F^s}{\partial L} \tag{3}$$

(1) says that the net of tax rates of return at home and abroad are equal at equilibrium (where, t is the tax rate on domestic investment, t_s is the tax rate on the subsidiary profit, t_s^* is the host tax rate on the subsidiary profit, and r is the credit rate for the tax paid to the host country). As a condition of production efficiency, (2) means that the host country firms and the subsidiaries pay a wage W^* equal to the marginal product of labor F_L^*, since host country workers are free to work for either the host country firms or the subsidiaries.

The home country selects t_s and r to maximize the national income (3) with the knowledge that firms will respond by adjusting K^s until (1) is satisfied and that the equilibrium of the host country labor market assures · (2) Thus the optimal tax rate under the model is "full tax after deduction" — taxing subsidiary profits net of the tax paid to the host country at the same rate as domestic profits are taxed. This optimal tax rate is based on the assumption that the subsidiary firms are small enough to leave the host country wage unchanged. Dropping this assumption and regarding r as zero (i.e., there is no tax credit) the optimal tax rate becomes:

$$t_s = t + \frac{1-t}{F_k^s}\left[\frac{L^s F_{LL}^s \; F_{LL}^*}{F_{LL}^* + F_{LL}^s}\right] = t + H^{(1)}$$

$$\text{where,}\quad H^{(1)} = \frac{1-t}{F_k^s}\left[\frac{L^s F_{LK}^s \; F_{LL}^*}{F_{LK}^* + F_{LL}^s}\right] > 0 \tag{4}$$

In the static short-run model, capital is already fully employed; there is no alternative for capital to evade the tax burden or to contribute to domestic capital formation by profit repatriation. That little attention has been paid to the impact of this tax on saving propensities and the level of capital formation in the model, may be one of the reasons why the monopoly-monopsony oriented interpretation is not sufficient for analysis of the real economy. To analyze this long-run capital change we have to investigate agents' affect capital accumulation. Several economists examined how savings behavior affects the optimal taxation on foreign investment (e.g. Negishi (1965)) and the longrun incidence of a tax on capital income (profit) in a growing economy (Diamond (1970), Feldstein (1974), Feldstein (1979), Bernheim (1981), Kotlikeoff and Summers (1979 and 1981)). With a fixed capital stock, owners of capital would bear the entire burden of a general tax on profits (i.e. the return to capital would fall but the price of the product and the wage rate would not be affected). They would avoid some of the burden of a partial tax on capital (such as the corporate income tax) to the extent that capital can shift away from the taxed sector to the untaxed sector without significantly reducing the marginal product of capital in the untaxed sector (Harberger (1962), and Mieszkowski (1969)).

But those papers about long-run incidence of a capital income tax show that replacing the usual static model and fixed capital stock by a model of a growing economy with variable saving rates or with variable factor supply substantially alters the conclusions about the incidence of a general tax on profits. A substantial fraction of the burden of a general profits tax is borne by labor. Therefore, Feldstein says that the assumption of a fixed capital stock may yield quite misleading conclusions in the analysis of the tax on capital income. Similarly, the optimal tax on foreign investment with fixed capital assumption may also lead to misleading conclusions. For example, under the fixed capital assumption capital outflow reduces capital-labor ratio in the home country and thus raises the marginal product of capital relatively to that of labor. But if saving is a function of the rate of return to savers, increasing the return to savers enhances savings, increases the capital stock and may increase the wage in the long run.

Negishi originally studied the optimal level of foreign investment from a long-run point of view by adopting an objective function which maximizes the long run steady state consumption of the home country. Making a somewhat special assumption about saving (namely, that only capitalists save), he said that foreign investment should be encouraged by means of a subsidy rather than discouraged by a tax on it. Let us introduce Negishi's model briefly. His model consists of the home country objective function (the level of long-run consumption), the condition of the stationary state for the home and the host country and the optimal condition of the marginal investment at home and abroad. In this model there are only two different technologies — those of the home and host representative firms. Foreign investment is restricted to pure capital movement such as capital lending or borrowing. Assuming full employment of the constant labor forces, outputs of the home and foreign countries are, respectively, $f(k-k^s)$ and $f^*(k^*+k^s)$. Then the home country consumption, which is to be maximized, is

