(1)

Strategic Behavior and the Tax Systems for Foreign Direct Investment

Tomoya Ida

1 Introduction

According to UNCTD (2000), world foreign direct investments (international balance of payments base, flow) have expanded rapidly for three consecutive years, and will exceed a billion dollars in 2000. In order to promote an inflow of foreign capital, many countries have ever established a tax systems to treat an imported capital very well. This process is often called tax competition and can be identified with non-cooperative behavior. Therefore, it is interesting and necessary to make tax systems an endogenous decision variable of government. The purpose of this paper is to examine a corporate income tax competition in an international capital flow model.

Many studies have ever been made on the tax systems. In this study, the combinations of tax principles (residence or source principle), tax rules (tax rates on a domestic and a foreign source income are same or not) and relief methods of international double taxation (credit, deduction, exemption and non-relief method) are considered as tax systems. The studies of tax competition under each tax principle (Bucovetsky and Wilson (1991), Razin and Sadka (1991), and Razin and Yuen (1999) etc.) indicated the superiority of residence principle. The analyses of tax competition under each relief method (Hamada (1966), Bond and Samuelson (1989), Janeba (1995), Oakland and Xu (1996) and Konan (1997) etc.) presented that all methods were indifferent under non-discriminatory tax rule, whereas were not so under discriminatory tax rule.

As shown above, the existing studies make tax rates an endogenous government decision variable. However, corporate income tax rate changes by governments are embedded within existing tax systems. Hence tax systems should also be seen as decision variables of governments. The contribution of this paper is to study the strategic decision of the tax system on which the existing research has not been done.

In conclusion, there can exist two equilibrium tax systems: (i) the home tax system composed of residence principle, discriminatory tax rule and credit method; and the foreign tax systems that contain residence principle; (ii) residence principle, non-discriminatory tax rule and non-relief method at home; and source principle at abroad. The home country would have a highest national income under (i), whereas the world economy would have a highest income under (ii).

Our conclusions derive the following policy implication. From the viewpoint of the home country, the international double taxation ought to be relieved by credit under discriminatory tax rule, whereas from the viewpoint of world economy, not to be done under non-discriminatory tax rule.

This paper is organized as follows: Section 2 presents the basic assumptions and the structure of this game. Section 3 shows the international capital flows determination. Section 4 and 5 analyze tax rate decision and tax system choice respectively, and Section 6 concludes.

2 The Model

Consider a two-country model in which both countries choose both tax rates and tax systems on capital so as to maximize national income. In order to isolate the strategic issues that arise in tax competition between countries and the role played by tax rule, we will keep the production side of the model as simple as possible. According to Ruffin (1984), MacDougall and Kemp model is the simplest model to analyze the international capital movements. Hence, we use this model to discuses international corporate income tax competition. This paper adopts what Janeba (1995) refer to as the model: there are two countries, home and foreign country (all foreign variables are indexed with an asterisk). The home (foreign) country produces one good by use of the factors, capital $K(K^*)$ and labor $L(L^*)$ under conditions of perfect competition in all markets. The production function $F(F^*)$ is homogeneous of degree one, strictly quasi-concave and satisfies the standard Inada conditions. Each country has strictly positive endowments of capital and labor, $(\overline{K}, \overline{K}^*, \overline{L}, \overline{L}^*)$, which are inelastically supplied. Capital, however, is internationally mobile whereas labor is not[1]. Since labor is inelastically supplied and internationally immobile, it is omitted from the production function for notational convenience.

We assume that the return on investment in the home country is below that in the foreign country when no capital is traded, i.e. $r = F_K(\overline{K}) < F^*_K(\overline{K}^*) = r^*$ where r and r^* denote the rental rates for the use of capital. As a measure of the difference in the marginal product of capital in autarky, the parameter c is introduced. This makes it possible to write

$$F_K(\overline{K}) \equiv cF^*_K(\overline{K}^*), \text{ where } 0<c<1. \tag{1}$$

(1) implies that in a free trade situation, firms in the home country will export capital and invest abroad. Let $Z>0$ denote capital exports, whereas $Z<0$ represents capital imports for the home country. In a free-trade equilibrium, firms hire capital and labor until both home and foreign labor markets clear (and labor is paid its marginal prod-

1) Moreover we assume that all capital is financed by equity and that all capital movement takes the form of foreign direct investment. We also assume that all earning are repatriated to capital owners in home country as earned, so that the corporate income tax applies to all income from capital services.

uct); world capital supply and demand equalize, and the following international capital market equilibrium condition holds

$$F_K(\overline{K}-Z^0)=F^*_K(\overline{K}^*+Z^0),$$

where $Z^0>0$. The properties of the production functions would ensure the existence of a unique equilibrium.

