Cross-border shopping with fiscal externalities

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August 21, 2018

Abstract**:** This paper constructs asymmetric regions model in which the numbers of borders are various by extending one country model of Lucas (2004) to two countries model. We consider the following three cases: an integrated world, a unitary nation and a decentralization. The integrated world means that a supranational government uniformly implements the policy: the outcome in this case is the second-best optimum. The unitary nation is that each central government takes a non-coordinated policy. The decentralization is that the central and local governments in both countries take non-coordinated policies. We show that the central governments cannot internalize fiscal externalities attributed to the existence of a national border under the unitary nation and the decentralization. Under the unitary nation, the central governments set a lower tax rate in the region with national border than in the region without national border.

JEL Classification: H3; H77; H21; R2

Keywords: Cross-border shopping, Commodity tax, Tax competition, Vertical and horizontal externalities

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1. Introduction

Horizontal and vertical fiscal externalities are major factors for the difficulty of fiscal management when governments -between central and local and/or between local governments- implement their own policies. It is well known that, under the existence of cross-border shopping, commodity taxation on which the same level of governments impose produces the horizontal fiscal externality. All governments set a lower tax rate to attract cross-border consumers. In contrast, when different levels of governments, such as central and local governments, impose taxes on the same tax base, vertical fiscal externalities arise. For example, the local governments set the local tax rate higher because they do not consider the negative effect of their own taxation on the central government's tax revenue. As a result, the higher local tax rate shrinks a tax base, so that the central government's tax revenue decreases: a negative fiscal externality occurs. Thus, horizontal and vertical externalities work in the opposite directions.

In the 2000s, the coexistence of these two kinds of fiscal externalities has been analyzed in symmetric regions model. However, to the best of our knowledge, there has been no research of asymmetric regions model treating both vertical and horizontal fiscal externalities. Therefore, this paper considers both vertical and horizontal fiscal externalities caused by the central and local governments, constructing two symmetric countries model with asymmetric two regions. We consider the following three cases: an integrated world, a unitary nation and a decentralization. The integrated world means that a supranational government uniformly implements the policy: the outcome in this case is the second-best optimum. The unitary nation is that each central government takes a non-coordinated policy. The decentralization is that the central and local governments in both countries take non-coordinated policies.

2. Model

This paper extends Lucas (2004) model, which treats horizontal and vertical fiscal externalities in a cross-border shopping model, from one country to two countries. We consider a Hotelling framework, described in Figure 2.1, consisting of two symmetric countries, $i = 1, 2$ with asymmetric regions $j = A, B$. We refer to region j in country i as region ij. The location space of each country is given by $\theta \in [-1, 1]$, divided into two regions at $\theta = 0$: the length of each country is 2. As shown in Fig. 1, region B in each country (region $1B$ and region $2B$) has borders not only with region A in domestic country but also with region B in foreign country; region A in each country has a border with region B only in domestic country. In each region, population size is normalized to one. Consumers are uniformly distributed and the ones living in region ij are identified by given distance d_{ij} from the regional border within the country and distance D_{ij} from the national border.

There are two private goods x and y in each region. Consumers can move to the other region to buy the good y: a good y can be bought in the other region; however, a good x cannot. We assume that the commodity tax is imposed only on a good y in this economy.

There is a central government and two local governments in each country. The central and the local governments supply a national public good G and a local public good g, respectively. The benefit of national public good accrues to all consumers irrespective of where they live, while that of local public good accrues only to consumers of the region.

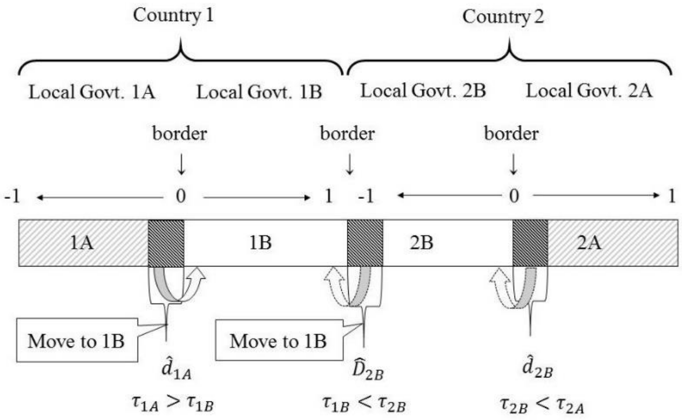

***Figure* 1: The location space**

Firms are located in all regions and maximize their profits in perfectly competitive markets. The output can be used interchangeably for the production of x, y, g and G: the marginal rates of transformation between public goods of each government and private goods are normalized to one. The production is subject to a linear technology where one unit of labor produces one unit of private goods or public goods.