$$c^h = f(k-k^s) + k^s f^{*\prime}(k^* + k^s) - nk \tag{5}$$

proportions s and s^* of the capital earnings of the home and foreign countries are assumed to be saved. The condition for the stationary state will therefore be

$$s[(k-k^s)f'(k-k^s) + k^s f^{*\prime}(k^* + k^s)] - nk \tag{6}$$

for the home country and

$$s^* k^* f^{*\prime}(k^* + k^s) = nk^* \tag{7}$$

for the host country. The optimal condition for the allocation of capital to foreign investment is

$$f'(k-k^s) = (1-t_s)f^{*\prime}(k^* + k^s)\ . \tag{8}$$

The optimal tax rate from this model is

$$t_s = -s(k-k^s)(s^* - 1)f''/(n-ns) < 0\ . \tag{9}$$

Under this model, with saving only from capital income, the optimal tax rate is always negative (i.e. a subsidy).

As Kemp mentioned in this comment on Negishi's paper, under this special saving function, the host capital-labor ratio is independent of the home country tax rate on foreign source income. Therefore, the host country wage rate would not be affected by foreign investment in this model. Presumably, some degree of monopoly-monopsony power for the home country could make the optimal tax equal to zero.

We now modify further the parameters of Negishi's simple model by introducting different technologies for home production, subsidiary firms' production and host country firms' production assuming that only home country capital is used by the subsidiary. This enables us to analyze the composite characteristics of modern direct foreign investment through multinational corporations motivated by different investment conditions across countries. Through this modification we can also analyze how the different investment conditions affect the optimal taxation and thus the level of foreign investment. With this modification, we can again analyze the importance of the home tax rate on its domestic investment and the host tax rate on the subsidiaries' profit, and different rates of saving from the two kinds of income.

II. The Home Country Model

This section sets out the basic model and analyzes the special case of optimal taxation when the tax rate on foreign investment income levied by the host country and that on domestic investments are given and when the constant saving propensity of each agent is given. The technology of the economy of the home country may be expressed by the production function of the representative firm $y = f(k)$, where y is output per man and k is capital per man. It is useful to assume the representative firm has a foreign subsidiary with production function $y^s = f^s(k^s)$ implying different technology from both the home country's and the host country's. Similarly, the host country technology can be represented by the production function $Y^* = f^*(k^*)$. If capital investment abroad is not through subsidiary firms but through the host country production function such as $f^*(k^* + k^s)$, foreign investment would be equivalent to a pure capital movement. Without introducing different subsidiary firms' technology, we could not analyze properly the impact of such important characteristics of modern direct foreign investment as superior technological know-how, and managerial skills on the optimal taxation. In this analysis, foreign investment through subsidiary firms is motivated by differences in technological production conditions as well as relative factor supplies across countries.

We assume that all three production functions f, f^s, and f^* are continuously twice differentiable and increasing concave functions ($f' > 0$, $f'' < 0$). The production functions are assumed also to satisfy the Inada (1963) conditions $f'(o) = \infty$, $f'(\infty) = 0$ to ensure the existence of an equilibrium.

If an amount K^s of domestic capital is exported to the foreign subsidiaries, the amount of capital employed for domestic production is $K\text{-}K^s$. Therefore, actual capital-labor ratio employed for domestic production is $(K\text{-}K^s)/L = c$, and the output per man is $y = f(c)$. Likewise, the host country's capital-labor ratio employed for production is $K^*/(L^*\text{-}L^s) = c^*$, since L^s level of the host country labor is employed for subsidiary production. Firms pay tax at the rate t on their domestic profits so the firms net marginal product of capital is $(1\text{-}t)f'(c)$. The host country collects a tax at the rate t_s^* on subsidiary profits. Every subsidiary investment earns a net return $(1\text{-}t_s^*)f^{s\prime}(k^s)$. If the home country levies a tax on the subsidiary's net return at the rate t_s, the actual net return from foreign investment which the parent firm receives is $(1\text{-}t_s)(1\text{-}t_s^*)f^{s\prime}(k^s)$.

