Abstract

This paper examines the relation of tax competition and fiscal equalization within a standard tax competition model with repeated actions (Itaya et al., 2008), in which regions differ in per capita capital endowment and production technologies. In particular, it asks the question how the fiscal equalization scheme affects the tax cooperation condition. It is shown when the scale of fiscal equalization scheme increases, a capital exporter (importer) is more (less) cooperative in implementing tax coordination. The paper also shows that the best cooperative tax rate in the sense that it provides the strongest potential for voluntary cooperation becomes $2\alpha$, of which $\alpha$ is the scale of the fiscal equalization scheme.

Keywords: Tax competition; Fiscal equalization; Cooperation; Repeated game; Tax coordination

1. Introduction

The efficiency and redistributive effects of tax competition has been extensively investigated in the literature of public finance. When a region increases its tax rate, the outflow of the tax base generates a positive fiscal externality. Then tax competition induces an inefficient low tax rate and low public service level. This implies that tax harmonization is needed to eliminate this inefficiency.

It is well known that cooperation may arise in a repeated interaction setting. Hence, a repeated interactions model would provide a better perspective to obtain a sustained and efficient tax coordination among local governments. It is only recently that a few studies confirmed this motivation. Coates (1993) investigates the open-loop equilibrium of a dynamic game of property tax competition. He pays attention to the intertemporal trade-off between current and future consumptions of private and local public goods, and finds that there may be incentives to subsidize capital. Cardarelli et al. (2002) proves that tax coordination can endogenously arise in a conventional repeated game, and tax coordination does not prevail when regional asymmetries are too strong. Their study assumes: (1) production activity does not occur; (2) the interest rate is exogenously determined at zero; (3) when capital is invested abroad, sunk cost occurs. Extending this study, Kawachi and Ogawa (2006) incorporates the benefit spillovers of local public goods to show that the cooperative outcome tends to take as the magnitude of spillover is significant. Catenaro and Vidal (2006), using the standard tax competition model with repeated interactions, demonstrate that tax coordination is not sustainable when region sizes are too different. But in their model the government’s objective is to maximize the revenue from capital income tax rather than the welfare of its citizen. Itaya et al. (2008) construct a repeated game model of tax competition, in which regions are asymmetrical in per capita capital endowment and production technologies. It is concluded that: the larger the differences in per capita capital endowments, the easier is tax coordination; the larger the differences in production technologies, the more difficult is tax coordination; the larger the
differences in net capital exporting positions, the more likely is tax coordination across regions. Furthermore, their study indicates that the best cooperative tax rate, which conduces to highest possibility to cooperate, is zero; this finding justifies the rule of no-tax on mobile capital.

However, the theoretical analyses of tax competition within a repeated game model have not taken the fiscal equalization scheme into account so far. The fiscal equalization scheme is an integral part of existing federal arrangements. In the US, the state tax sharing is one of two forms state intergovernmental aid to local governments, which is itself the largest element of state expenditure. Within the EU, the Structural Fund and the Cohesion Fund allocate more than 40% of the EU budget to regions and states that lag behind. The fiscal equalization schemes are also implemented in Canada, Australia, Denmark and Switzerland and many developing countries. These facts imply that there exists a systematic interaction between tax competition and fiscal equalization.

Recently, some literatures formally address this issue. Janeba and Peters (2000) demonstrate that capital tax rates are increased if regions are combined by a tax revenue equalization system. This means fiscal transfers partially internalize fiscal externalities. Kothenburger (2002) analyzes the relation between fiscal equalization and tax competition in a standard model of capital tax competition among regions which are allowed to differ with respect to labor endowment (Wilson, 1991). They show that fiscal equalization may eliminate the externalities induced by tax competition. Especially, when the tax base equalization is introduced, efficient tax rates arise. Kotsogiannis (2010) extends the analysis to a standard capital tax competition model in which there are horizontal tax externalities between regions and vertical tax externalities between the levels of government. He shows that an efficient level of lower-level government taxation can be achieved with a standard tax base equalization formula, which is appropriated adjusted.