2.1 Consumers

Consumers in region ij obtain utility from two private goods, x_{ij} and y_{ij}, and local public goods, g_{ij}, and national public goods, G_{ij}. The utility function is given by the following separable quasi-linear utility function:

$$x_{ij} + v(y_{ij}) + b(g_{ij}) + B(G_i),$$

where $v(y_{ij})$, $b(g_{ij})$ and $B(G_i)$ are increasing and strictly concave functions.

While consumers can buy a private good without transportation cost in their own regions, they must burden transportation cost to the border when they buy the private good in other region. As the case with Lucas (2004), we suppose that a private consumption good x is non-taxable and a good y is subject to taxable in destination principle. Let t_{ij} be the tax rate which the local government in region ij sets, and T_{ij} be the one which the central government in country i sets in region ij. Only a good y is taxed at a rate of $\tau_{ij} = t_{ij} + T_{ij}$ in region ij. Both consumption goods x and y are assumed to be a numeraire: consumers' prices of x_{ij} and y_{ij} are 1 and $1 + \tau_{ij}$, respectively. In what follows, as both countries are symmetric, we consider only the economy in country i.

2.1.1. Consumers who buy a good in their own region

When consumers living in region ij buy a good y in their own region, they solve the following problem:

$$\max_{x_{ij}, y_{ij}} \; x_{ij} + v(y_{ij}) + b(g_{ij}) + B(G_i)\,, \qquad s.t.\; x_{ij} + (1 + \tau_{ij})y_{ij} = wl_i, \tag{1}$$

where l_i is labor supply which is constant. From (2.1), we obtain demand functions represented by $x_{ij}(\tau_{ij})$ and $y_{ij}(\tau_{ij})$ ($j = A, B$). By substituting these functions into utility function, an indirect utility function can be obtained as $V_{ij}(\tau_{ij}) + b(g_{ij}) + B(G_i)$. Roy's identity yields the following result: $\partial V_{ij}(\tau_{ij})/\partial \tau_{ij} = -y_{ij}$.

2.1.2 Consumers who buy a good in the other region of domestic country

We consider consumers in region ij buy a good y in the other region of their own country. We refer to i' and j' as foreign country for country i and the other region for region j, respectively. If $\tau_{ij} > \tau_{ij'}$, they may buy a good y in the other region. They choose to buy a good y in their own or in the other region, depending on the difference between τ_{ij} and $\tau_{ij'}$ and the distance d_{ij} from the regional boarder. This distance $d_{ij} \in [0, 1]$ is distributed according to a continuous distribution function $N[d_{ij}]$ with the positive density $n[d_{ij}]$, where $n_{ij} = \int_0^1 n[d_{ij}]\,\mathrm{d}d_{ij} = 1$.

When consumers in region ij buy a good y in the other region of their own country, they solve the following utility maximization problem:

$$\max_{x_{ij},y_{ij'}} \; x_{ij} + v(y_{ij'}) + b(g_{ij}) + B(G_i)\,,$$
$$s.t.\; x_{ij} + (1+\tau_{ij'})y_{ij'} + d_{ij} = wl_i. \tag{2}$$

This gives the demand function $x_{ij}(\tau_{ij'}, d_{ij})$ and $y_{ij}(\tau_{ij'})$. Substituting these demand functions into the utility function given in (2) again yields the indirect utility function $V_{ij}(\tau_{ij'}, d_{ij}) + b(g_{ij}) + B(G_i)$. From Roy's identity, we obtain the following results: $\partial V_{ij}(\tau_{ij'}, d_{ij})/\partial\tau_{ij} = -y_{ij}$ and $\partial V_{ij}(\tau_{ij'}, d_{ij})/\partial d_{ij} = -1$.