Firms of the capital exporting country invest at home and abroad until the net of tax rates of return are equal:

$$(1-t)f'(c) = (1-t_s)(1-t_s^*)f^{s\prime}(k^s)$$

$$\text{where,} \quad c = \frac{K-K^s}{L}, \quad k^s = \frac{K^s}{L^s} \tag{10}$$

The home country population is assumed to grow at the rate n. The labor force participation rate is assumed constant. Ignoring technical progress and depreciation has no effect on the qualitative conclusions of the analysis. Otherwise, n can be interpreted as the growth rate of the home labor force plus the rate of capital stock depreciation.

Subsidiary firms' profit repatraition and its impact on consumption in the model can be described by equation (11). This equation also can be considered as the objective function to be maximized with respect to t_s.

$$c^h = f(c) + f^{s\prime}(k^s)(k-c)(1-t_s^*) - nk \tag{11}$$

$(k\text{-}c)$ is per capita foreign investment $(K^s/L = K/L - (K\text{-}K^s)/L)$ and $f^{s\prime}(k^s)(k\text{-}c)(1\text{-}t_s^*)$ is subsidiary firm's profit repatriation net of the host country's tax. Here all of the profits earned are assumed to be returned to the home country without deferment or retention for reinvestment.

Saving per man is

$$\begin{aligned} s &= s_L w + s_K kr \\ &= s_L[f(c) - cf'(c)] + s_K[1-t)f'(c)c \\ &\quad + f^{s\prime}(k^s)(k-c)(1-t_s)(1-t_s^*)] \end{aligned} \tag{12}$$

where s_L and s_K are the propensities to save out of labor and capital income and w is wage rate, r is marginal product of capital. Here, we assume that capital income only is taxed with the proceeds being spent on kinds of expenditure which does not affect savings decisions or production functions. For example, all government expenditure could be transfer payments. This assumption implies that a balanced budget is always achieved. Traditionally, optimal income or sales tax is derived by maximizing a social welfare function under a tax revenue constraint. But in this home country model tax revenue is always spent as a government expenditure or as a private consumption as shown in the objective function (11). A tax revenue constraint is not necessary for the derivation of optimal taxation.

The equilibrium condition for steady state growth is that all savings are invested and that the rates of growth of capital and labor are equal. In other words, a balanced growth path is maintained under the condition that

$(\frac{dK}{dt}/K = n$ (i.e. $\frac{s}{k} = n$):

$$s = nk \quad . \tag{13}$$

Since capitalists are assumed to save s_K portion of their marginal net return from domestic investment (K-K^s) and foreign investment (K^s), the equilibrium condition for balanced growth is not $s = nc$.

From (12) and (13)

$$s_L [f(c) - cf'(c)] + s_K [(1-t)f'(c)c + f^{s\prime}(k^s)(k-c)(1-t_s)(1-t_s^*)] = nk \tag{14}$$

To further facilitate computation the production function of the subsidiary is expressed as a linear combination of that of the home country. Since f and f^s are continuously increasing functions, a linear combination of them does not change the qualitative characteristics of the model:

$$f(c) = \gamma f^s(k^s) \; (\Rightarrow f^s(k^s) = \frac{1}{\gamma} f(c) = \delta f(c))$$

where, $c=k^s \quad 0<\gamma<1 \; (\Rightarrow \delta > 1)$. (15)

We assumed that the two aggregrage production functions are of similar general form. The influence of technology difference and the composite factors mentioned earlier are assumed to be representable by a scale parameter r which ranges from zero to one.

