Capital Tax Competition in the Presence of Rent-Shifting Incentives

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Abstract

The tax competition literature usually specifies competitive product markets, so that the rent-shifting effect is overlooked. By incorporating an duopolistic product market, this paper considers two exporting countries that use capital taxes as devices to promote exports in a two-stage game. We find that when firms compete in terms of quantity, the rent-shifting effect aggravates the under-provision of public goods. However, when firms compete in terms of price, the rent-shifting effect reduces the inefficiency arising from tax competition. Moreover, we show that cooperation between exporting countries enhances the welfare of both countries in a Cournot duopoly, but this is not necessarily true in a Bertrand duopoly.

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1. Introduction

The potential efficiency problem resulting from tax competition has attracted increasing attention. Tax competition models argue that jurisdictions tend to set taxes inefficiently low to attract investment, thus giving rise to an under-provision of public goods.[1] However, by not only attracting investment, tax incentives have long been, intentionally or unintentionally, used to promote exports.[2] Strategic trade theory (e.g., Brander and Spencer, 1985) has pointed out that a country with market power in the product market will attempt to shift rents from other countries by subsidizing exports. The prevalence of free trade significantly restricts the use of the traditional trade instruments such as export subsidies, and thus other instruments have been considered to serve as a secondary means to promote export. Capital tax preferences are one of them.[3] Since the tax competition literature usually assumes a perfectly competitive product market, such a rent-shifting effect is assumed away. By incorporating an oligopolistic product market, this paper investigates how exporting countries use tax incentives as devices to promote trade and thereby shift rents from other countries, and examines how the rent-shifting effect affects the distortion arising from tax competition among jurisdictions.

The main conclusion arising from tax competition studies is that

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1 For a general survey, see Wilson (1999), Wellisch (2000), or Wilson and Wildasin (2004).

2 For example, various tax incentives to promote exports have been introduced in Taiwan since the 1960s. See Kuo et al. (1981).

3 Another candidate is the environmental policy. Ulph (1997) provides a review of the vast literature surrounding the issue of strategic environmental policy. Many papers of strategic environmental policy, like Barrett (1994) and Kennedy (1994), do not incorporate the traditional trade instruments into models. Here we follow their approach, so the export subsidies are not involved.

the competition for capital among a group of independent jurisdictions generally results in sub-optimal capital tax rates and an under-provision of public goods.[4] Most studies in the tax competition literature focus on factor markets and assume that the product markets are competitive.[5] In such a competitive market setting, the strategic trade incentive or the rent-shifting effect has no roll to play.[6] Thus in the usual tax competition models, capital taxation is not used as a strategic trade tool to shift rents from other countries; instead, it is used only to compete for investment.

If we suppose that public goods are financed by capital taxes, the domestic government then faces a trade-off when it acts strategically to shift rents from foreign firms by reducing the capital tax. A capital tax incentive will decrease the domestic firm's costs, thereby shifting rents from foreign competitors. However, on the other hand, it will reduce the provision of public goods. Our focus is on knowing whether the rent-shifting effect will worsen or alleviate the under-provision of public goods.

By considering the rent-shifting effect, this paper unifies the tax competition model with the strategic trade policy. We build a two-stage game to examine how the traditional results are modified in a Cournot duopoly. From this we find that the rent-shifting effect reduces the provision of public goods, and thus aggravates the inefficiency arising from tax competition. Furthermore, we consider a

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4 See, for example, Wilson (1986), Zodrow and Mieszkowski (1986).

5 Many studies, for example Wildasin (1988, 1989), Hoyt (1991), and DePater and Myers (1994), consider imperfectly competitive capital markets but assume competitive product markets. A few tax competition models that consider imperfectly competitive product markets will be discussed below.

6 According to trade theory, if product markets are competitive, export subsidies should be zero. See Helpman and Krugman (1989).

Bertrand duopoly, and find that the distortion arising from tax competition is reduced in this case.

Few papers on tax competition incorporate imperfectly competitive product markets. Using a framework similar to that of Brander and Spencer (1985), Hands and Mann (1987) extend the usual tax competition modelling framework by considering imperfectly competitive firms. In a similar framework, Janeba (1998) examines how the subsidies (or taxes) offered by two exporting countries affect firms' location decisions. However, neither of them considers the provision of public goods, and thus each of them overlooks the issue of the under-provision of public goods, which is the focus of the tax competition literature.