2.1.3 Consumers who buy a good in a foreign country

In this subsection, we consider a case in which consumers in region iB of country i buy a good y in region $i'B$. Such a situation can occur if $\tau_{i'B} < \tau_{iB}$. Suppose the consumers who live at a distance of D_{iB} from the border. D_{iB} is the same distributive feature as d_{ij}. Then, utility maximization problem of the consumers is represented by:

$$\max_{x_{iB},y_{i'B}} \; x_{iB} + v(y_{i'B}) + b(g_{iB}) + B(G_i)\,,$$
$$s.t.\; x_{iB} + (1+\tau_{i'B})y_{i'B} + D_{iB} = wl_i. \tag{3}$$

Solving this problem, we obtain the demand functions $x_{iB}(\tau_{i'B}, D_{iB})$ and $y_{i'B}(\tau_{i'B})$, and therefore, the indirect utility function $v_{iB}(\tau_{i'B}, D_{iB}) + b(g_{iB}) + B(G_i)$. From Roy's identity, we obtain the following features: $\partial v_{iB}(\tau_{i'B}, D_{iB})/\partial\tau_{i'B} = -y_{i'B}$ and $\partial v_{iB}(\tau_{i'B}, D_{iB})/\partial D_{iB} = -1$.

2.2. Threshold

Consumers decide where to buy a good y, depending on the distance from national border or regional border. To see this, we solve the threshold in which consumers are indifferent as to whether they buy a good y in their own region or in the other region of a domestic country.

Consumers in region ij obtain the utility $v_{ij}(\tau_{ij}) + b(g_{ij}) + B(G_i)$ and $v_{ij}(\tau_{ij'}, d_{ij}) + b(g_{ij}) + B(G_i)$ if they buy a good y in their own region j or if they buy in the other region j', respectively. A condition in which consumers are indifferent as to whether they buy a good y in their own region or in the other region can be given by:

$$v_{ij}(\tau_{ij}) = v_{ij}(\tau_{ij'}, d_{ij}). \tag{4}$$

We represent the distance at which (4) holds as $\hat{d}_{ij}(\tau_{ij}, \tau_{ij'})$. If $v_{ij}(\tau_{ij}) > v_{ij}(\tau_{ij'}, d_{ij})$, the consumers buy a good y in their own region j; if $v_{ij}(\tau_{ij}) < v_{ij}(\tau_{ij'}, d_{ij})$, they buy it in the other region j'. That is, consumers who live at $d_{ij} > \hat{d}_{ij}$ buy a good y in their own region j; consumers who live at $d_{ij} < \hat{d}_{ij}$ buy a good y in the other region j'.

Differentiating (4) with respect to t_{ij}, $t_{ij'}$, T_{ij} and $T_{ij'}$, we obtain the following results:

$$\frac{\partial\hat{d}_{ij}}{\partial t_{ij}} = \frac{\partial\hat{d}_{ij}}{\partial T_{ij}} = y_{ij}, \qquad \frac{\partial\hat{d}_{ij}}{\partial t_{ij'}} = \frac{\partial\hat{d}_{ij}}{\partial T_{ij'}} = -y_{ij'}. \tag{5}$$

The threshold of the distance $\hat{d}_{ij}$ increases (decreases) if the commodity tax rate in their own region increases (decreases), and decreases (increases) if tax rate in the other region of their own country increases (decreases).

We turn to obtain the threshold in which consumers in region iB are indifferent as to whether they buy a good y in their own region or foreign country. The condition is expressed by:

$$v_{iB}(\tau_{iB}) = v_{iB}(\tau_{i'B}, D_{iB}). \tag{6}$$

We denote the distance which (6) holds as $\widehat{D}_{iB}(\tau_{iB}, \tau_{i'B})$. Differentiating (6) with respect to t_{iB}, $t_{i'B}$, T_{iB} and $T_{i'B}$, we obtain the following:

$$\frac{\partial\widehat{D}_{iB}}{\partial t_{iB}} = \frac{\partial\widehat{D}_{iB}}{\partial T_{iB}} = y_{iB}, \qquad \frac{\partial\widehat{D}_{iB}}{\partial t_{i'B}} = \frac{\partial\widehat{D}_{iB}}{\partial T_{i'B}} = -y_{i'B}. \tag{7}$$

These results show that the threshold of the distance $\widehat{D}_{iB}$ increases (decreases) if a commodity tax rate in their own region (in the other country) increases.

The above thresholds are depicted in Figure 2.1. If $\tau_{1A} > \tau_{1B}$, all consumers in region $1B$ of country buy a good y in their own region because they have no incentive to go shopping in region $1A$ ($\hat{d}_{1B} = 0$). In contrast, while consumers in region $1A$ located within the distance $d_{1A} < \hat{d}_{1A}$ buy a good y in region $1B$, those who are located in the distance $d_{1A} > \hat{d}_{1A}$ do in their own region $1A$.

