Tax Coordination among Moderate Leviathans*

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Abstract

This study investigates how tax coordination is formed by governments who are neither entirely benevolent nor wholly self-serving in an asymmetric three-country model of tax competition. Although tax coordination internalizes both fiscal and pecuniary externalities among member countries, it simultaneously encourages members' incentives to deviate from the tax union. The results show that partial tax coordination may increase or decrease the welfare of a non-member country depending on the government's attitudes toward policy objectives, which crucially determine the degree of both externalities. The most noteworthy finding is that the inclination of policymakers' attitudes toward Leviathan make fiscal externality more rigorous, and thus, more likely for partial tax coordination excluding the medium country to prevail.

JEL classification: H73; F21; F59

Keywords: Tax coordination; Moderate Leviathan; Tax competition

1 Introduction

With the world becoming more borderless, governments' attitudes toward the global economy has dramatically changed in the recent decades. Although worldwide competition in the private sector may enhance efficiency, it also leads sovereign nations to a prisoners' dilemma owing to the international mobility of the tax base. The well-known result of tax competition is that the increasing mobility of capital will drive down the equilibrium tax rate on capital. The literature (see, e.g., Zodrow and Mieszkowski, 1986; Wildasin, 1989; Bucovetsky, 1991; and Wilson, 1991) pays significant attention to this issue and examines whether Pareto-improving harmonizing reforms of capital income taxes exist. Tax coordination among all countries could overcome the inefficiency in world capital allocation if a supra-national government that enforces such an agreement existed.

In spite of its supra-national structure, the European Union (EU) has failed to implement any serious cooperation or harmonization in corporate taxation, although the EU commission had agreed to a Code of Conduct in business taxation as part of a package to tackle harmful tax competition. Is it in the interest of the subsets of EU members to cooperate with the harmonized policy for capital taxation? Several studies offer insights into partial tax coordination supported by a tax union consisting of any subset of countries. Burbidge, DePater, Myers, and Sengupta (1997) analyze the endogenous coalition formation for a jurisdictional capital tax policy and demonstrate that the grand coalition among all jurisdictions is stable if the economy consists of two jurisdictions, although this is not the case for three or more jurisdictions. Konrad and Schjelderup (1999) and Bucovetsky (2009) demonstrate that partial tax harmonization mitigates downward pressure on capital taxation and hence, improves the welfare of not only the union members but also the outsiders. Itaya, Okamura, and Yamaguchi (2016), on the other hand, show that the tax union may increase in market power and thus, generate winners and losers by manipulating the capital price against the outside countries. Vrijburg and de Mooij (2016) show that the formation of a tax union might make member countries worse off because of the adverse response in the outside country.

Although such partial tax coordination would be desirable or Pareto improving in a sense that it could somewhat eliminate the consequences of related externalities, it is unclear whether

heterogeneous countries would wish to form a tax union, particularly if it has to sort out multiple externalities. The inefficiency arising from tax competition may be of two types: the abovementioned race-to-the-bottom (i.e., fiscal externality), which refers to inefficiently low tax rates that lead to the underprovision of public expenditure for all countries, and production inefficiency, which results from pecuniary externality (i.e., terms of trade effect) associated with asymmetric countries model (see, e.g., DePater and Myers, 1994; Peralta and van Ypersele, 2005, 2006). In a symmetric tax competition model, the analysis focuses on the former such that tax coordination toward higher capital tax rates could simultaneously benefit all competing countries since there is no conflict in terms of trade. In contrast, since countries' net of trade positions induce each country to manipulate the capital price in its favor, the latter may hamper tax coordination. Accordingly, to form a tax union, member countries must simultaneously coordinate not only the common problem, that is, the race to the bottom, but also the conflict of interests, which is the pecuniary externality.

This study contributes to the understanding of tax coordination using a standard model of tax competition, where both fiscal and pecuniary externalities simultaneously exist. To do so, we adopt a hypothesis of the moderate Leviathan (see, e.g., Edwards and Keen, 1996; Rauscher, 1998; and Wrede, 1998) such that policymakers are neither entirely benevolent nor fully self-interested. The governments, in this analysis, are assumed to derive utility from the welfare of the representative resident as well as their tax revenue (i.e., public expenditure). Furthermore, we employ a three-country model, whereby countries are heterogeneous with respect to capital endowments, that is, rich enough to capture some of the central features of tax competition among asymmetric countries but sufficiently simple to yield sharp insights into certain central questions such as the stability of tax coordination supported by a tax union consisting of any subset of countries.