By considering two oligopolistic firms competing in both the home and foreign product markets for market share, Conrad and Seitz (1997) demonstrate that infrastructure-related policy can be used as a strategic trade policy device. Unlike this present paper that considers a public consumption good, the public good in Conrad and Seitz (1997) is productive.

All of these papers only take the quantity-setting oligopoly into consideration. However, the strategic trade literature has pointed out that the market structure is crucial in determining trade policy.[7] Thus, in addition to considering a quantity-setting duopoly, we also examine the optimal capital taxes and the provision of public goods in a price-setting duopoly.

One possible way of reducing the inefficiency arising from tax competition is for jurisdictions to cooperate in terms of their taxes and expenditure policies. The existing literature has demonstrated that,

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[7] Eaton and Grossman (1986) show that the optimal trade policy is an export subsidy when firms compete in terms of quantity, and that the government should tax exports when firms compete in terms of price.

under the framework of competitive product markets,[8] cooperation among jurisdictions will lead to a Pareto improvement. We find that when firms compete in terms of quantity, the exporting countries will by cooperatively raising their taxes by the same small amount increase both countries' welfare. However, we also show that cooperatively raising taxes does not necessarily give rise to a Pareto improvement in a Bertrand duopoly.

The rest of this paper proceeds as follows. In Section 2, we introduce the model underlying our analysis. In Sections 3, we investigate the determination of the public good in the Cournot-competition case. The case of Bertrand-type competition is examined in Section 4. In Section 5, we discuss whether cooperation between exporting countries will enhance their welfare in various market structures. In Section 6, we present the concluding remarks.

2. Basic Model

Consider two countries, each containing a single firm. The ownership of the firm is in the hands of residents of the country in which the firm is located. The two firms produce differentiated commodities, and export all of the output to a third country. The demand in the third country is given by $p^i = p^i(x^i, x^j)$, where x^i denotes country i's output, with the properties $\partial p^i / \partial x^i < 0$ and $\partial p^i / \partial x^j < 0$. There is no domestic consumption of x in the exporting countries. Firms employ capital (K) and a fixed input (L), such as land or labor, to produce output. Capital is homogeneous and moves freely between countries. The fixed input is inter-jurisdictionally immobile, and its supply in each country is perfectly inelastic. The total amount of the fixed factor in each

[8] See, Wellisch (2000), Chap. 4.

country is normalized as one. The production function in country *i* (*i* =1,2) is $x^i = F^i(K^i)$.[9] Due to the inelastic supply of the fixed input, the marginal product of capital is decreasing, so $F_k^i > 0$ and $F_{kk}^i < 0$.

Without loss of generality, we assume that there is a representative consumer in each country. The utility function of the consumer in country i is given by $u^i(c^i, z^i)$, where c is the consumer's private consumption and z is the amount of the public good. The function u is strictly quasi-concave, and increases in both c and z. The consumer earns income from two sources: capital income and rents from the fixed input. Capital income is equal to $r\bar{K}^i$, where r is the net rate of return on capital, and $\bar{K}^i$ is the exogenously determined capital endowment of country i. Rents from the fixed input are given by

$$\pi^i = p^i F^i(K^i) - (t^i + r)K^i, \tag{1}$$

where t^i is country i's capital tax rate. By normalizing the price of the private consumption as unity, the consumer's budget constraint is $c^i = \pi^i + r\bar{K}^i$.

The goal of the government is to maximize social welfare. Each government taxes the domestic use of capital to finance a public consumption good. By assumption, both countries' public goods have no interregional spill-over effects. We first discuss the case where the two firms engage in quantity competition in the third country. The strategic trade theory reveals that an exporting country intends to shift rents from other countries by subsidizing exports, provided that it has market power in the product market. Here we consider the situation where governments subsidize exports by means of capital tax preferences. By so doing, as we will demonstrate, the government can increase its domestic

[9] Here we omit the fixed input.

firm's rents.

Once the governments are fully aware of the fact that they can give their domestic firms a competitive advantage over competing foreign firms by reducing capital taxes, not only the firms, but also the governments, act strategically. This competition between the exporting countries can be described as a two-stage game. At the first stage, the two governments choose their capital tax rates simultaneously; and then at the second stage, based on the capital tax rates decided at stage one, the two firms simultaneously choose their respective outputs.

To obtain a subgame perfect Nash equilibrium, we solve the game backwards, i.e. by starting from the second stage. The objective of the firm in country *i*, which is owned by the representative consumer, is to maximize the rent from the fixed input that is given by eq. (1). To focus on the strategic interdependence in the product market, we assume that both countries are unable to affect *r*.[10] As indicated by Wildasin (1993), almost all countries are small and open relative to the world capital market, and there are few instances where a single jurisdiction could expect to have a very significant effect on the world net return on capital.