Within the framework of a repeated tax competition game (Itaya et al, 2008), in which regions differ in per capita capital endowment and production technologies, this paper investigates the relation between tax competition and fiscal equalization. In particular, it focuses on the question how the fiscal equalization scheme affects the cooperation condition of tax competition with repeated interactions. The main results of this paper are as following: (i) when the scale of fiscal equalization scheme increases, the capital exporter is more likely to cooperate, but the capital importer is less likely to cooperate; (ii) while the best cooperative tax rate without fiscal transfer is zero, as argued by Itaya et al. (2008), in the presence of fiscal transfers, it becomes $2\alpha$, of which $\alpha$ is the scale of the fiscal equalization scheme. It is interesting that when the cooperative tax rate is set at $2\alpha$, even the scale of fiscal equalization $\alpha$ changes, the willingness of both regions to cooperate in tax coordination keeps the same level; (iii) in the cooperation phase, the introduction of the fiscal equalization scheme decreases the welfare of the large region, increases the welfare of the small region, and does not affect the total welfare of the federal economy.

The paper is organized as follows. Section 2 describes a basis model of tax competition, a central feature of which is the introduction of a fiscal equalization transfers. Section 3 presents the relative results in a repeated game. Section 4 briefly concludes the paper.

2. The model
The structure and parameters of the model are completely the same with that of Itaya et al. (2008); the only difference is the introduction of a fiscal equalization scheme into the federation.

The model considers a federal economy that consists of two regions, which are asymmetric with respect to the per capita capital endowment and production technologies. Both regions own the same populations. The per capita capital endowment of region S (small) and region L (large) are $k_S \equiv \bar{k} - \epsilon$ and $k_L \equiv \bar{k} + \epsilon$, respectively, where $\epsilon \in (0, \bar{k}]$. We can see that the average per capita capital in the economy is $\bar{k} = (k_S + k_L) / 2$. Capital can costlessly and freely flow across regions, but workers are fixed in each region. A homogeneous consumption good is produced. The production function in per capita terms is

$$f'((i)k) \equiv (A_i - k_i) - k_i, \quad i = S, L.$$  

$A_i$ is the technology parameter of each region. If $A_i > 2k_i$, $i = S, L$, then the marginal productivity of capital is positive but diminishing. $k_i$ denotes the capital employed in region $i$.

Firms in each region maximize profits. Given a source-based capital tax $\tau_i$, the profit maximizing input equilibrium can be characterized as $r = \frac{f'((S)k) - \tau_S}{(S)k} = A_S - 2k_S - \tau_S$, and $w_i = f'((k)) - k_i f'_i((k)) = k_i$.

The federation implements a fiscal equalization transfer system. Here we consider a tax base equalization scheme, which is conditioned on the difference in the tax base capacity between two regions. This means that:

$$\beta_S = \alpha(k_S - k_i)$$
$$\beta_L = \alpha(k_L - k_i)$$

where $\beta_i$ is the fiscal transfer component allocated to region $i$. $\alpha$ is the scale of the fiscal equalization system. We assume that the federal government can freely adjust $\alpha$ and $0 \leq \alpha < 1 / 2$. It should be noted that this fiscal equalization scheme is budget-balancing, i.e., $\beta_S + \beta_L = 0$.

In the capital market equilibrium, we obtain the interest rate and the capital allocation as

$$r^* = \frac{1}{2} [A_S + A_L - (\tau_S + \tau_L)] - 2\bar{k}, \quad (1)$$
$$k_i^* = \bar{k} + \frac{1}{4} [(\tau_L - \tau_S) - (A_L - A_S)], \quad (2)$$
$$k_i^* = \bar{k} + \frac{1}{4} [(\tau_S - \tau_L) + (A_S - A_L)]. \quad (3)$$

In addition to the capital endowment, each resident inelastically provides one unit of labor. So the total income is constituted by the wage $w_i$ and the interest income $r^* k_i$. The residents use these incomes to consume private goods $c_i$. The public good in each region is financed by the capital tax revenue and the fiscal equalization transfer from the federation. Therefore the budget constraint of the regional government is $g_i = \tau_i k_i^* + \beta_i$. The regional governments maximize utility of a representative resident by choosing an optimal tax rate, then
Since the slope of the reaction functions is positive and less than one, there exists a Nash equilibrium. We derive the Nash equilibrium in a one-shot game as following:

\[ \tau^*_i = 2\alpha + (\varepsilon - \frac{\theta}{4}), \quad \tau^*_i = 2\alpha - (\varepsilon - \frac{\theta}{4}). \]  