To derive the optimal $\hat{t}_s$, we differentiate totally (11) with respect to t_s under the constraints (10) and (14). We obtain three equations stating the first order necessary conditions for the optimal taxation and four unknowns. Since the number of unknowns exceeds the number of equations, we cannot solve for all of the unknowns. However, any one may be fixed arbitrarily, and the solutions for the other three as a function of the values chosen for the fixed one may be obtained. Another way of solving this problem is to represent k^s as a function of c and k:

$k^s=g(c,k)$

where, $g_c = \frac{\partial g}{\partial c} \gtreqless 0, \; g_k = \frac{\partial g}{\partial k} > 0$ (16)

Since there are two offsetting effects of the marginal change of the capital-labor ratio adopted by the parent firm (c) on that employed by the subsidiary (k^s), the sign to which g_c should be constrained is not determinate. The similiar technological conditions of the two firms suggests that the sign of the partial derivative should be positive, i.e. an increase in the parent capital-labor ratio which is technology oriented may raise the subsidiary capital-labor ratio. On the other hand, a c increase which is not technology oriented may be realized by a reduced capital outflow. This is quite evident from the definition of per capita foreign investment, $\frac{k^s}{L} = k-c$. From the definition itself we can also see that $g_k > 0$.

Another way of expressing the equation (16) is:

$$k^s = (k-c)\,\theta\,[c,\ (k-c)]$$

where, $\theta = \frac{L}{L^s}$, $\frac{\partial \theta}{\partial c} > 0$, $\frac{\partial \theta}{\partial (k-c)} < 0$, and

$$k^s = \frac{k^s}{L^s} = \left(\frac{k}{L} - \frac{k-k^s}{L}\right) = (k-c)\theta \tag{17}$$

The ratio of labor employed at home to foreign labor employed in the foreign investment sector (θ) is related positively to the home capital intensity and negatively to the per capita foreign investment, (k-c). High domestic capital intensity induced by low capital outflow would reduce the foreign labor employed by subsidiaries and thus raise θ. On the other hand, an increase of foreign investment would raise employment of foreign labor which in turn decreases θ.

Let's rewrite the original model with the transformed production function (15) and subsidiary's capital-labor ratio (16):

$$(1-t)f'(c) = (1-t_s)\,(1-t_s^*)\,f[g(c,k)] \tag{18}$$

$$c^h = f(c) + f[g(c,k)]\,(k-c)\,(1-t_s^*) - nk \tag{19}$$

$$\begin{aligned} s_L\,[f(c) - cf'(c)] + s_K\{\,f'(c)\,c(1-t) + \\ f[g(c,k)]\,(k-c)\,(1-t_s)\,(1-t_s^*)\,\} = nk\,. \end{aligned} \tag{20}$$

One way of deriving the optimal t_s is to take the total derivative of the objective function (19) under the constraints (18) and (20) Instead of taking total derivative of (19), the optimal tax, t_s is derived by egualizing the marginal rate of substitution between k and c assuming a constant consumption level ($dc^h = 0$) with that of the constraint (20) following Negishi's method of solution. The Lagrangian multiplier method and Negishi's is equivalent. Negishi's method is very convenient for a computer simulation.

We, at first, differentiate totally equations (19) and (20) and equalize dk/dc of these two. Totally differentiate (19) and set equal to zero to obtain dk/dc:

$$dc^h = 0 = f'(c)dc + \delta\, f''(k^s)\, g_c\,(k-c)\,(1-t_s^*)\,dc + \delta f''(k^s)$$

$$g_k(k-c)(1-t_s^*)\,dk - \delta f'(k^s)(1-t_s^*)\,dc + \delta f'(k^s)(1-t_s^*)\,dk - n\,dk$$

$$\frac{dk}{dc} = \frac{[f'(c) - \delta f'(k^s)(1-t_s^*)}{n - \delta f'(k^s)(1-t_s^*)} \frac{+\delta f''(k^s) g_c(k-c)(1-t_s^*)]}{-\delta f''(k^s) g_k(k-c)(1-t_s^*)} \tag{21}$$

Substituting (20) for (18) and totally differentiate it

$$\begin{aligned} &s_L[f(c) - cf'(c)] + s_K[(1-t)f'(c)k] = nk \\ &s_L[-cf''(c)]\,dc + s_K[(1-t)f''(c)k]\,dc \\ &\quad = n\,dk - s_K(1-t)f'(c)\,dk \end{aligned} \tag{22}$$

$$\frac{dk}{dc} = \frac{f''(c)\,[s_K(1-t)k - s_L c]}{n - s_K(1-t)f'(c)} \tag{23}$$