Next, let us present this game structure. The players of this game are the home and the foreign government. The strategic variables of the home (foreign) government are tax rate $t\in[0,\ 1)$ ($t^*\in[0,\ 1)$) and tax system $\{RC, RD, RE, RN, RCN, RDN, REN, RNN, S\}$ as shown in Table 1[2].

Moreover, the tax rate on non-traded capital is assumed to be zero under discriminatory tax rule. However, it doesn't loss the generality of the discussion[3].

Table 1 Tax Systems of Home and Foreign Country

Tax Systems	Tax Rule	Relief Method	Tax Principle
RC	Discriminatory	Credit	Residence
RCN	Non-Discriminatory		
RD	Discriminatory	Deduction	
RDN	Non-Discriminatory		
RE	Discriminatory	Exemption	
REN	Non-Discriminatory		
RN	Discriminatory	Non-Relief	
RNN	Non-Discriminatory		
S	—	—	Source

2) We will explain the tax systems in next section.
3) Since countries are national income maximisers and capital is in perfect inelastic supply, taxes on nontraded capital are pure transfers that do not affect national income. The optimal such tax is then arbitrary and can be chosen to be zero.

The decision on a tax system is long-run decision, since the tax system is changed less often than the corporate tax rate. Foreign direct investment seems to be more sensitive to the tax system than to tax rate, because the latter affects both type of investment whereas the former applies only to foreign direct investment. In following three-stage game, the corporate income tax rate and tax system are made endogenous, and all action taken by governments are observed in subsequent stages. Namely, the game mechanism is

First Stage	Governments simultaneously choice the tax system
Second Stage	Governments simultaneously decide the tax rate
Third Stage	International capital movement is determined

and each payoff is determined respectively. The payoff of both countries is the following national income:

$$Y(t,\ t^*)=F[\overline{K}-Z(t,\ t^*)] + (1-t^*)\cdot F^*_K[\overline{K}^*+Z(t,\ t^*)]\cdot Z(t,\ t^*), \qquad (2a)$$

$$Y^*(t,\ t^*)=F^*[\overline{K}^*+Z(t,\ t^*)] - (1-t^*)\cdot F^*_K[\overline{K}^*+Z(t,\ t^*)]\cdot Z(t,\ t^*). \qquad (2b)$$

Namely, the home national income (2a) is the sum of the domestic product and net income from abroad, and the foreign national income (2b) is the domestic product minus interest-dividend payments abroad. All above things are the common knowledge among all players.

To examine the backward induction outcome of this game, let us begin at the capital flows determination of third stage in next section.

3 The Capital Flows Determination —Third Stage—

Here, let us present capital market equilibrium under each tax system. In this study, the combinations of tax principles, tax rules and relief methods of international double taxation are considered as tax systems. Before turning to the examination of the capital flows determination, we will first explain the following three components of the tax systems

First, in the tax principle, there are residence and source principle. Under the residence principle, an income earned by a home resident is taxed regardless of the origin whereas a home source income by a foreign resident is not taxed. Under the source principle, an income earned in the home country is taxed regardless of the residence status whereas a foreign source income by a home resident is not taxed.

Second, in the relief methods, there are credit, deduction and exemption method. Under the credit method, tax paid in the foreign country is credited from tax paid at home, up to the amount of the foreign source income multiplied by the foreign tax rate. Under the deduction method, tax paid in the foreign country is deducted as cost from taxable income at home. Under the exemption method, income in the foreign country is not taxed at home.

Third, in the tax rule, there are discriminatory and non-discriminatory tax rule. The tax rates on a domestic and a foreign source invest income are same under non-discriminatory tax rule, whereas are not so under discriminatory tax rule.

Corporate taxation according to different tax systems changes the capital market equilibrium condition. Regarding to Z, there exist many types of equilibrium. The respective capital market equilibrium condition is

$$T \cdot F_K(\overline{K}-Z)=T^* \cdot F^*_K(\overline{K}^*+Z). \tag{3}$$

$T(T^*)$ is the tax factors in the home (foreign) country shown in Table 2 and 3.

Foreign direct investment is carried out until the net return on the domestic and the foreign investment for the home country firm are same. There exist equilibria with not only $Z>0$ and $Z=0$ but also

Table 2 Tax Factors at Positive Capital Flows

Home Tax System	Foreign Tax System	T	T^*
RC	*S*	1	$[1-\max(t, t^*)]$
RCN		$(1-t)$	
RD		1	$(1-t)(1-t^*)$
RDN		$(1-t)$	
RE		1	$(1-t^*)$
REN		$(1-t)$	
RN		1	$(1-t-t^*)$
RNN		$(1-t)$	
S		1	$(1-t^*)$
RC	*R* (*RC, RD, RE, RN, RCN, RDN REN, RNN*)	1	$(1-t)$
RD			
RE			
RN			
RCN		$(1-t)$	$(1-t)$
RDN			
REN			
RNN			
S		1	1

$Z<0$. In the case of $Z=0$, capital owners in one country are indifferent to investing in any country, or capital owners in both countries strictly prefer to invest their capital domestically. However, the case $Z<0$ can also occur as following lemma shows.