(5)

Based on Eqs. (1), (2), (3) and (5), the Nash equilibrium interest rate \( r^* \) and the per capita capital demand in each region \( k^* \) are:

\[ r^* = \frac{1}{2}(A_s + A_l) - 2\alpha - 2\bar{k}, \]

(6)

\[ k^*_s = \bar{k}_s + \frac{1}{2}(\varepsilon - \frac{\theta}{4}), \]

(7)

\[ k^*_l = \bar{k}_l - \frac{1}{2}(\varepsilon - \frac{\theta}{4}). \]

(8)

When \( \theta = 0 \), a small region imposes high taxation to import capital and a large region imposes low taxation to export capital. This result is induced by the pecuniary externality or the terms-of-trade effect, which is the same as that in Depater and Myers (1994), Peralta and van Ypersele (2005) and Itaya et al. (2008). However, the effects on the terms of trade, manipulated by both regions, are canceled each other out. Then the interest rate \( r^* \) is unchanged as Eq. (6).

It is completely the same as Itaya et al. (2008) that: Since the higher marginal capital product can induce greater capital demand in the large region, which exceeds its large capital endowment. Then the technology difference \( (\theta > 0) \) can reverse the above net capital exporter position and tax policy. To summarize, we state the following proposition:

**Proposition 1.** The sign of \( \Phi \equiv \varepsilon - (\theta / 4) \) determines the net capital positions of the two regions; when \( \Phi \geq 0 \), the large (small) region is a capital exporter.

Using Eqs. (4), (6), (7), (8), we derive the Nash equilibrium utility level of each regions \( u^*_i \) as:

\[ u^*_s = [\bar{k} + \frac{1}{2}(\varepsilon - \frac{3}{4}\theta)][\bar{k} - \frac{1}{2}(\varepsilon + \frac{3}{4}\theta)] + r^*(\bar{k} - \varepsilon) + 2\alpha \bar{k} \]

(9)

\[ u^*_l = [\bar{k} - \frac{1}{2}(\varepsilon - \frac{3}{4}\theta)][\bar{k} + \frac{1}{2}(\varepsilon + \frac{3}{4}\theta)] + r^*(\bar{k} + \varepsilon) + 2\alpha \bar{k} \]

(10)

From Eqs. (9) and (10), we can obtain that: \( u^*_l - u^*_s = \theta \bar{k} + 2\varepsilon r^* > 0 \). It means that the large region’s payoff outweighs that of the small region. When \( \alpha \) increases, the interest rate \( r^* \) decreases, as implied by Eq. (6). We can conclude that the fiscal equalization scheme can cut down the payoff differences between two regions.
3. A repeated game

Now we consider a repeated game between the two regions. The discount factor of each region is \( \delta_i \in [0,1) \). It is recognized that the punishment strategy is a subgame perfect Nash equilibrium of a repeated game. Hence, each region cooperates in tax competition on the current stage unless the other region defected on the last stage; if the other region defected on the last stage, then defect forever, which implies the Nash equilibrium persists. The conditions of sustained cooperation in region \( i = S, L \), are:

\[
\frac{1}{1 - \delta_i} u_i^c \geq u_i^o + \frac{\delta_i}{1 - \delta_i} u_i^\pi, i = S, L,
\]

(11)

where \( u_i^j \) for \( j = C, D, N \) denote the utility levels of the cooperation, deviation, and punishment phases. The left side of Eq. (11) indexes the total discounted utility of the residents in region \( i \), when both regions cooperate infinitely in taxation. The right side of Eqs. (11) indexes the sum of the current period’s utility of tax deviation and the discounted total utility of Nash equilibrium in the following periods.