From (21) and (23) the optimal c and k, $\hat{c}$ and $\hat{k}$ are obtained if the production function f is explicitly given:

$$\hat{c} = \hat{c}(s_K, s_L, t, t_s^*, n, g, \delta) \tag{24}$$

$$\hat{k} = \hat{k}(s_K, s_L, t, t_s^*, n, g, \delta)\,. \tag{25}$$

The optimal tax rate $\hat{t}_s$ can be obtained by inserting (24) and (25) into (18) and it is expressed such that

$$\hat{t}_s = \hat{t}_s(s_K, s_L, t, t_s^*, n, f, g, \delta) \tag{26}$$

Since we do not have an explicit form of f we can better express the optimal steady state equilibrium by $f'(\hat{c})$ instead of $\hat{c}$ and $\hat{k}$ from (21) and (23)

$$f'(\hat{c}) = h(\hat{c}, \hat{k}, s_K, s_L, t, t_s^*, n, g, \delta, f'') \tag{27}$$

i.e., combining (21) and (23) it can be expressed by a quadratic function of $f'(\hat{c})$ such that:

$$a[f'(\hat{c})]^2 + b[f'(\hat{c})] + d = 0$$

where, $a = s_K(1-t)$

$$b = n - s_K(1-t)\,[\delta f''(k^s) g_C(\hat{k}-\hat{c})(1-t_s^*) - \delta f'(\hat{k}_s)(1-t_s^*)]$$

$$\begin{aligned} d = {} & [\delta f''(k^s) g_C(\hat{k}-\hat{c})(1-t_s^*) - \delta f'(k^s)(1-t_s^*)]\,n \\ & -[n - \delta f'(k^s)(1-t_s^*) - \delta f''(k^s) g_K(\hat{k}-\hat{c}) \\ & (1-t_s^*)]\,f''(\hat{c})\,[s_K(1-t)\hat{k} - s_L\hat{c}] \end{aligned}$$

Substituting (27) into (18), the optimal tax $\hat{t}_s$ can be expressed:

$$\hat{t}_s = 1 - \frac{(1-t)f'(\hat{c})}{(1-t_s^*)\delta f'(\hat{k}^s)}$$
$$= t + \frac{(1-t)\,[(1-t_s^*)\delta f'(\hat{k}^s) - f'(\hat{c})]}{(1-t_s^*)\delta f'(\hat{k}^s)} = t + H\,. \tag{28}$$

Here, $H<0$, if $\frac{\partial k^s}{\partial c} > 0$ (which is more likely,

$H>0$, if $\frac{\partial k^s}{\partial c} < 0$ see Appendix) .

$H < O$ implies that the optimal tax rate on foreign investment under in this model is also likely to be less than the domestic investment tax rate to maximize the steady state consumption. Since the short-run general equilibrium models treat capital as just a primary factor like labor, they ignore the interdependence of return of labor and saving rate which can be both a cause and an effect of capital accumulation. Relaxing the fixed capital assumption and introducing a saving function, capital outflow (foreign investment) in the long run may raise domestic capital formation and thus the marginal productivity of labor through the repatriation of high profits which in turn raise saving rates of each agent, producer, consumer, and government. Therefore, we would recommend to reduce the taxation on foreign investment if the government policy goals are to increase capital formation and long-run consumption streams.

As far as there is no reaction to the home country tax policy from the host country, I think, the traditional international economic theory that a free flow of commodities is a good thing for the world economy also applies to capital flow in the long-run contrary to the conclusions based on the short-run models.

From (26) we can see that the optimal taxation depends upon saving rates of laborers and capitalists, population growth, the technologies of the home country representative firm and subsidiaries, the home domestic investment tax, the host tax on subsidiaries' profits, and functional form of k^s. But in Negishi's model, the optimal tax is a function of the saving rates of the home and host country, population growth rate, and the home (or host) representative firm's production function (i.e., $t_s = x(s, s^*, n, f)$). Since t and t_s^* are important institutional variables for the determination of the optimal t_s, they should be taken into consideration in the analysis. With these two variables we can analyze the optimal taxation from a game theoretic approach.