Lemma: The home country imports capital $(Z<0)$ if, and only if, the combination of tax systems is *S-REN* and $t^*>1-(1-t)\ c$.
Proof: See Appendix A

Therefore, we will first examine the most natural case of $Z>0$, i.e. the home country exports capital[4]. In the case of $Z>0$, differentiating

Table 3 Tax Factors at Negative Capital Flows

<table>
<tr><th>Home Tax System</th><th>Foreign Tax System</th><th>T</th><th>T^*</th></tr>
<tr><td rowspan="9">S</td><td>RC</td><td rowspan="2">$[1-\max(t, t^*)]$</td><td>1</td></tr>
<tr><td>RCN</td><td>$(1-t^*)$</td></tr>
<tr><td>RD</td><td rowspan="2">$(1-t)(1-t^*)$</td><td>1</td></tr>
<tr><td>RDN</td><td>$(1-t^*)$</td></tr>
<tr><td>RE</td><td rowspan="2">$(1-t)$</td><td>1</td></tr>
<tr><td>REN</td><td>$(1-t^*)$</td></tr>
<tr><td>RN</td><td rowspan="2">$(1-t-t^*)$</td><td>1</td></tr>
<tr><td>RNN</td><td>$(1-t^*)$</td></tr>
<tr><td>S</td><td>$(1-t)$</td><td>1</td></tr>
<tr><td rowspan="9">R
(RC, RD, RE, RN, RCN, RDN, REN, RNN)</td><td>RC</td><td rowspan="4">$(1-t^*)$</td><td rowspan="4">1</td></tr>
<tr><td>RD</td></tr>
<tr><td>RE</td></tr>
<tr><td>RN</td></tr>
<tr><td>RCN</td><td rowspan="4">$(1-t^*)$</td><td rowspan="4">$(1-t^*)$</td></tr>
<tr><td>RDN</td></tr>
<tr><td>REN</td></tr>
<tr><td>RNN</td></tr>
<tr><td>S</td><td>1</td><td>1</td></tr>
</table>

(3) yields as follows.

$$\frac{dZ}{Z} = \frac{\varepsilon\varepsilon^*}{\varepsilon+\varepsilon^*}\left[D\frac{dt}{1-t} + D^*\frac{dt^*}{1-t}\right], \tag{4}$$

where the elasticity of demand of exported capital $\varepsilon \equiv -F_K/(F_{KK}Z)$, the elasticity of demand for imported capital $\varepsilon^* \equiv -F^*_K/(F^*_{KK}Z)$, and both D and D^* are the tax system-dummy variables shown in Table 4.

Having presented the relation between international capital flows

4) We present only the case of $Z>0$, since $Z=0$ or $Z<0$ cannot occur in the equilibrium (See Appendix B).

Table 4 Dummy Variables of Tax Systems

<table>
<tr><th>Combination of Tax Systems</th><th>D</th><th>D^*</th></tr>
<tr><td>RC-S</td><td>-1 (as $t \geq t^*$)
0 (as $t < t^*$)</td><td rowspan="2">0 (as $t \geq t^*$)
-1 (as $t < t^*$)</td></tr>
<tr><td>RCN-S</td><td>0 (as $t \geq t^*$)
1 (as $t < t^*$)</td></tr>
<tr><td>RD-S</td><td>-1</td><td rowspan="5">-1</td></tr>
<tr><td>RDN-S</td><td rowspan="3">0</td></tr>
<tr><td>S-S</td></tr>
<tr><td>RE-S</td></tr>
<tr><td>REN-S</td><td>1</td></tr>
<tr><td>RN-S</td><td>$-\dfrac{1-t}{1-t-t^*}$</td><td rowspan="2">$-\dfrac{1-t^*}{1-t-t^*}$</td></tr>
<tr><td>RNN-S</td><td>$-\dfrac{t^*}{1-t-t^*}$</td></tr>
<tr><td>RC-R</td><td rowspan="4">-1</td><td rowspan="9">0</td></tr>
<tr><td>RD-R</td></tr>
<tr><td>RE-R</td></tr>
<tr><td>RN-R</td></tr>
<tr><td>RCN-R</td><td rowspan="5">0</td></tr>
<tr><td>RDN-R</td></tr>
<tr><td>REN-R</td></tr>
<tr><td>RNN-R</td></tr>
<tr><td>S-R</td></tr>
</table>

note) For example, *RC-S* means *RC* at home and *S* at abroad.

and tax rates, we will examine the equilibrium tax rates based on these things in section 4.