The cooperative tax rate \( \tau^c \) maximizes the federation’s utilitarian welfare:

\[
u(\tau) = u_S + u_L = f(S(k) + f(L(k))
\]

We can derive the cooperative tax rate as

\[
\tau^c = \tau_S = \tau_L.
\]

(12)

Although the cooperative tax rate is indeterminate, the capital allocation of the cooperative phase is unique:

\[
k_S^c = \bar{k}_S + \Phi,
\]

(13)

\[
k_L^c = \bar{k}_L - \Phi.
\]

(14)

Based on Eqs. (1), (4), (12), (13) and (14), we obtain the following utility levels in the cooperative phase:

\[
u^c = (k + \tau - \theta)\bar{k} - \frac{\theta}{4} + r^c(k - \varepsilon) + \frac{\alpha\theta}{2},
\]

(15)

\[
u^c = (k + \tau + \theta)\bar{k} - \frac{\theta}{4} + r^c(k + \varepsilon) - \frac{\alpha\theta}{2},
\]

(16)

\[
u^c = \nu^c + \nu^c = A_S k_S^c - k_S^c + A_L k_L^c - k_L^c,
\]

(17)

where \( r^c = [(A_S + A_L) / 2] - \tau^c - 2\bar{k} \), \( u^c \) for \( i = S, L, F \), represent the utility levels of the small region, the large region and the federation. Then, we can state the following proposition:

**Proposition 2.** The introduction of fiscal equalization scheme increases the utility level of the small region, decreases utility level of the large region and has no effect on the total utility level of the federation in the cooperation phase.
Following Eqs. (9), (10), (15) and (16), the participation constraint for each region, i.e., \( u^c_i \geq u^c_S, i = S, L \), is as follows:

\[
\begin{align*}
\Delta u^c_i - u^c_S &= \frac{1}{4} \Phi^c + \tau^c - 2\alpha \Phi \geq 0, \\
\Delta u^c_i - u^c_L &= \frac{1}{4} \Phi^c - \tau^c + 2\alpha \Phi \geq 0,
\end{align*}
\]

which implies that the necessary condition to sustain cooperation is

\[
\left| \tau^c - 2\alpha \right| \leq \frac{1}{4} \Phi. \tag{20}
\]

Assuming the rival region’s tax rate is \( \tau^c \), the best-deviation tax rates \( \tau^o_i \) maximize the utility of region \( i \)’s residents. They can be derived that:

\[
\tau^o_i = \frac{\tau^c}{3} + \frac{4}{3} \Phi + \frac{4}{3} \alpha, \tag{21}
\]

\[
\tau^o_i = \frac{\tau^c}{3} - \frac{4}{3} \Phi + \frac{4}{3} \alpha. \tag{22}
\]

The utility levels of deviation \( u^o_i, i = S, L \), are respectively:

\[
\begin{align*}
u^o_i &= \frac{\frac{1}{2} \left( \theta - \tau^c - 2\epsilon \right) }{\frac{\frac{1}{6} \left( \theta - \tau^c + 2\epsilon \right) + r^c_S(k - \epsilon) + \frac{2\alpha k}{3} + \frac{\alpha \theta}{3} + \frac{\alpha^i}{3} - \alpha \tau^c}{3}}, \tag{23}

\end{align*}
\]

\[
\begin{align*}
u^o_i &= \frac{\frac{1}{2} \left( \theta + \tau^c - 2\epsilon \right) }{\frac{\frac{1}{6} \left( \theta + \tau^c + 2\epsilon \right) + r^c_L(k + \epsilon) + \frac{2\alpha k}{3} - \frac{\alpha \theta}{3} - \frac{\alpha^i}{3} + \alpha \tau^c}{3}}, \tag{24}
\end{align*}
\]

Substituting (9), (10), (15), (16), (23) and (24) into (11), we can obtain the threshold of discount factor in each region \( i \) as:

\[
\Delta^c_i = \frac{u^c_i - u^c_S}{u^c_S - u^c_L} = \frac{4(2\tau^c - 4\alpha + \theta + 4\epsilon)^3}{(4\tau^c - 8\alpha - 7\theta + 28\epsilon)(4 \tau^c - 8\alpha - \theta + 4\epsilon)}, \tag{25}
\]

\[
\Delta^c_i = \frac{u^c_i - u^c_L}{u^c_S - u^c_L} = \frac{4(2\tau^c - 4\alpha - \theta + 4\epsilon)^3}{(4\tau^c - 8\alpha + 7\theta - 28\epsilon)(4 \tau^c - 8\alpha + \theta - 4\epsilon)}. \tag{26}
\]

When the actual discount factor exceeds both discount factor thresholds \( \Delta^c_i, i = S, L \), in two regions, the tax cooperation can be a subgame perfect Nash equilibrium of the repeated tax interaction.