Next, if $\tau_{1B} < \tau_{2B}$, all consumers in region $1B$ buy a good y in their own country because they have no incentive to go shopping in country 2 ($\widehat{D}_{1B} = 0$). In contrast, while consumers in region $2B$ located in the distance $D_{2B} < \widehat{D}_{2B}$ buy a good y in region $1B$, they located in the distance $D_{2B} > \widehat{D}_{2B}$ in their own region $2B$.

3. Integrated world and unitary nations

3.1. Integrated world

This section considers an integrated world in which a supranational government uniformly imposes a tax on a good y and provides public goods to consumers in each region: $\tau_{1A} = \tau_{1B} = \tau_{2A} = \tau_{2B} = \tau$, $g_{1A} = g_{1B} = g_{2A} = g_{2B} = g$ and $G_{1A} = G_{1B} = G_{2A} = G_{2B} = G$. Welfare maximization problem in integrated world is formulated by:

$$\max_{\tau,g,G} \; 4\{v(\tau) + b(g) + B(G)\}\ , \quad s.t.\ 4g + 2G = 4\tau y(\tau). \tag{8}$$

We obtain the following necessary condition:

$$b' = 2B' = \frac{y(\tau)}{y(\tau) + \tau \dfrac{\partial y(\tau)}{\partial \tau}}. \tag{12}$$

The most right-hand side in this equation represents the social marginal cost of public fund (SMCPF), while b' and $2B'$ does the social marginal benefits (SMB) of the local public goods and national public good, respectively. These equations mean the optimality conditions for the supply of public goods noted as Atkinson and Stern (1974) rule. This condition obtained from equations (12), together with the budget constraint (8), gives the second-best optimum, denoted by (τ^*, g^*, G^*).

3.2. Unitary nations

Next, we consider a unitary nation in which each central government chooses all policies in its own country. Central government in country i behaves as a Nash competitor and chooses their tax rates τ_{iA} and τ_{iB}. The central government supply local public goods and national public good with tax revenue. The central government maximizes social welfare to choose τ_{iA}, τ_{iB}, g_{iA}, g_{iB} and G_i, taking $\tau_{i'B}$ as given. If $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, the central government in country i's maximization problem is formulated by:

$$\begin{aligned}
&\max_{\tau_{iA},\tau_{iB},g_{iA},g_{iB},G_i} V(\tau_{iB}) + \int_{\hat{d}_{iA}}^{1} V(\tau_{iA})\,\mathrm{d}d_{iA} + \int_0^{\hat{d}_{iA}} V(\tau_{iB}, d_{iA})\,\mathrm{d}d_{iA} + \sum_{j=A,B} b(g_{ij}) + 2B(G_i),\\
&s.t.\ g_{iA} + g_{iB} + G_i\\
&\qquad = \tau_{iB}\left(y_{iB}(\tau_{iB}) + \int_0^{\hat{d}_{iA}} y_{iB}(\tau_{iB})\mathrm{d}d_{iA} + \int_0^{\widehat{D}_{i'B}} y_{iB}(\tau_{iB})\mathrm{d}D_{i'B}\right)\tau_{iA}\int_{\hat{d}_{iA}}^{1} y_{iA}(\tau_{iA})\mathrm{d}d_{iA}\,.
\end{aligned} \tag{13}$$

We obtain the following necessary conditions for the local public goods and the national public good:

$$\begin{aligned}
2B_i' = b_{iA}' = b_{iB}' &= \frac{(1-\hat{d}_{iA})y_{iA}}{(1-\hat{d}_{iA})y_{iA}(1-\varepsilon_{\tau iA}) + (\tau_{iB}y_{iB} - \tau_{iA}y_{iA})\dfrac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}}\\
&= \frac{(1+\hat{d}_{iA})y_{iB}}{y_{iB}\left[(1+\hat{d}_{iA})(1-\varepsilon_{\tau iB}) + \tau_{iB}\left(\dfrac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \dfrac{\partial \widehat{D}_{i'B}}{\partial \tau_{iB}}\right)\right] - \tau_{iA}y_{iA}\dfrac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}}.
\end{aligned} \tag{19}$$

where $\varepsilon_{\tau ij} \equiv -\tau_{ij}\partial y_{ij}(\tau_{ij})/(y_{ij}(\tau_{ij})\partial \tau_{ij}) > 0$. These conditions mean that marginal benefits (MB) of public goods, $2B_i'$, b_{iA}', and b_{iB}' are equal to the marginal cost of public funds (MCPF) of the local public good A and that of the local public good B. Comparing (12) with (19), we can verify that the central governments in the unitary nations cannot replicate the second-best optimum. This is intuitively clear because each central government plays a Nash competition.