4 The Tax Rates Decision —Second Stage—

Here, we will present the subgame-Nash equilibrium results, which in the context of international tax competition under each tax system, can be defined as follows.

Definition: A subgame-Nash equilibrium is a pair of tax rates (t_{NE}, t^*_{NE}) that solve

$$t_{NE} \in \arg\max_{t} Y\ (t,\ t^*_{NE}),$$
$$t^*_{NE} \in \arg\max_{t^*} Y^*\ (t_{NE},\ t^*).$$

To derive subgame-Nash equilibrium from the examination of the reaction curves, a few remarks will be made concerning the relation between national incomes and tax rates. Differentiating both national incomes (2), we have the following results.

$$\mathrm{d}Y = [(1-t^*)F^*_K - F_K - (1-t^*)\ F^*_K/\varepsilon^*]\mathrm{d}Z - F^*_K Z \mathrm{d}t^*, \tag{5a}$$
$$\mathrm{d}Y^* = [F^*_K t^* + (1-t^*)F^*_K/\varepsilon^*]\mathrm{d}Z + F^*_K Z \mathrm{d}t^*. \tag{5b}$$

Substituting (4) into (5) yields the following equations.

$$\mathrm{d}Y = BD\left[1 - \frac{T^*}{(1-t^*)T} - \frac{1}{\varepsilon^*}\right]\frac{\mathrm{d}t}{1-t} + B\left[D^*\left(1 - \frac{T^*}{(1-t^*)T} - \frac{1}{\varepsilon^*}\right) - \frac{\varepsilon+\varepsilon^*}{\varepsilon\varepsilon^*}\right]\frac{\mathrm{d}t^*}{1-t^*}, \tag{6a}$$

$$\mathrm{d}Y^* = BD\left[\frac{t^*}{1-t^*} + \frac{1}{\varepsilon^*}\right]\frac{\mathrm{d}t}{1-t} + B\left[D^*\left(\frac{t^*}{1-t^*} + \frac{1}{\varepsilon^*}\right) + \frac{\varepsilon+\varepsilon^*}{\varepsilon\varepsilon^*}\right]\frac{\mathrm{d}t^*}{1-t^*}, \tag{6b}$$

where $B \equiv (1-t^*)F^*_K Z\, \varepsilon\varepsilon^*/(\varepsilon+\varepsilon^*)$. (6) reduces as shown in Table 5.

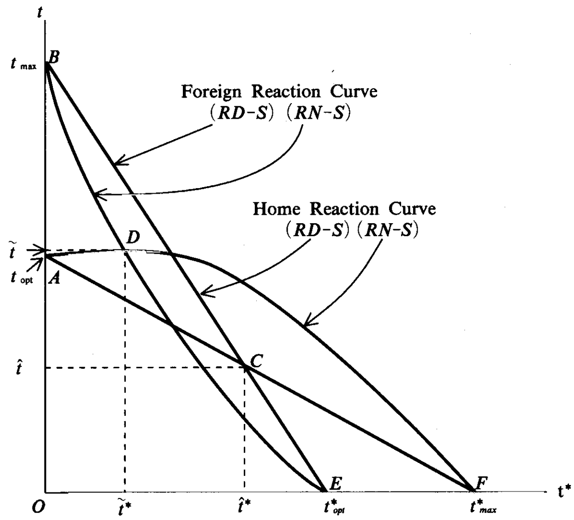
From Table 5, we can say as follows. In *RD-S*, for given t^*, Y is optimized by satisfying $t=1/\varepsilon^*$. The home reaction curve can then be illustrated as *ACF* at Figure 1. For given t, Y^* is optimized by setting $t^*=1/(1+\varepsilon)$. The foreign reaction curve can be then illustrated as *BCE* at Figure 1. The vertical intercept of the home reaction curve, t_{opt}, is the tax rate imposed by the home country when the foreign country sets a zero tax rate. From (5a), the vertical intercept of the foreign reaction curve must be the home tax rate that eliminates the