Since the production function $x^i = F^i(K^i)$ is a monotonistically increasing function, its inverse function, $K^i = f^i(x^i)$, exists, with $f^i_x > 0$ and $f^i_{xx} > 0$. We can rewrite firm *i*'s objective function as

$$\pi^i = p^i(x^i, x^j)x^i - (t^i + r) f^i(x^i). \qquad (2)$$

Under the Nash assumption, firm *i*'s optimization requires

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[10] In our setting, the exporting countries are price makers in the product market, and price takers in the capital market. The same specification can be seen in Conrad and Seitz (1997).

$$\pi_i^i = p^i + x^i \cdot \partial p^i / \partial x^i - (t^i + r) f_x^i = 0, \tag{3}$$

where $\pi_i^i = \partial \pi^i / \partial x^i$. Equation (3) implicitly defines firm *i*'s reaction function as $x^i = x^i(x^j)$. Then, solving for the two firms' reaction functions yields the Nash equilibrium at the second stage. The comparative-static calculation reveals that

$$\frac{\partial x^i}{\partial t^i} = \frac{f_x^i \pi_{jj}^j}{\pi_{ii}^i \pi_{jj}^j - \pi_{ij}^i \pi_{ji}^j}, \tag{4}$$

$$\frac{\partial x^j}{\partial t^i} = \frac{-f_x^i \pi_{ji}^j}{\pi_{ii}^i \pi_{jj}^j - \pi_{ij}^i \pi_{ji}^j}, \tag{5}$$

where $\pi_{ij}^i = \partial^2 \pi^i / \partial x^i \partial x^j$. The stability condition of the Cournot game requires that the denominator be less than zero, and the second-order condition of optimization requires that $\pi_{jj}^j < 0$. We further assume that x^i and x^j are strategic substitutes,[11] so that $\pi_{ji}^j < 0$. Accordingly, $\partial x^i / \partial t^i$ is negative and $\partial x^j / \partial t^i$ is positive, indicating that a fall in t^i increases x^i but reduces x^j.

The effects of changing t^i on K^i and K^j can also be obtained from eqs. (4) and (5). Since $K^i = f^i(x^i)$ and $f_x^i > 0$, we have $\partial K^i / \partial t^i = f_x^i \cdot (\partial x^i / \partial t^i) < 0$ and $\partial K^j / \partial t^i = f_x^j \cdot (\partial x^j / \partial t^i) > 0$. This indicates that a decline in t^i will attract more capital inflow into country *i* and reduce the demand for capital in country *j*.

We can also show that $\partial \pi^i / \partial t^i < 0$ and $\partial \pi^j / \partial t^i > 0$. Thus, country *i* can increase its domestic firm's rents by decreasing t^i at the

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[11] Following Bulow et al. (1985), firm *i*'s output is defined to be a strategic substitute for firm *j*'s output if an increase in x^i reduces firm *j*'s marginal profitability. There is a tendency to regard strategic substitutes as the normal case for a quantity-setting oligopoly.

expense of the foreign competitor, which is known as the "rent-shifting effect".[12] This result confirms the notion that capital taxation can be used as a device to promote trade.

3. The Provision of Public Goods

We now turn our attention to stage one, in which the capital taxes and public goods are determined. At stage one, by taking into consideration the two firms' reaction functions, the government of country *i* chooses t^i to maximize social welfare. Given government *j*'s policy choice, government *i* solves

$$\begin{aligned} \max \quad & W^i = u^i(c^i, z^i), \\ \text{s.t.} \quad & c^i = \pi^i + r\overline{K}^i, \\ & z^i = t^i K^i, \end{aligned}$$

where $z^i = t^i K^i$ is the government budget constraint. Given the government budget constraint, once t^i is chosen, z^i is determined as well.