We show that the grand coalition among all countries can be an equilibrium structure in the limited case that the pecuniary externality is relatively stronger than the fiscal externality. Full tax harmonization internalizes both the fiscal and pecuniary externalities among all the countries. However, this also encourages each country's incentive to deviate from that as long as a partial tax union between remaining countries will be maintained. That is, impossibilities of remaining partial tax unions prevent them from being a free-rider. Furthermore, we show that all possible

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coalitions including a singleton can be an equilibrium coalition structure depending on both the degree of asymmetry among countries and governments' attitudes toward policy objectives, which crucially determine the degree of both fiscal and pecuniary externalities. The most noteworthy finding is that the more inclined governments' attitudes are toward revenue maximizes (i.e., Leviathans), the easier it is for a partial tax union consisting of dissimilar countries to prevail.

The remainder of this paper is organized as follows. Section 2 presents the model of tax competition comprising three heterogeneous countries whose capital endowments and policymakers are neither entirely benevolent nor wholly self-serving and characterizes its fully noncooperative Nash equilibrium. Section 3 investigates the stability of tax coordination among a subset of countries. Section 4 offers concluding remarks and a discussion on the extensions.

2   Model

Consider an economy composed of three countries with heterogenous capital endowments. The capital endowments per capita of the *large*, *medium*, and *small* countries, respectively, are represented by $\overline{k}_L > \overline{k}_M > \overline{k}_S$; it is convenient to express them as $\overline{k}_L \equiv \overline{k} + \varepsilon$, $\overline{k}_M \equiv \overline{k}$, and $\overline{k}_S \equiv \overline{k} - \varepsilon$, where $\overline{k} \equiv (\overline{k}_L + \overline{k}_M + \overline{k}_S)/3$ is the average capital endowment of all countries and $\varepsilon \in (0, \overline{k})$ denotes the difference in the capital endowments of $\overline{k}_M$ and $\overline{k}_L$ (or $\overline{k}_S$). Each country $i = L, M, S$ has a representative resident and firm; workers are immobile, while capital is perfectly mobile across countries. These factors are used in the production of a numéraire good using the CRS technology: $f(k_i) \equiv (A - k_i)k_i$, where $A > 0$ is a technology parameter that is identical across all countries and k_i is the capital per capita demanded in country i.[1] We assume $A > 2k_i$ to ensure that the marginal productivity of capital is always positive. Public expenditure, denoted by g_i, is entirely financed by a source-based tax on capital τ_i, such that the budget constraint of government i is $g_i = \tau_i k_i$. Given the market prices and tax rates, firms choose their inputs to maximize profit: $\pi_i = f(k_i) - w_i - (r + \tau_i)k_i$, where r is the net return on capital and w_i is the country-specific wage rate. Then, the profit-maximizing behavior is characterized by the

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[1] This quadratic production function follows Bucovetsky (1991, 2009), Peralta and van Ypersele (2005, 2006), Itaya et al. (2014, 2016), Ogawa (2013), Pal and Sharma (2013), Hindrikes and Nishimura (2015), and Kawachi et al. (2016).

following first-order conditions:

$$r = f'(k_i) - \tau_i = A - 2k_i - \tau_i, \tag{1}$$

$$w_i = f(k_i) - k_i f'(k_i) = k_i^2.$$

Each competitive firm employs capital until its marginal productivity $f'(k_i)$ is equal to the costs of capital $r + \tau_i$ and labor such that the marginal productivity of labor $f(k_i) - k_i f'(k_i)$ is equal to the wage rate w_i. The international mobility of capital ensures that the net return on capital r is equalized across all countries. Hence, the capital market equilibrium is characterized by arbitrage conditions (1) for all i and the international capital market clearing condition, $\sum k_i = \sum \overline{k}_i = 3\overline{k}$, which yields the equilibrium net return on capital and capital demanded in country i:

$$r^* = A - 2\overline{k} - \overline{\tau}, \tag{2}$$

$$k_i^* = \overline{k} + \frac{1}{2} \left(\overline{\tau} - \tau_i \right), \tag{3}$$

where $\overline{\tau} \equiv \left(\sum \tau_i \right)/3$ is the average capital tax rate for all countries. These conditions imply that country i that increases tax rate τ_i not only loses its amount of tax base, i.e., k_i^*, but also decreases the equilibrium capital price r^*. That is, the outflow of capital reduces the marginal productivity of capital in the other countries as a result of capital inflow.[2]