Table 5 Relation between National Income and Tax Rate

<table>
<tr><th>Combination of Tax Systems</th><th>$\partial Y/\partial t$</th><th>$\partial Y^*/\partial t^*$</th></tr>
<tr><td>RC-S</td><td>$-\frac{B}{1-t}\left[\frac{t-t^*}{1-t^*}-\frac{1}{\varepsilon^*}\right]$ (as $t \geq t^*$)
0 (as $t < t^*$)</td><td rowspan="2">Plus (as $t \geq t^*$)
$-\frac{B}{1-t^*}\left[\frac{t^*}{1-t^*}-\frac{1}{\varepsilon}\right]$ (as $t < t^*$)</td></tr>
<tr><td>RCN-S</td><td>0 (as $t \geq t^*$)
Minus (as $t < t^*$)</td></tr>
<tr><td>RD-S</td><td>$-\frac{B}{1-t}\left[t-\frac{1}{\varepsilon^*}\right]$</td><td rowspan="4">$-\frac{B}{1-t^*}\left[\frac{t^*}{1-t^*}-\frac{1}{\varepsilon}\right]$</td></tr>
<tr><td>RDN-S</td><td rowspan="2">0</td></tr>
<tr><td>RE-S</td></tr>
<tr><td>REN-S</td><td>Minus</td></tr>
<tr><td>RN-S</td><td>$-\frac{B}{1-t}\left[\frac{t}{1-t^*}-\frac{1}{\varepsilon^*}\right]$</td><td rowspan="2">$-\frac{B}{1-t^*}\left[\frac{\varepsilon+\varepsilon^*}{\varepsilon\varepsilon^*}-\frac{1-t}{1-t-t^*}\left(\frac{t^*}{1-t^*}+\frac{1}{\varepsilon^*}\right)\right]$</td></tr>
<tr><td>RNN-S</td><td>$-\frac{B}{1-t}\left[\frac{tt^*}{(1-t)(1-t^*)}-\frac{1}{\varepsilon^*}\right]$</td></tr>
<tr><td>S-S</td><td>0</td><td>$-\frac{B}{1-t^*}\left[\frac{t^*}{1-t^*}-\frac{1}{\varepsilon}\right]$</td></tr>
<tr><td>RC-R</td><td rowspan="4">$-\frac{B}{1-t}\left[t-\frac{1}{\varepsilon^*}\right]$</td><td rowspan="9">0</td></tr>
<tr><td>RD-R</td></tr>
<tr><td>RE-R</td></tr>
<tr><td>RN-R</td></tr>
<tr><td>RCN-R</td><td rowspan="5">0</td></tr>
<tr><td>RDN-R</td></tr>
<tr><td>REN-R</td></tr>
<tr><td>RNN-R</td></tr>
<tr><td>S-R</td></tr>
</table>

international capital movements (denoted t_{max}), since an optimal choice of $t^*=0$ (within ε finite) by the foreign country requires $Z=0$. Clearly, if $t^*=0$, there exits a home tax rate $t<t_{max}$ which induces $Z>0$ and yields $Y>F(\bar{K}, \bar{L})$. Any such tax rate gives a higher value of Y than does t_{max} (or any $t>t_{max}$) and satisfies $t<t_{max}$. This

Figure 1 Home and Foreign Reaction Curves
—*RD-S* and *RN-S*—

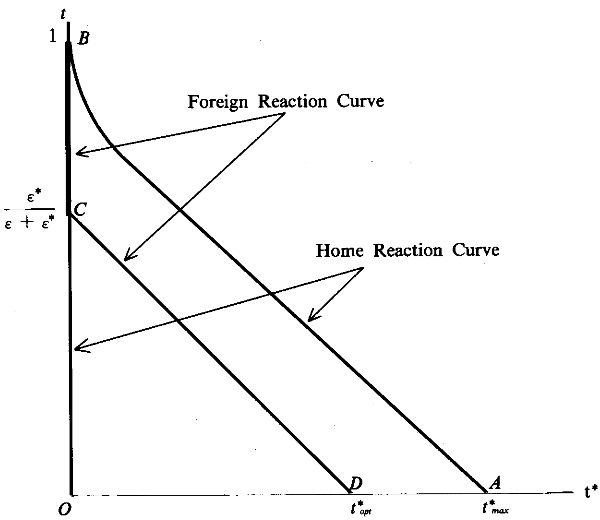


guarantees $t_{opt} < t_{\max}$. A similar argument establishes that the horizontal intercept of the home reaction curve must exceed the horizontal intercept of the foreign reaction curve, ensuring the existence of one intersection and hence subgame-Nash equilibrium *C*. Therefore, the subgame-Nash equilibrium tax rates, which corresponds to *C*, are respectively $\hat{t}$ and $\hat{t}^*$.

Under *RN-S*, for given t^*, Y is optimized by satisfying $t/(1-t^*)=1/\varepsilon^*$. The home reaction curve can then be illustrated as *ADF* at Figure 1. For given t, Y^* is optimized by setting $t^*/(1-t^*)=[1-t(\varepsilon+\varepsilon^*)/\varepsilon^*]/\varepsilon^*$. The foreign reaction curve can be then illustrated as *BDE* at Figure 1. A same argument as *RD-S* ensures the existence of one intersection and thereby subgame-Nash equilibrium *D*. Hence, the subgame-Nash equilibrium tax rates, which corresponds to *D*, are respectively $\tilde{t}$ and $\tilde{t}^*$.