The first-order condition of the optimal choice of t^i (and the public good) is

$$\frac{u_z^i}{u_c^i} \equiv \text{MRS}_{zc}^i = \frac{1}{1+\eta^i} - \frac{\pi_j^i \dfrac{\partial x^j}{\partial t^i}}{K^i(1+\eta^i)}, \tag{6}$$

where $\eta^i = (\partial K^i / \partial t^i)(t^i / K^i) < 0$, denoting country *i*'s elasticity of capital demand with respect to t^i. We assume that the absolute value of η is less than one to ensure that the economy is on the "right" side of the Laffer curve; i.e. the capital tax revenues increase in *t*. When t^i

[12] Graphically, a fall in t^i shifts firm *i*'s reaction curve outwards in the output space.

is reduced, the consumer in country *i* enjoys more private consumption at the expense of less public good provided.[13] Thus the government faces a trade-off between the private and public consumption when deciding the capital tax. Equation (6) states that the capital tax (and the public good) should be chosen to equalize the marginal benefit of the public good, reflected by u_z^i / u_c^i in eq. (6), with the marginal cost of public funds (MCF), represented by the right-hand side of eq. (6).

The MCF is critical in the following analysis, and so it deserves more discussion. The MCF consists of three elements. First, an increase in the capital tax rate shifts resources from the private sector to the public sector, and reduces the private consumption. This component is known as the "revenue effect" of collecting taxes, which is a common feature of all taxes, even if they are not distortive. Second, when raising the capital tax rate, the government has to consider the induced capital flight that causes a reduction in the tax base. This "tax-base effect" and the revenue effect are reflected by the first term on the right-hand side of eq. (6). The tax-base effect is positively related to η, the capital demand elasticity. The more elastic the demand for capital, the larger will be the tax-base effect and the MCF. When a lump-sum tax is available, since it is neutral in relation to the capital allocation, the tax-base effect will no longer exist.

The third component is the "rent-shifting effect", reflected by the second term on the right-hand side of eq. (6). This describes the effect

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[13] This can be seen from the first-order condition of the optimal capital tax:

$$\frac{dW^i}{dt^i} = \frac{\partial u^i}{\partial c^i}\frac{\partial c^i}{\partial t^i} + \frac{\partial u^i}{\partial z^i}\frac{\partial z^i}{\partial t^i} = 0,$$

from which we derive eq. (6). Since the capital tax revenues increase in *t* by assumption, the product $\partial u^i / \partial z^i \cdot \partial z^i / \partial t^i$ is positive. In order to satisfy the first-order condition, $\partial c^i / \partial t^i$ must be negative, which means that the private consumption increases as t^i is reduced.

whereby a rise in t^i increases x^j, which in turn reduces x^i and π^i. The rent-shifting effect does not exist provided that the country is a price taker in the product market.[14]

When (i) a lump-sum tax is available, and (ii) the exporting country is a price taker, the tax-base effect and the rent-shifting effect do not exist, so that eq. (6) reduces to $\mathrm{MRS}^i = 1$. If we retain condition (ii), but change condition (i) to consider the case where the government charges a tax on mobile capital instead of imposing a lump-sum tax, then the tax-base effect will arise, and eq. (6) will become

$$\mathrm{MRS}^i_{zc} = \frac{1}{1+\eta^i}. \tag{7}$$

Equation (7), which restates the results derived by Wilson (1986) and Zodrow and Mieszkowski (1986), indicates that jurisdictions competing for capital leads to the under-provision of public goods.[15]

In addition to considering the imposition of a capital tax, this paper goes one step further to modify condition (ii) by specifying the existence of a duopoly product market. The strategic interdependence in the duopoly market gives rise to the rent-shifting effect. A comparison between eqs. (6) and (7) highlights the rent-shifting effect on the provision of public goods. When a country has market power, an increase in its capital tax not only leads to capital flight (the tax-base effect), but also impairs its domestic firm's rents (the rent-shifting effect), thus making the government more reluctant to raise the capital

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[14] When country *i* has no market power in the product market, π^j_{ji} is equal to zero. Then according to eq. (5), $\partial x^j / \partial t^i$ is equal to zero, and the second term of eq. (6) will vanish.

[15] The usual tax competition models regard the first-best optimum, in which a lump-sum tax is available, as the benchmark, so that the optimal condition for the supply of public goods is $\mathrm{MRS}^i = 1$. Comparing eq. (7) with the first-best optimal condition reveals that tax competition results in the under-provision of the public goods.

tax. Consequently, the rent-shifting effect increases the MCF of the capital tax, thereby reducing the public goods supplied. The following proposition summarizes what we have found:

Proposition 1.

When the firms compete in terms of quantity, the rent-shifting effect worsens the under-provision of public goods resulting from tax competition.