The residents of all countries are identical; they inelastically supply one unit of labor to the domestic firms and invest their capital endowments in the home and/or foreign countries. They derive utility from their consumption of the numéraire good, denoted by c_i, such that the utility function of a resident in country i is simply defined by $u_i(c_i) \equiv c_i$. Hence, each resident chooses its consumption level subject to the budget constraint, $c_i = w_i + r^* \overline{k}_i$. Furthermore, since each government i provides public expenditure g_i (i.e., a lump-sum income transfer) to its resident, the budget constraint of the representative resident can be written as

$$c_i = f(k_i) - k_i f'(k_i) + r^* \overline{k}_i + g_i = f(k_i) + r^* \left(\overline{k}_i - k_i^* \right). \tag{4}$$

[2] We assume throughout the study that $A > 7\overline{k}$ renders the net return on capital non-negative.

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Each government is assumed to behave as a moderate Leviathan that derives utility from the total amount of public expenditure g_i as well as from the welfare of the representative resident u_i (see, e.g., Edward and Keen, 1996; Rauscher, 1998; Wrede, 1998). Following Pal and Sharma (2013) and Kawachi, Ogawa, and Susa (2016), the objective function of the government, denoted by $V_i(g_i, u_i)$, is simply a linear combination of g_i and u_i as follows:

$$V_i(g_i, u_i) \equiv \theta g_i + (1 - \theta) u_i,$$

where $\theta \in (0, 1)$ is an exogenous weight parameter of governments identical across countries.[3] Hence, governments become perfectly benevolent (Leviathan) as θ approaches 0 (1). The first-order condition for government i is as follows:

$$\frac{\partial V_i}{\partial \tau_i} = \theta \left[k_i^* + \tau_i \frac{\partial k_i^*}{\partial \tau_i} \right] + (1 - \theta) \left[\tau_i \frac{\partial k_i^*}{\partial \tau_i} + (\overline{k}_i - k_i^*) \frac{\partial r^*}{\partial \tau_i} \right] = 0. \tag{5}$$

This first-order condition implies that as long as $\theta \neq 0$, each government's behavior depends on the weight of the two objectives θ, which determines how significant the fiscal and pecuniary externalities simultaneously.

Lemma 1 *The larger the governments' weight parameter θ, the more intense the fiscal externality.*

Proof. The first-order condition (5) can be rewritten as

$$-\tau_i \frac{\partial k_i^*}{\partial \tau_i} = \theta k_i^* + (1 - \theta) (\overline{k}_i - k_i^*) \frac{\partial r^*}{\partial \tau_i}.$$

This shows that the *capital movement effect* in the LHS comprises of a weighted average of a *tax base effect* k_i^* and the *terms of trade effect* $(\overline{k}_i - k_i^*)(\partial r^*/\partial \tau_i)$ (see also Peralta and van Ypersele, 2006), which implies that an increase in θ not only generates more capital flight but also moderates the latter effect. Furthermore, the condition (5) can be expressed with the elasticity

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[3] Pal and Sharma (2013) and Kawachi et al. (2016) analyze the asymmetric policy making in a tax competition model by treating the weights of government objective functions as endogenous variables. Our study, however, omits this since we focus on the stability of tax coordination among identical governments.

form as follows:

$$-\frac{\tau_i}{k_i^*}\frac{\partial k_i^*}{\partial \tau_i} = \theta + (1-\theta)\left[\frac{\overline{k}_i}{k_i^*} - 1\right]\frac{\partial r^*}{\partial \tau_i}. \tag{6}$$

Suppose there is no pecuniary externality (i.e., $\partial r^*/\partial \tau_i = 0$), then the elasticity of capital (i.e., the fiscal externality) in the LHS of (6) increases in the governments' weight parameter θ. ∎