In *RNN-S*, the home optimal tax of $t^*=0$ is $[0, 1)$ since the international capital flows are independent of both tax rates, and for given $t^*\neq 0$, Y is optimized by satisfying $tt^*/(1-t)(1-t^*)=1/\varepsilon^*$. Hence, the home reaction curve is illustrated as *ABO* at Figure 2. As $t\geq \varepsilon^*/(\varepsilon+\varepsilon^*)$, on the other hand, the foreign optimal tax rate is zero from $(\partial Y^*/\partial t^*)<0$, and for given $t<\varepsilon^*/(\varepsilon+\varepsilon^*)$, Y^* is optimized by setting $t^*/(1-t^*)=[1-t^*(\varepsilon+\varepsilon^*)/\varepsilon^*]/\varepsilon^*$. Therefore, the foreign reaction curve is illustrated as *BCD* at Figure 2. The above reaction curve of both countries overlap at *BC*. At *BC*, foreign tax rate is zero and thereby capital export neutrality is satisfied from Table 2. Capital export neutrality, in which the taxation does not affect the location decision of investment, causes an international optimal allocation of capital. Accordingly, the subgame-Nash equilibrium tax rates, which correspond to the subgame-Nash equilibrium *BC*, are $[\varepsilon^*/(\varepsilon+\varepsilon^*), 1)$ at home and zero at abraad and hence causes the international optimal

Figure 2 Home and Foreign Reaction Curves
—*RNN-S*—



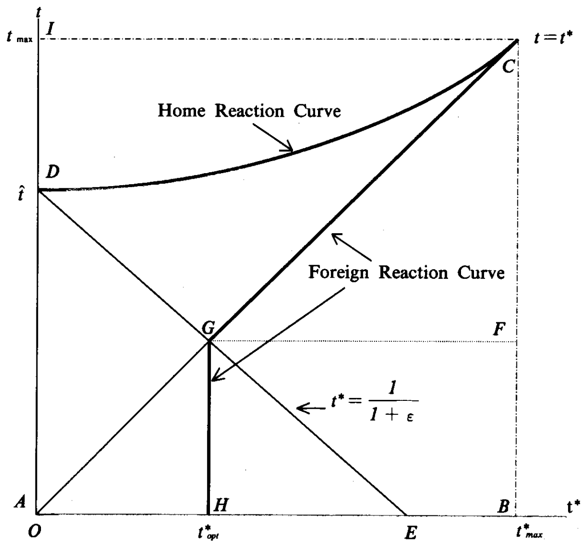
allocation of capital. From the above discussion, the following proposition is derived.

Proposition 1: *In non-discriminatory tax rate* competition, *no allowance for foreign taxes paid causes the international optimal allocation of capital at Nash equilibrium.*

Proposition 1 is contrary to Musgrave (1969) who takes the tax rates of both countries as exogenously given.

Under *RC-S*, at Figure 3, we can present the home reaction curve as *CD* which satisfies the home optimal condition $(t-t^*)/(1-t^*)=1/\varepsilon^*$. On the other hand, from Table 5, $(\partial Y^*/\partial t^*)$ is positive at *AHGCI* whereas negative at *CBGH* and hence the foreign reaction curve is expressed as *CGH*. Consequently, the subgame-Nash equilib-

Figure 3 Home and Foreign Reaction Curves
—*RC-S*—



rium tax rates, which corresponds to *C*, are $t_{\max}$ and $t^*_{\max}$.

For *S-S, RCN-S, RDN-S, REN-S* and *RE-S,* the foreign country sets t^*_{opt} satisfying the foreign optimal condition at subgame-Nash Equilibrium. The reason is why the home country exempts the foreign source income from the taxable income in *S-S*; and the home tax rate does not affect *Z* in *RE-S* and *RDN-S*; and the subgame-Nash equilibrium tax rate of the home country is zero since *Y* is a decrease function of *t* in *RCN-S* and *REN-S*. On the other hand, at *RC-R*, *RD-R* and *RN-R,* the foreign source income is not taxable at abroad, and thereby the home country adopts t_{opt} satisfying the home optimal con-

Table 6 Summary of Each Equilibrium

Combination of Tax Systems	t_{NE}	t^*_{NE}	Each Equilibrium Point Shown at Figure 1
RC-S	$t_{\max}$	$t^*_{\max}$	*B or F*
RD-S	$\hat{t}$	$\hat{t}^*$	*C*
RN-S	$\tilde{t}$	$\tilde{t}^*$	*D*
RC-R			
RD-R	t_{opt}	0	*A*
RN-R			
S-S			
RCN-S			
RDN-S	0	t^*_{opt}	*E*
REN-S			
RE-S			
S-R			
RE-R			
RCN-R			
RDN-R	0	0	*O*
REN-R			
RNN-R			
RNN-S	$[\varepsilon^*/(\varepsilon+\varepsilon^*), 1)$	0	

dition at subgame-Nash Equilibrium. In the other tax systems, both national incomes are unrelated to both tax rates. Hence, the following proposition is derived.