Notice that market power per se does not necessarily exacerbate the under-provision of public goods. To see this, consider a country, which contains a single firm, that is a monopolist in the world market. It is easy to show that the first-order condition for an optimal behavior of the country is the same as eq. (7). In a competitive market setting, an exporting country is unable to influence the market price. However, in the monopolistic market case, there is no rival from which the domestic firm can shift rents, so that the government is unable to enhance national welfare by distorting the capital tax. The exporting country thus has no incentive to subsidize its domestic firm in both cases. In sum, market power per se does not worsen the under-provision of public goods; it is the rent-shifting effect that aggravates the inefficiency of tax competition.

4. Bertrand Competition

In this section we return to the situation in which each country has a single firm. We assume that x^i and x^j are differentiated, and that the two firms engage in price competition. Similarly, we build a two-stage game to characterize the optimal capital taxes, and investigate how price competition affects the properties of tax competition.

The demand function faced by firm i is $x^i = x^i(p^i, p^j)$, with

$\partial x^i / \partial p^i < 0$ and $\partial x^i / \partial p^j > 0$. In country i, the rents that accrue to the fixed input are given by $\pi^i = p^i x^i(p^i, p^j) - (t^i + r) f^i [x^i(p^i, p^j)]$. The first-order condition of rent-maximizing requires that $\partial \pi^i / \partial p^i = 0$, which implies that firm *i*'s reaction function is $p^i = p^i(p^j)$. Then solving the two firms' reaction functions yields the equilibrium prices at the second stage. The comparative statics of the firms show that:

$$\frac{\partial p^i}{\partial t^i} = \frac{1}{H}\left(f_x^i \frac{\partial x^i}{\partial p^i} \frac{\partial^2 \pi^j}{\partial p^{j2}} \right), \tag{8}$$

where

$$H = \frac{\partial^2 \pi^i}{\partial p^{i2}} \frac{\partial^2 \pi^j}{\partial p^{j2}} - \frac{\partial^2 \pi^i}{\partial p^i \partial p^j} \frac{\partial^2 \pi^j}{\partial p^j \partial p^i}.$$

The stability condition of the Bertrand game requires that $H > 0$, and the second-order condition for rent-maximizing requires that $\partial^2 \pi^j / \partial p^{j2} < 0$. Therefore, we obtain $\partial p^i / \partial t^i > 0$, indicating that p^i increases with t^i.

Moreover, the effect of t^i on p^j is

$$\frac{\partial p^j}{\partial t^i} = \frac{1}{H}\left(-f_x^i \frac{\partial x^i}{\partial p^i} \frac{\partial^2 \pi^j}{\partial p^i \partial p^j} \right). \tag{9}$$

The sign of $\partial p^j / \partial t^i$ depends upon that of $\partial^2 \pi^j / \partial p^i \partial p^j$. Since the normal case for price-setting oligopoly is strategic complements, we assume that $\partial^2 \pi^j / \partial p^i \partial p^j$ is positive. As a result, $\partial p^j / \partial t^i$ is positive, meaning that an increase in t^i will raise p^j.

At the first stage, the governments choose capital taxes to maximize their social welfare. To this end, the government of country i will allocate resources between private consumption and the public good to satisfy

$$MRS_{zc}^{i} = \frac{1}{1+\eta^{i}} - \frac{\dfrac{\partial \pi^{i}}{\partial p^{j}} \dfrac{\partial p^{j}}{\partial t^{i}}}{K^{i}(1+\eta^{i})}. \tag{10}$$

Again, the left-hand side measures the marginal benefit of public consumption, and the right-hand side represents the MCF of the capital tax.

As in the Cournot competition case, the MCF of the capital tax consists of three parts. The revenue effect and the tax-base effect are described by the first term, and the second term depicts the rent-shifting effect. The sign of the rent-shifting effect depends on that of $\partial \pi^{i} / \partial p^{j}$ and $\partial p^{j} / \partial t^{i}$. Partially differentiating π^{i} with respect to p^{j} yields

$$\frac{\partial \pi^{i}}{\partial p^{j}} = \left[p^{i} - (t^{i} + r) f_{x}^{i} \right] \frac{\partial x^{i}}{\partial p^{j}} > 0. \tag{11}$$

Here we use the relationship $p^{i} - (t^{i} + r) f_{x}^{i} = -x^{i} \Big/ \left(\partial x^{i} / \partial p^{i} \right) > 0$ to sign $\partial \pi^{i} / \partial p^{j}$.[16] Since both $\partial p^{j} / \partial t^{i}$ and $\partial \pi^{i} / \partial p^{j}$ are positive, the rent-shifting effect reduces the MCF of the capital tax, and so we have

$$\mathrm{MRS}_{zc}^{i} = \frac{1}{1+\eta^{i}} - \frac{\dfrac{\partial \pi^{i}}{\partial p^{j}} \dfrac{\partial p^{j}}{\partial t^{i}}}{K^{i}(1+\eta^{i})} < \frac{1}{1+\eta^{i}}. \tag{12}$$

Equation (12) proves the following proposition.