Another main difference between the two models is in the marginal investment condition. In Negishi's model foreign investment is limited to pure capital movements through the host country's technology. Thus, the host country's capital intensity or technology rather than subsidiaries' is one of the main determinants of the optimal taxation. But modern direct foreign investment has usually been done through subsidiary firms. For the home country investors' point of view, they would invest until after tax marginal productivity of the home production and subsidiaries' are equal. Therefore, subsidiaries' capital intensity and production function rather than the host representative firm's should be included in the marginal investment condition.

Even if we assume that only capitialists save, under this model, a subsidy rather than a tax is not optimal. This is discussed in the next section.

III. Numerical Examples of a Hypothetical Economy

Let us examine how the optimal taxation of the home country foreign investment in the model looks like if we specify the aggregate production f(c) as a Cobb-Douglas production function, $c^q(y) = c^q L^{1-q}$ $(\rightarrow \frac{Y}{L} = y = c^q)$ and vary other parameters of the model. Parameters will be selected so that they might resemble those that are sometimes thought to be capable of representing the U.S. economy. In addition, the function g(c,k) is specified based on the equation (1.36) such that:

$$k^s = g(c,k) = (k-c)\theta\ [c, (k-c)]$$

$$= (k-c)\left[\frac{\alpha c}{(k-c)} + \beta c\right] \text{ where, } \alpha = .75\ \ \beta = .05. \tag{29}$$

Through assuming numerous functional forms of θ and inserting wide range of consecutive numerical values (around more than one thousand combinations) of α and β into them, θ, α, and β are obtained by searching one of the best combinations which explains the relationships between c, k, and k^s realistically. Through this numerical calculation we can have at least some ideas about the possible ranges of the optimal taxation and can check the theoretical results obtained in the previous sections.

At first, let's rewrite the condition for the optimal c, k, and k^s which lead us to the optimal taxation t_s. From (21) and (23) the optimal condition would be obtained by inserting $f'(c) = c^q$, $f'(c) = qc^{q-1}$, and $f''(c) = q(q-1)c^{q-2}$.

$$\frac{qc^{q-1} - \delta\, qk^{s(q-1)}\,(1-t_s^{*}) + \delta\, q(q-1)k^{s(q-2)} \cdot g_c \;(k-c)\,(1-t_s^{*})}{n - \delta\, qk^{s(q-1)} \cdot (1-t_s^{*}) - \delta\, q(q-1)k^{s(q-2)} \cdot g_k \quad (k-c)\,(1-t_s^{*})} = \frac{q(q-1)\, c^{q-2}\,[s_K\,(1-t)k - s_L\, c]}{n - s_K\,(1-t)qc^{q-1}} \quad (30)$$

From (14) the optimal $\hat{k}$ would be expressed:

$$\hat{k} = \frac{s_L\,(1-q)\hat{c}^{\,q}}{n - s_K\,(1-t)q\hat{c}^{\,q-1}} \quad (31)$$

Now the optimal $\hat{c}$, $\hat{k}$, $\hat{k}^s$ are finally obtained from (29) (30), and (31). These optimal capital-labor ratios of the non-linear constraint maximization problem have been derived by Gausian elimination method of computer simulation. With these three optimal capital-labor ratios, the optimal $\hat{t}_s$ is derived from (22).

As shown below, substituting three realistic values for each parameter, population growth rate (n), capitalist's marginal propensity to save (s_K), labor's marginal propensity to save (s_L), capital's share of total output (g), and domestic business tax (t), we can see the possible ranges of the optimal $\hat{c}$, $\hat{k}$ and $\hat{t}_s$.