Proposition 2: *The home (foreign) country would have a highest national income under RC-R, RD-R and RN-R (S-S, RCN-S, RDN-S, REN-S and RE-S), while the world economy would have a highest income under S-R, RE-R, RCN-R, RDN-R, REN-R, RNN-R, and RNN-S.*

The result of *RCN-S*, *RDN-S*, and *REN-S* is agreed with Janeba (1995), while the other results seem to be accord with an intuition.

This section analyzed the decision of both equilibrium tax rates on the second stage. Following section discusses the decision of both tax systems on first stage.

5 The Tax System Choice —First Stage—

In this section, we will show the tax systems choice. Regarding equilibrium tax system, the following proposition is derived.

Proposition 3: *There can exist two combinations as Nash equilibrium tax systems of the home and the foreign country: RC-R and RNN-S.*

Proof: When the home (foreign) country exempts the foreign source income from the home (foreign) taxable income, we can regard $t(t^*)$ as zero. Therefore, each regime is regarded as special regime of *RD-S*, and thereby all subgame-Nash equilibrium points are presented as each point of Figure 1. These results are as set out in Table 6. Moreover, each equilibrium national income, which corresponds to the iso-national income contours on each point of Figure 1, are summarized at Table 7. Here, $Y_k(Y^*_k)$ denotes the home (foreign) national income corresponding to point k of Figure 1. From (6), $Y(Y^*)$

Table 7 Payoff Matrix of the Home and the Foreign Government

		Home Country				
		RC	*RD*	*RN*	*RNN*	Others
Foreign Country	*R*	$\underline{Y_A}, \underline{Y^*_A}$	$\underline{Y_A}, Y^*_A$	$\underline{Y_A}, Y^*_A$	$Y_0, \underline{Y^*_0}$	Y_0, Y^*_0
	S	Y_F, Y^*_B	$Y_C, \underline{Y^*_C}$	$Y_D, \underline{Y^*_D}$	$\underline{Y_0}, \underline{Y^*_0}$	$Y_E, \underline{Y^*_E}$

increases as $t^*(t)$ become small under *RD-S*. Hence, it is found that

$Y_A > Y_O > Y_i$ $(i=C, D, E, F)$ and $Y^*_E > Y^*_O > Y^*_j > Y^*_A > Y^*_B$ $(j=C, D)$.

In this game, a pair of strategies is a Nash equilibrium if each country's strategy is a best response to the other's every feasible strategy - that is, if both payoff are underlined in the corresponding cell of the bi-matrix. Therefore, both *RC-R* and *RNN-S* can be the equilibrium tax systems, since in either case, the national incomes of both countries don't increase simultaneously. □

This study used game theory to examine the strategic choice of tax systems. As a result, we got the three propositions of the international taxation.

6 Concluding Remarks

This paper found the following two results. First, there could exist two equilibrium tax systems: (i) the home tax system composed of residence principle, discriminatory tax rule and credit method; and the foreign tax systems that contain residence principle; (ii) residence principle, non-discriminatory tax rule and non-relief method at home; and source principle at abroad. Second, (i) gives a highest national income to the home country, whereas (ii) cause a highest income to world economy.

These equilibrium tax systems differ from not only the equilibrium tax system by the existing literatures of international tax competition

(Bond and Samuelson (1989), Janeba (1995) and Oakland and Xu (1996)), but also the international optimal tax system by Mintz and Tulkens (1996). It seems to cause the above difference that the existing literatures never include non-relief method in an endogenous decision variable of government.

This analysis uses a simple model of international capital flows (i.e. both capital and labor inelastically supplied). Hence, there might be the real phenomena that are unable to explain partly. Therefore, in the future, we have to use a more realistic model to study it. However, by the above simplification, this analysis seems to be able to examine the strategic decision of the tax systems which has never been analyzed from the complexities.

Finally, our analysis derives the following policy implication. From the viewpoint of the home country, the international double taxation ought to be relieved by credit method under discriminatory tax rule, whereas from the view of the world economy, not to be allowed under non-discriminatory tax rule.

Appendix

A. Proof of Lemma

Here, we will use the method of Janeba (1995) to prove the Lemma. If the combination of tax systems is *S-REN* the condition on tax rate $t^* > 1-(1-t)c$ implies $Z<0$, since $(1-t)c>(1-t^*) \Leftrightarrow (1-t)\ F_K(\bar{K}) > (1-t^*)\ F^*_K(\bar{K}^*)$. On the other hand, if that is the other combination, Z can never be negative. This will be proved by contradiction.