Proposition 1 *Under unitary nations, the tax rate in region A is higher than that in region B.*

This is because region B has more borders than region A: region B faces the intensified tax competition. This result cannot be acknowledged in Lucas (2004) who considers two symmetric regions in one country model.

4. Decentralization

This section considers the following decentralization. The local governments supply the local public goods by using commodity tax revenue and intergovernmental transfers from the central government to maximize social welfare in its own region. Then, the central government chooses the central tax rates T_{ij}, the national public good and the matching grant to maximize social welfare in its own country. Intergovernmental transfer is a form of matching grant on local tax rates, t_{ij}. The central government is a first-mover and the local governments are follower. However, the governments of the same levels behave as Nash competitors.

We consider the following two stage game. In the first stage, the central government has Stackelberg advantage vis à vis the local governments. However, each central government behaves as Nash competitors with respect to all other country's governments. In the second stage, each local government, a follower to the central government, behaves as Nash competitors with respect to all other country's governments.

4.1. Local governments' behavior

The central government provides fiscal transfer by using a matching grant on the local tax rate, m_{ij}. The local governments supply the local public goods by using commodity tax revenue and intergovernmental transfers from the central government to maximize social welfare in its own region. In the situation of $\tau_{iA} > \tau_{iB}$ and $\tau_{iB} < \tau_{i'B}$, budget constraints of the local governments are given by:

$$g_{iA} = (1 + m_{iA})t_{iA} \int_{\hat{d}_{iA}}^{1} y_{iA}(\tau_{iA}) \mathrm{d}d_{iA} \tag{20}$$

Because countries are symmetric, we focus on the only regions in country i. The local government in region iA which is follower and has the only one border chooses t_{iA} and g_{iA} to maximize utility of consumers in region iA, taking T_{iA}, τ_{iB}, G_i, m_{iA} and m_{iB} as given. In the situation of $t_{iA} > t_{iB}$, maximization problem for the local government in region iA is given by:

$$\max_{t_{iA}, g_{iA}} \int_{\hat{d}_{iA}}^{1} V(\tau_{iA})\, \mathrm{d}d_{iA} + \int_{0}^{\hat{d}_{iA}} V(\tau_{iB})\, \mathrm{d}d_{iA} + b(g_{iA}) + B(G_i)\,, \ \ s.t.\ (3.20). \tag{31}$$

We obtain the following necessary condition for public good provision in region iA:

$$b'(g_{iA}) = \frac{(1 - \hat{d}_{iA})y_{iA}}{(1 + m_{iA})y_{iA}\left\{(1 - \hat{d}_{iA})(1 - \varepsilon_{tiA}) - t_{iA}\dfrac{\partial \hat{d}_{iA}}{\partial \tau_{iA}}\right\}}, \tag{34}$$

where $\varepsilon_{tiA} \equiv -\frac{t_{iA}}{y_{iA}(\tau_{iA})}\frac{\partial y_{iA}(\tau_{iA})}{\partial t_{iA}} > 0$ is elasticity of demand for a good y_{iA} with respect to tax rate in region iA.

The local government in region iB which has two borders chooses t_{iB} and g_{iB} to maximize utility of consumers in region iB, taking T_{iB}, τ_{iA}, $\tau_{i'B}$, m_{iA} and m_{iB} as given. In the situation of $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, the maximization problem for the local government in region iB is given by:

$$\max_{t_{iB}, g_{iB}} V(\tau_{iB}) + b(g_{iA}) + B(G_i)\,, \ \ s.t.\ (21). \tag{35}$$