Proposition 2.

When the firms compete in terms of price, the rent-shifting effect mitigates the inefficiency of tax competition.

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[16] This relationship is derived from the first-order condition of rent-maximizing $\partial \pi^{i} / \partial p^{i} = x^{i} + p^{i} \partial x^{i} / \partial p^{i} - (t^{i} + r) f_{x}^{i} \partial x^{i} / \partial p^{i} = 0$.

Proposition 2 reveals that the rent-shifting effect does not always aggravate the distortion of tax competition. In a price-setting oligopoly, price instruments are usually strategic complements, implying that the firms' reaction functions are upward-sloping; that is, when p^i decreases, the best response for firm j is to reduce p^j as well. To prevent the competitor from behaving more aggressively, the exporting countries will act like "puppy dogs" and raise the capital tax to behave less aggressively.[17] When the two countries act in the same way, they avoid a "lose-lose" situation, and moderate the inefficiency of tax competition as well. We also note that when the rent-shifting effect is sufficiently strong, eq. (12) will give rise to the over-provision of public goods.

5. Cooperation between Governments

One possible solution suggested in the literature to remedy the inefficiency arising from tax competition is for there to be cooperation among jurisdictions. If the two countries cooperatively raise their capital taxes away from the non-cooperative equilibrium by the same amount, can this improve both countries' welfare? This section attempts to address this question.

We first consider the case in which the firms compete in terms of quantity. If the two countries raise their capital taxes by the same amount, dt, then the effect of the tax increase on firm *i*'s sales is

$$\frac{dx^i}{dt} = \frac{f_x^i \pi_{jj}^j - f_x^j \pi_{ij}^i}{\pi_{ii}^i \pi_{jj}^j - \pi_{ij}^i \pi_{ji}^j}. \tag{13}$$

Since x^1 and x^2 are strategic substitutes, π_{ij}^i is less than zero. Comparing

[17] For the details of the "puppy dog" strategy, see Fudenberg and Tirole (1984).

eq. (13) with eq. (4) reveals that the absolute value of dx^i/dt is less than that of $\partial x^i/\partial t^i$, indicating that a bilateral tax increase gives rise to a less negative effect on sales. Furthermore, the bilateral tax increase makes the demand for capital less elastic with respect to t, so that $\eta^i < \overline{\eta}^i < 0$, where $\overline{\eta}$ is the elasticity of capital demand with respect to t under the cooperative game. When either country raises its capital tax unilaterally, it will give rise to intensive capital flight; we can therefore reasonably conclude that capital demand is less elastic when the two countries mutually raise taxes.

With the help of these comparative-static results, we have the following proposition:

Proposition 3.

When firms compete in terms of quantity, a bilateral increase in the capital taxes of the two countries will enhance both countries' welfare.

Proof. Differentiating country *i*'s social welfare function with respect to *t* yields

$$\begin{aligned} \frac{dW^i}{dt} &= u_c^i \cdot \left[\pi_j^i \frac{dx^j}{dt} - K^i + \mathrm{MRS}^i (1+\overline{\eta}^i) K^i \right] \\ &= u_c^i \cdot \left[\pi_j^i \frac{dx^j}{dt} + K^i (1+\overline{\eta}^i) + \left(\mathrm{MRS}^i - \frac{1}{1+\overline{\eta}^i} \right) \right]. \end{aligned} \tag{14}$$

It should be noted that all variables are evaluated at the non-cooperative equilibrium. Since $\pi_j^i \cdot dx^j/dt$ is positive, if we can show that the second term in the square brackets of eq. (14) is positive, then dW^i/dt is positive as well. As demonstrated before, since $\eta^i < \overline{\eta}^i < 0$, we obtain $1/(1+\eta^i) > 1/(1+\overline{\eta}^i)$. Moreover, according to eq. (6),

$\text{MRS}^i > 1/(1+\eta^i)$. By combining the two inequalities, we have $\text{MRS}^i > 1/(1+\bar{\eta}^i)$, and thus the second term in the square brackets is positive. Consequently, dW^i/dt is positive, indicating that the exporting countries' decisions to cooperatively raise *t* improves the welfare of both exporting countries. □

The intuition behind this result is that cooperation between the two countries reduces the negative impact of raising *t* on exports, which in turn makes the capital demand less sensitive to an increase in *t*, resulting in a smaller value of η (in absolute value terms). A less negative impact of raising *t* on exports reduces the rent-shifting effect, and a smaller value of $|\eta|$ represents a less severe tax-base effect. Both of them reduce the MCF of capital taxation. With lower MCFs, the two countries will set higher capital tax rates and provide more public goods, and thus the distortion arising from tax competition will be mitigated.