Assume first that the combination of tax system is *S-RCN* and $Z<0$. Then, it must hold $[1-\max(t, t^*)]c>(1-t^*)$. If $t \leq t^*$, it follows that $c>1$, which is not possible by assumption. However, $t>t^*$ would require $(1-t)c>(1-t^*)$, or at least $(1-t)>(1-t^*)$. But this implies that $t>t^*$ is a contradiction.

On the other hand, under the other than the above, $Z<0$ requires the following conditions:

$[1-\max(t, t^*)]\ c>1$: *S-RC*,
$(1-t)(1-t^*)c>1$: *S-RD*,
$(1-t)c>1$: *S-RDN*, *S-RE*, and *S-S*,
$(1-t-t^*)c>1$: *S-RN*,
$c(1-t^*)/(1-t-t^*)>1$: *S-RNN*,
$(1-t^*)c>1$: *R-RC*, *R-RD*, *R-RE* and *R-RN*,
$c>1$: *R-RCN*, *R-RDN*, *R-REN*, *R-RNN* and *R-S*,

which is impossible. □

B. The International Capital Flows in the Equilibrium

In this section, let us show the following results proved by Janeba (1995): if an equilibrium exits, then $Z>0$.

To prove this fact, it will first be shown that $Z<0$ is not compatible with an equilibrium. From lemma, it is known that $Z<0$ requites *S-REN* as combination of the tax system. Hence, in either regime, we have the following result from Table 5.

$$\frac{\partial Y^*}{\partial t^*}=-\frac{B}{1-t^*}\left[\frac{t^*}{1-t^*}-\frac{1}{\varepsilon}\right]$$

If $Z<0$, then ε and ε^* are negative and thereby both B and the term in brackets are positive. Accordingly, the foreign national income is decreasing in t^*, hence a reduction of the foreign tax rate is beneficial and capital flows are non-negative if equilibrium exists.

Secondly, it is shown that autarky $(Z=0)$ is not optimal for the foreign country. For $Z<0$, (6b) reduces to

$$\frac{\partial Y^*}{\partial t^*}=t^*F^*_K Z\frac{\partial Z}{\partial t^*}$$

A small reduction of t^*, which makes Z positive (the left side derivative at $Z=0$), increases the foreign national income from $(\partial Z/\partial t^*)<0$. Hence, for any t, the optimal foreign tax implies $Z>0$. □

References

Bond, E. W. and L. Samuelson (1989), "Strategic Behaviour and the Rules for International Taxation of Capital," *Economic Journal*, Vol.99, No.4, pp.1099-1111.

Bucovetsky, S. and J. D. Wilson (1991), "Tax Competition with Two Tax Instruments," *Regional Science and Urban Economics*, Vol.21, No.3, pp.333-350.

Hamada, K. (1966), "Strategic Aspects of Taxation on Foreign Investment Income," *Quarterly Journal of Economics*, Vol.80, No.2, pp.361-375.

Janeba, E. (1995), "Corporate Income Tax Competition, Double Taxation Treaties, and Foreign Direct Investment," *Journal of Public Economics*, Vol.56, No.2, pp.311-325.

Konan, D. E. (1997), "Strategic Taxation of the Multinational Enterprise: A New Argument for Double Taxation," *Journal of Public Economics*, Vol.63, No.2, pp.301-309.

Mintz, J. and H. Tulkens (1996), "Optimality Properties of Alternative Systems of Taxation of Foreign Capital Income," *Journal of Public Economics*, Vol.60, No.3, pp.373-399.

Musgrave, P. B. (1969), *United States Taxation of Foreign Investment Income: Issues and Arguments*, Law School of Harvard University, Cambridge Massachusetts.

Oakland, W. H. and Y. Xu (1996), "Double Taxation and Tax Deduction: A Comparison," *International Tax and Public Finance*, Vol.3, No.1, pp.45-56.

Razin, A. and E. Sadka (1991), "International Tax Competition and Gains from Tax Harmonization," *Economics Letters*, Vol.37, No.1, pp.69-76.

Razin A. and C. W. Yuen (1999), "Optimal International Taxation and Growth Rate Convergence: Tax Competition vs. Tax Coordination," *International Tax and Public Finance*, Vol.6, No.1, pp.61-78.

Ruffin, R. J. (1984), "International Factor Movements," in: Jones, R. W. and P. B. Kenen eds, *Handbook of International Economics Vol.1*, Amsterdam, North-Holland, pp.237-288.

UNCTD (2000), *World Investment Report 2000*, United Nations, New York.