[Table 1.1] Numerical Examples of the Optimal C,K and Ts

N	SK	SL	Q	T	C	K	KS	TS	CH
.015	.150	.050	.300	.400	5,703	7,680	4,841	.236	1,697
.020	.150	.050	.300	.450	4,101	4,956	3,251	.272	1,500
.030	.150	.050	.300	.450	2,399	2,744	1,840	.288	1,261
.020	.100	.050	.300	.450	2,927	3.974	2,282	.262	1,410
.020	.150	.050	.300	.450	4,101	4,956	3,251	.272	1,500
.020	.200	.050	.300	.450	5,605	5,797	4,258	.293	1,575
.020	.150	.050	.300	.450	4,101	4,956	3,251	.272	1,500
.020	.150	.100	.300	.450	4,315	9,773	4,414	.130	1,727
.020	.150	.150	.300	.450	4,152	14,815	5,329	= .020	1,873
.020	.150	.050	.250	.450	3,500	4,296	2,764	.282	1,341
.020	.150	.050	.300	.450	4,101	4,956	3,251	.272	1,500
.020	.150	.050	.350	.450	4,884	5,837	3,896	.260	1,714
.020	.150	.050	.300	.350	4,875	5,439	3,794	.151	1,542
.020	.150	.050	.300	.400	4,479	5,203	3,521	.210	1,522
.020	.150	.050	.300	.450	4,101	4,956	3,251	.272	1,500

Table (1.1) shows how the optimal $\hat{c}$, $\hat{k}$, $\hat{k}^s$, and $\hat{t}_s$ change by inserting three different numerical values for each parameter keeping the values of other parameters in the middle or the most plausible values. For the calculation of the optimal $\hat{t}_s$ we used parametric values to t_s^* and δ as .40 and 1.07 respectively based on the estimation done by P. Musgrave (1975).

The optimal tax rate of foreign investment income $\hat{t}_s$ under each set of parametric values of Table (1.1) is far less than domestic business tax t. This confirms the previous theoretical result. Population growth rate (n), saving rate out of capital income (s_K), and domestic business tax (t) are positively related to optimal tax rate (t_s). But as the saving rate out of labor income (s_L) and capital's share of total income (q) increases the optimal tax rate (t_s) has been decreased.

Among those parameters, s_L and t have the strongest impact on the optimal taxation and population growth rate affects per capita long-run consumption level (c^h) most greatly.

As n increases, domestic capital labor ratio and per capita consumption diminish so rapidly, the relative advantage of foreign investment which is mainly obtained from comparatively high productivity of capital also decreases. Therefore, the increase of population growth raises $\hat{t}_s$ to maximize long-run consumption level. It is interesting that an increment of s_K and s_L have opposite impacts on the optimal tax rate. Since the capital share out the total income is .3, an increase in s_K does not contribute as much to domestic capital formation does as the same percentage increase in s_L. An s_L increase raises the domestic steady state capital-labor ratio before foreign investment (k) so rapidly, encouraging foreign investment under high level of k by reducing tax rate can keep the productivity of the home capital and thus can increase capital accumulation and the long-run level of consumption. This is the reason why a subsidy (− .02) rather than a positive tax is optimal under the value of S_L 0.15.

Foreign investment income is capitalists', as long as capitalist's saving rate is high, government favorable tax policy on foreign investment may not be necessary. The impact of q increase on the optimal tax rate can be interpreted similarly that that of s_L change is done.

A marginal increase of the home domestic business tax t discourages domestic capital formation and thus reduces the steady state capital-labor ratio. As explained before, this diminishes the comparative advantage of foreign investment. Therefore, t and t_s are positively related and it reflects optimal condition of investment between home and abroad.

This analysis of the relationship between the optimal taxation and these parameters gives us some policy suggestions on how the government does manage foreign investment policy efficiently and effectively to achieve its social goal.

The figures presented on Table (1.1) are based on several particular parameterizations of a stylized U.S. economy and on the assumption of 100 percent profit repatriation to the home country from its foreign investment. A more realistic model may alter the results somewhat.

IV. Concluding Remarks

We have shown how the optimal taxation of foreign investment under the long-run steady state equilibrium model is different from that under the short-run model of fixed aggregate capital assumption.

In the static short-run model, capital is already fully employed, there is no alternative for capital to contribute to domestic capital formation by profit repatriation. In the model, we could not consider the impact of the tax on saving rate and capital formation for the derivation of the optimal taxation. Therefore, taxing foreign investment income more heavily than domestic investment income is optimal.

Eliminating the assumption of fixed aggregate capital the optimal tax is less than that under the short-run model as long as $\frac{\partial k^s}{\partial c} > 0$ which is realistic in the long.