\( \Delta^c_i \) can be regarded as a function of \( \tau^c \). Substituting the upper- and lower-bound values of \( \tau^c \), given by Eq. (20), into Eqs. (25) and (26), we get

\[
\Delta^c_i(2\alpha - \Phi / 4) = \Delta^c_i(2\alpha + \Phi / 4) = 1 \text{ and } \Delta^c_i(2\alpha - \Phi / 4) = \Delta^c_i(2\alpha + \Phi / 4) = 49 / 145 .
\]

Differentiating Eqs. (25) and (26) with respect to \( \tau^c \) yields
\[
\frac{\partial \delta}{\partial \tau^c} = \frac{1536 \Phi \left( \tau^c - 2\alpha - 2\Phi \right) (2\tau^c - 4\alpha + 5\Phi)}{\left[ (4\tau^c - 8\alpha - 7\theta + 28\epsilon)(4\tau^c - 8\alpha - \theta + 4\epsilon) \right]}, \tag{27}
\]

\[
\frac{\partial \delta}{\partial \tau^c} = \frac{1536 \Phi (2\Phi + \tau^c - 2\alpha)(5\Phi - 2\tau^c + 4\alpha)}{\left[ (4\tau^c - 8\alpha - 7\theta + 28\epsilon)(4\tau^c - 8\alpha - \theta + 4\epsilon) \right]}, \tag{28}
\]

which imply the following results:

\[
\frac{\partial \delta}{\partial \tau^c} < 0, \frac{\partial \delta}{\partial \tau^c} > 0 \text{ if } \Phi > 0, \tag{29}
\]

\[
\frac{\partial \delta}{\partial \tau^c} > 0, \frac{\partial \delta}{\partial \tau^c} < 0 \text{ if } \Phi < 0. \tag{30}
\]

It is shown that \( \delta_c(\delta_i) \) is a decreasing (increasing) function of \( \tau^c \) if \( \Phi > 0 \) and vice versa if \( \Phi < 0 \), and \( \delta_c(2\alpha) = \delta_i(2\alpha) = 4 / 7 \). We define \( \delta^* \equiv \max \{ \delta_c, \delta_i \} \). In Fig. 1 \( \delta^* = \delta_c \) for \( \tau^c \in [2\alpha, 2\alpha + \Phi / 4] \), whereas \( \delta^* = \delta_i \) for \( \tau^c \in [2\alpha - \Phi / 4, 2\alpha] \) if \( \Phi > 0 \). Fig. 2 shows the following features are independent of the sign of \( \Phi \): \( \delta^* \in [4 / 7, 1] \); the closer the value of \( \tau^c \) is to \( 2\alpha \), the easier it is for the two regions to enter tax cooperation. We can summarize the above results in the following proposition:

**Proposition 3.** A capital exporter (importer) has a relatively stronger incentive to deviate from the cooperative tax rate, when the cooperative tax rate is larger (less) than \( 2\alpha \). The closer the value of the cooperative tax rate is to \( 2\alpha \), the easier it is to cooperate in tax coordination.

It is important that the best cooperative tax rate is \( 2\alpha \) in Proposition 3. By introducing the fiscal equalization scheme, our model is a more general case of Itaya et al. (2008). When \( \alpha = 0 \), our model reduces to their model. Then the best cooperative tax rate becomes zero. But in any federal economy, US, Canada and EU etc. al, the cooperative tax rate is not zero. Itaya et al. (2008)’s model can not explain the economic reality perfectly. Our model implies that since the existence of fiscal equalization scheme in every federal economy, the best cooperative tax rate should take the positive value and increases with the size of equalization transfers.

![Fig. 1. The effects of an increase in \( \alpha \) on \( \delta_i \) \( i = S, L \), when the large (small) region is an exporter (importer); that is \( \Phi \equiv \epsilon - (\theta / 4) > 0 \).](image-url)
Fig. 2. The effects of an increase in \( \alpha \) on \( \delta_i \), \( i = S, L \), when the small (large) region is an exporter (importer); that is \( \Phi \equiv \varepsilon - (\theta / 4) < 0 \).