As to the case where the firms compete in terms of price, when the two countries cooperate to raise the capital taxes by the same amount, the comparative-static result reveals that

$$\frac{dp^i}{dt} = \frac{1}{H}\left[f_x^i \frac{\partial x^i}{\partial p^i}\frac{\partial^2 \pi^i}{\partial p^{j2}} - f_x^j \frac{\partial x^j}{\partial p^j}\frac{\partial^2 \pi^i}{\partial p^i \partial p^j} \right]. \tag{15}$$

Since p^1 and p^2 are assumed to be strategic complements, $\partial^2 \pi^i / \partial p^i \partial p^j$ is positive, and so is dp^i/dt. Comparing eq. (15) with eq. (8) shows that a bilateral tax increase has a greater effect on increasing the prices than a unilateral tax increase.

Before we discuss the welfare implications of cooperation between exporting countries, it is worthwhile comparing the elasticity of capital demand in a cooperative game with that in a non-cooperative game. In the case of Cournot competition, the demand for capital in a non-

cooperative game is more elastic than that in a cooperative game. However, in the case of Bertrand competition, we cannot rule out the possibility that cooperation between countries leads to a more elastic demand for capital, i.e. $|\eta_b^i| > |\eta_b^i|$, where the subscript b stands for Bertrand competition. This can be seen from

$$\bar{\eta}_b^i = f_x^i \left(\frac{\partial x^i}{\partial p^i} \frac{dp^i}{dt} + \frac{\partial x^i}{\partial p^j} \frac{dp^j}{dt} \right) \frac{t^i}{K^i}, \tag{16}$$

$$\eta_b^i = f_x^i \frac{\partial x^i}{\partial p^i} \frac{\partial p^i}{\partial t^i} \frac{t^i}{K^i}. \tag{17}$$

Although $\bar{\eta}_b^i$ contains a positive term $\left(\partial x^i / \partial p^j\right)\left(dp^j / dt\right)$, from eqs. (8) and (15) we know that dp^i / dt is greater than $\partial p^i / \partial t^i$. Thus $|\bar{\eta}_b^i|$ will be greater than $|\eta_b^i|$, provided that dp^i / dt is sufficiently large. This is because a bilateral tax increase gives rise to larger effects in terms of raising p^i, which in turn reduce x^i and K^i more intensively than in the case of a unilateral tax increase.

With these comparative-static results, the following proposition reveals the welfare effect of the exporting countries' cooperation:

Proposition 4.

If the firms compete in terms of price, then a bilateral tax increase does not necessarily enhance the two countries' welfare.

Proof. The optimization of government i requires that

$$\begin{aligned}\frac{dW^i}{dt} &= u_c^i \cdot \left[\frac{d\pi^i}{dt} + \mathrm{MRS}^i \frac{dz^i}{dt} \right] \\ &= u_c^i \cdot \left[\frac{\partial \pi^i}{\partial p^j} \frac{dp^j}{dt} + K^i \left(1+\overline{\eta}_b^i\right) \left(\mathrm{MRS}^i - \frac{1}{1+\overline{\eta}_b^i} \right) \right].\end{aligned} \tag{18}$$

It should be noted that all variables are evaluated at the non-cooperative equilibrium. Since $\partial \pi^i / \partial p^j$, dp^j/dt, and $K^i(1+\overline{\eta}_b^i)$ are all positive, the sign of dW^i/dt depends on that of $\mathrm{MRS}^i - 1/(1+\overline{\eta}_b^i)$, which can be expressed as

$$\mathrm{MRS}^i - \frac{1}{1+\overline{\eta}_b^i} = \underbrace{\left[\frac{1}{1+\eta_b^i} - \frac{1}{1+\eta_b^i} \right]}_{(?)} - \underbrace{\frac{\dfrac{\partial \pi^i}{\partial p^j} \dfrac{\partial p^j}{\partial t^i}}{K^i(1+\eta_b^i)}}_{(+)} . \tag{19}$$