Otherwise (if $\frac{\partial k^s}{\partial c} < 0$) , the optimal tax rate is close to the one under the short run model. Under the assumption of fixed aggregate capital the home country's capital intensity tends to inversely related to the subsidiary's. In other words under the assumption reducing capital outflow implies increasing domestic capital stock. Since there is no mechanisms to take domestic capital formation into a consideration through profit repatriation. From the numerical examples, we can see that the optimal tax rate is rarely negative even under the assumption that capitalists only save as was done in the Negishi's model.

From this study, we once again confirm that whenever we deal with the optimal taxation on capital income or its incidence we have to at least consider it in terms of long-run equilibrium as well as short-run equilibrium. For the optimal taxation on foreign investment, we can say that, it is more general to talk about it under a long-run model. Since it includes the short-run result if $\frac{\partial k^s}{\partial c} < 0$.

Selecting model in terms of long-run or short-run equilibrium mainly depends on the government policy goals. If the government objective is to maximize long-run welfare or long-run consumption streams, it should economize current consumption and raise current saving. Reducing tax on capital income is a way of achieving this goal. If the government policy makers of the home country have a philosophy putting more emphasis on the short-run national income rather than the long-run, they would raise tax on foreign investment.

In this analysis so far, the government capital accumulation is disregarded under the implicit assumption that tax revenue is entirely consumed and agent's marginal propensity to save S_K, S_L are given a priori. Relaxing these assumptions with more general saving functions derived from agent's saving decisions based on life cycle overlapping generation model, may be a way of improving this study. We can extend the home country model by combining it with the host country model (the first chapter of the author's thesis). Similar analysis can be made from the host country point of view (the 2nd chapter of the author's thesis). It can become more realistic to analize the optimal taxation in terms of Cournot-Nash game theoretic approach by combining the two independent models, home and host (the 3rd chapter of the author's thesis).

Furthermore, an extension of this study such as two-sector or multisector general equilibrium analysis with good empirical studies would surely bring more general theoretical results as well as more persussive policy recommendations. Combining this analysis with investors portfolio choice under risk and uncertainty would also be a challenging future study.

Even though this study does not depict the real economy perfectly, it suggests clearly how different the effects of tax policies are, depending upon various models and their assumptions, and how important the policy makers' insight is in building models and in choosing policy options.

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Appendix

To show that H is likely to be negative is equivalent to showing that $f'(c)$ is likely to be greater than $(1-t_s^*)\,\delta f'\,[g(k,c)]$

For that, let's rewrite (1.46) so that:

$$f'(c) = \frac{n - s_K(1-t)A - \sqrt{[n - s_K(1-t)A]^2 + 4s_K(1-t)\,[An-(n-B)E]}}{2s_K(1-t)}$$

$$= \frac{n - s_K(1-t)A - \sqrt{(n + s_K(1-t)A]^2 - 4s_K(1-t)\,(n-B)E}}{2s_K(1-t)}$$

$$> \frac{n - s_K(1-t)A - [n + s_K(1-t)A]}{2s_K(1-t)} \quad (\because\ -4s_K(1-t)\,(n-B)E > 0)$$

$$= -A = (1-t_s^*)\,\delta f'\,(k^s) - \delta f''(k^s) g_c\,(\hat{k}-\hat{c})\,(1-t_s^*)$$

if $g_c\ (= \frac{\partial k^s}{\partial c})$ is positive $f'(c) > (1-t_s^*)\,\delta f'\,(k^s)$.

Therefore, the sufficient condition $H < 0$ is $g_c > 0$ which is more likely to be in reality

where, $A = \delta f''\,(\hat{k}^s)\,(\hat{k}-\hat{c})\,(1-t_s^*) - \delta f'\,(\hat{k}^s)\,(1-t_s^*)$

$B = \delta f\,(\hat{k}^s)\,g_K\,(k-c)\,(1-t_s^*) - \delta f'\,(\hat{k}^s)\,(1-t_s^*)$

$E = f''(\hat{c})\,[s_K(1-t)\,\hat{k} - s_L\,\hat{c}]$.