We obtain the following necessary conditions for public good provision in region iB:

$$b'(g_{iB}) = \frac{y_{iB}}{(1 + m_{iB})y_{iB}\left\{(1 + \hat{d}_{iA})(1 - \varepsilon_{tiB}) - t_{iB}\left(\dfrac{\partial \hat{d}_{iA}}{\partial \tau_{iB}} + \dfrac{\partial \hat{D}_{i'B}}{\partial \tau_{iB}}\right)\right\}}, \tag{38}$$

where $\varepsilon_{tiB} \equiv -\frac{t_{iB}}{y_{iB}(\tau_{iB})}\frac{\partial y_{iB}(\tau_{iB})}{\partial t_{iB}} > 0$ is elasticity of demand for a good y_{iB} with respect to tax rate in region iB. This condition is interpreted in a similar way to (34). The left-hand side of (38) is marginal benefit of the public good and the right-hand side is MCPF. If $m_{iA} = m_{iB} = 0$, (34) and (38) are not identical to (12) and (19). That is, in the decentralization without the matching grant, the central government cannot replicate the second-best outcomes and equilibrium outcomes under unitary nation.

4.2. Central governments' behavior

The central government supplies the national public good by taxing a good y and setting matching grants. If $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, the budget constraint of the central government in country i is:

$$G_i = (T_{iA} - t_{iA}m_{iA})\int_{\hat{d}_{iA}}^{1} y_{iA}(\tau_{iA})\,\mathrm{d}d_{iA} + (T_{iB} - t_{iB}m_{iB})\left(y_{iB}(\tau_{iB}) + \int_{0}^{\hat{d}_{iA}} y_{iB}(\tau_{iB})\mathrm{d}d_{iA} + \int_{0}^{\hat{D}_{i'B}} y_{iB}(\tau_{iB})\mathrm{d}D_{i'B}\right). \tag{39}$$

In the situation of $\tau_{iA} > \tau_{iB}$ and $\tau_{i'B} > \tau_{iB}$, the maximization problem for the central government in country i is given by:

$$\max_{T_{iA},T_{iB},m_{iA},m_{iB},G_i} V(\tau_{iB}) + \int_{0}^{\hat{d}_{iA}} V(\tau_{iB},d_{iA})\mathrm{d}d_{iA} + \int_{\hat{d}_{iA}}^{0} V(\tau_{iA})\mathrm{d}d_{iA} + b(g_{iA}) + b(g_{iB}) + 2B(G_i),\ \ s.t.\ (19) \tag{44}$$

We obtain the following optimal matching grants:

$$m_{iA} = \frac{(1-\hat{d}_{iA})T_{iA}\dfrac{\partial y_{iA}}{\partial t_{iA}} + (\tau_{iB}y_{iB} - T_{iA}y_{iA})\dfrac{\partial \hat{d}_{1A}}{\partial t_{iA}}}{(1-\hat{d}_{iA})\left(y_{iA} + t_{iA}\dfrac{\partial y_{iA}}{\partial \tau_{iA}}\right) - t_{iA}y_{iA}\dfrac{\partial \hat{d}_{1A}}{\partial \tau_{iA}}}, \tag{49}$$

$$m_{iB} = \frac{-\hat{d}_{iA}E_{iB} + T_{iB}\dfrac{\partial y_{iB}}{\partial \tau_{iB}} - \left(\dfrac{\hat{d}_{iA}t_{iB} + T_{iB}}{(1+\hat{d}_{iA})}\right)y_{iB}F_{iB} - \dfrac{\tau_{iA}y_{iA}}{(1+\hat{d}_{iA})}\dfrac{\partial \hat{d}_{iA}}{\partial \tau_{iB}}}{(1+\hat{d}_{iA})E_{iB} - t_{iB}y_{iB}F_{iB}}, \tag{50}$$

where $E_{iB} \equiv y_{iB}(\tau_{iB}) + t_{iB}\partial y_{iB}(\tau_{iB})/\partial \tau_{iB}$ and $F_{iB} \equiv \partial \hat{d}_{iA}/\partial \tau_{iB} + \partial \hat{D}_{i'B}/\partial \tau_{iB}$. Substituting (49) and (50) into (34) and (38), respectively, we obtain the condition (19).

Therefore, we see that the central government under the decentralization can replicate equilibrium outcomes under the unitary nation by using the matching grants on the local tax rate. It should be noted that, similar to the case of the unitary nation, when the central government uses the matching grant, the tax rates are different in region A and B.

Proposition 2 *Under the decentralization, the central government can achieve the equilibrium outcomes under the unitary nation by the matching grant on the local tax rate.*

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