As demonstrated in eqs. (16) and (17), $|\overline{\eta}_b^i|$ is not necessarily smaller than $|\eta_b^i|$, and thus the sign of eq. (19) is ambiguous. When MRS^i is greater than $1/\left(1+\overline{\eta}_b^i\right)$, cooperation between the exporting countries improves their welfare. However, if MRS^i is less than $1/\left(1+\overline{\eta}_b^i\right)$, then the sign of dW^i/dt is ambiguous, indicating that the bilateral tax increase does not necessarily enhance both countries' welfare. □

The reason for this is not hard to understand. As shown in Section 5, the under-provision of the public good is alleviated in the case of Bertrand competition. In this situation, an increase in the public good due to a bilateral tax increase does not enhance welfare significantly, because the marginal rate of substitution between z and c has already been close to the optimal level. However, raising taxes will reduce profits, and this fall in profits will outweigh the welfare improvement resulting from increasing public goods, provided that dp^i/dt is sufficiently large.

6. Concluding Remarks

The tax competition literature concludes that jurisdictions competing for capital inflow gives rise to an inefficiently low provision of public goods. However, typical tax competition models assume competitive product markets, and therefore assume away any rent-shifting effects. By incorporating an oligopolistic product market, this present paper unifies the tax competition models with the strategic trade policy, and investigates how the rent-shifting effect modifies the traditional results.

We find that when the firms compete in terms of quantity, the rent-shifting effect aggravates the inefficiency of tax competition, causing fewer public goods to be provided than if that were not the case. This result, however, is reversed in the case of Bertrand-type competition, where the rent-shifting effect alleviates distortions arising from tax competition.

We also demonstrate that when the firms engage in quantity competition, cooperation between exporting countries will improve both countries' welfare. However, this is not necessarily true in the case of Bertrand competition. Bilaterally raising taxes does not enhance welfare significantly when the firms compete in terms of price, because the marginal benefit arising from the public good is already low. Thus, a decrease in profits due to bilaterally raising taxes may outweigh the welfare improvement arising from more public goods being provided, thereby reducing social welfare.

With the increasing prevalence of free trade, tariff barriers have been reduced in many countries. Trade liberalization serves to intensify competition in the world market, and increases the incentives for

exporting countries to promote exports.[18] We believe that the effect of trade liberalization on the consequence of tax competition is an interesting topic for further research. To extend the present model, we can consider the effect of a decrease in the export subsidy (may be due to the requirement of World Trade Organization), on the result of tax competition. However, in such a setting more complication is expected, and the need for parametric examples is also necessary, like what Janeba and Wilson (1999) do.

[18] For example, Janeba and Wilson (1999) investigate the interactions between capital tax competition and trade policy. In their model the import tariff rate is determined by the central government; and then they consider two cases: the centralization case in which the central government decides the capital taxes, and the decentralization case in which the regional governments determine the capital taxes. They find that the import tariff plays an important role in determining the capital tax rates. Although their paper and this present one examine the issues concerning tax competition and trade, several differences exist between the two papers. First, the capital tax serves as a means of trade protection in Janeba and Wilson (1999), whereas it plays a role as promoting export in this present paper. Second, by specifying competitive industries, Janeba and Wilson (1999) do not consider the rent-shifting effect, which is our major focus.

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考慮利潤移轉效果之租稅競爭

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摘 要

在典型的租稅競爭模型中，財貨市場爲完全競爭，因此不會出現利潤移轉效果。本文將假設財貨市場爲雙佔市場，並分析利潤移轉效果的出現將對國際間的資本稅競爭產生何種影響。本文建構一個兩階段賽局，在第二階段，兩個出口國的廠商在第三國市場進行數量或價格上的競爭。在第一階段，出口國則決定該國的資本稅稅率。在此架構下，出口國政府在決定稅率時，會試圖利用資本稅以移轉對手國的利潤，換言之，資本稅具有策略性貿易政策之性質。本文發現，當廠商進行數量競爭時，利潤移轉效果會使公共財提供過少的情況加劇；在價格競爭下，利潤移轉效果則會改善公共財提供過少的情況。本文進一步指出，在數量競爭下，出口國相互合作可增進彼此的福利；然而在價格競爭下，出口國的合作有可能使雙方的福利下降。

關鍵詞：租稅競爭、公共財、利潤移轉效果
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