Now we examine the effect of increasing the scale of fiscal equalization \( \alpha \) on the willingness of each region \( i \) to tax cooperation. We differentiate \( \delta_i \), \( i = S, L \), in Eqs. (25) and (26) with respect to \( \alpha \), then

\[
\frac{\partial \delta_S}{\partial \alpha} = \frac{3072\Phi(2\Phi - \tau^c + 2\alpha)(5\Phi + 2\tau^c - 4\alpha)}{[(4\tau^c - 8\alpha - 7\theta + 28\varepsilon)(4\tau^c - 8\alpha - \theta + 4\varepsilon)]},
\]

(31)

\[
\frac{\partial \delta_L}{\partial \alpha} = \frac{3072\Phi(\tau^c - 2\alpha + 2\Phi)(2\tau^c - 4\alpha - 5\Phi)}{[(4\tau^c - 8\alpha - 7\theta + 28\varepsilon)(4\tau^c - 8\alpha - \theta + 4\varepsilon)]},
\]

(32)

which imply that

\[
\frac{\partial \delta_S}{\partial \alpha} > 0, \frac{\partial \delta_L}{\partial \alpha} < 0 \text{ if } \Phi > 0,
\]

(33)

\[
\frac{\partial \delta_S}{\partial \alpha} < 0, \frac{\partial \delta_L}{\partial \alpha} > 0 \text{ if } \Phi < 0.
\]

(34)

The above analysis allows us to state the following proposition:

**Proposition 4.** When the scale of fiscal equalization \( \alpha \) increases, the capital exporter (importer) is more (less) cooperative in implementing tax coordination.

Based on Eqs. (9) and (15), when \( \alpha \) increases, \( u_i^n \) marginally increases by \( 2\varepsilon \), \( u_i^c \) marginally increases by \( \theta / 2 \). If \( \Phi = \varepsilon - \theta / 4 > 0 \), the marginal increase of \( u_i^n \) is larger than that of \( u_i^c \). Eq. (25) implies that \( \delta_S \) will decrease. From Eqs. (10) and (16), when \( \alpha \) increases, \( u_i^n \) marginally decreases by \( 2\varepsilon \), \( u_i^c \) marginally decreases by \( \theta / 2 \). If \( \Phi = \varepsilon - \theta / 4 > 0 \), the marginal decrease of \( u_i^n \) is larger than that of \( u_i^c \). Eq. (26) implies that \( \delta_L \) will increase. We can also proceeds the analysis of the case \( \Phi = \varepsilon - \theta / 4 < 0 \) with the same way as above \( \Phi = \varepsilon - \theta / 4 > 0 \).

In Fig. 1 and Fig. 2, when \( \alpha \) increases, the locus \( \delta_S \) of a capital exporter will parallel shift right, the locus \( \delta_L \) of a capital importer will also parallel shift right. And it should be noted that \( \delta_S(2\alpha) = \delta_L(2\alpha) = 4 / 7 \). Thus we have the following result:
Proposition 5. When the cooperative tax rate is set at $2\alpha$, even $\alpha$ changes, the willingness of both regions to cooperate keeps the same level.

4. Conclusion

Itaya et al. (2008), in a repeated game model of capital tax coordination, analyzes how the increased regional differences in per capita capital endowment and/or production technologies affect the willingness of each region to tax cooperation. They show regional asymmetries in net capital exporting position may be advantageous to achieve tax coordination. But the best cooperative tax rate is zero in their model. Motivated by this point, this paper introduces a fiscal equalization scheme to the model of Itaya et al. (2008). Its purpose is to examine how the fiscal equalization scheme affects the tax cooperation condition. It has shown that: without change in the federal utility level, the best cooperative tax rate becomes $2\alpha$; when the scale of fiscal equalization $\alpha$ increases, a capital exporter is more cooperative to tax coordination, a capital importer is less cooperative to tax coordination; interestingly, when the cooperative tax rate is set $2\alpha$, even $\alpha$ changes, the willingness of both regions in implementing tax coordination keeps constant.

References