Needless to say, there is no fiscal externality when $\theta = 0$, because no pecuniary externality in (6) implies no tax competition; that is, each government chooses zero capital tax rate since $-\tau_i(\partial k_i^*/\partial \tau_i)/k_i^* = 0$. Thus, the non-zero tax results for $\theta = 0$ arise due to the terms of trade effect (see, Peralta and van Ypersele, 2005, 2006, and Itaya et al., 2008, 2016). In the presence of the pecuniary externality (i.e., $\partial r^*/\partial \tau_i < 0$), the inclination of policymakers' attitudes toward Leviathan (i.e., $\theta \to 1$) not only intensifies the tax base effect but also diminishes the impact of the terms of trade effect. Furthermore, for $\theta \in (0,1)$, each country's whole effect (i.e., elasticity of capital) depends on its net exporting position (the sign of the square bracket in (6)) as well, which yields the following:

Lemma 2 *The elasticity of capital for a capital importer is higher than that for a capital exporter.*

From (2), (3), and (5), the best-response function of government $i = L$, M, S, is as follows:

$$\tau_i = \frac{1+2\theta}{4(2+\theta)}(\tau_j + \tau_h) + \frac{3\left[(1+2\theta)\overline{k} - (1-\theta)\overline{k}_i\right]}{2(2+\theta)}, \ \ i \neq j \neq h, \tag{7}$$

which reveals that tax rates are strategic complements, as in Konrad and Schjelderup (1999). Note that an increase in θ not only makes the slope of (7) steeper but also increases its intercept, which leads to a higher equilibrium tax rate. By solving the equations (7) for all governments, we obtain the Nash equilibrium tax rates, denoted by τ_i^N, as follows:

$$\tau_L^N = 3\theta\overline{k} - \frac{2(1-\theta)\varepsilon}{3+2\theta}, \ \ \tau_M^N = 3\theta\overline{k}, \ \text{ and } \ \tau_S^N = 3\theta\overline{k} + \frac{2(1-\theta)\varepsilon}{3+2\theta}. \tag{8}$$

Note that these equilibrium tax rates can be divided into two components: $3\theta\overline{k}$ corresponds to the common fiscal externality and the other term is associated with the pecuniary externality, while country M is indifferent to the latter. For countries L and S, which component dominates

the other depends on the governments' attitudes toward Leviathan, i.e., $\theta \in (0,1)$. Substituting (8) into (2) and (3) yields the following Nash equilibrium net return and the amount of capital demanded in country i, denoted by r^N and k_i^N:

$$r^N = A - (2 + 3\theta)\,\overline{k}, \tag{9}$$

$$k_L^N = \overline{k} + \frac{(1-\theta)\,\varepsilon}{3 + 2\theta}, \ \ k_M^N = \overline{k}, \ \text{and} \ \ k_S^N = \overline{k} - \frac{(1-\theta)\,\varepsilon}{3 + 2\theta}. \tag{10}$$

It follows from (8) and (10) that $\overline{k}_L - k_L^N = (2+3\theta)\varepsilon/(3+2\theta) > 0$, $\overline{k}_S - k_S^N = -(2+3\theta)\varepsilon/(3+2\theta) < 0$, and $\overline{k}_M - k_M^N = 0$; that is, country L exports capital with a lower tax rate than the average one, $\overline{\tau}^N = 3\theta\overline{k}$ (i.e., $\tau_L^N < \overline{\tau}^N$), while country S imports capital with a higher tax (i.e., $\tau_S^N > \overline{\tau}^N$). This result stems from the terms of trade effect; that is, the capital exporting country L levies a lower tax rate to increase the capital remuneration through a rise in capital price r^* in (2). On the other hand, the capital exporter (i.e., country S) has an opposite incentive to manipulate r^*, although country M neither gains nor loses by manipulating r^* since its net trade of capital equals zero (i.e., $k_M^N = \overline{k}_M$). Notably, an increase in θ reduces these countries' tax differences caused by the terms of trade effect and hence, enlarges the equilibrium amount of capital trade between countries L and S: i.e., $\partial \left(\overline{k}_L - k_L^N \right) / \partial\theta = \partial \left(k_L^N - \overline{k}_L \right) / \partial\theta > 0$.

By using (8), (9), and (10), the welfare levels of the governments at the Nash equilibrium, denoted by $V_i^N = \theta g_i^N + (1-\theta)\,u_i^N$, are expressed as follows:

$$V_L^N = \theta \tau_L^N k_L^N + (1-\theta)\left[(A - \overline{k}_L)\overline{k}_L - \frac{\varepsilon(2+3\theta)[3\theta\,(3+2\theta)\,\overline{k} - \varepsilon\,(4+\theta)]}{(3+2\theta)^2} \right], \tag{11}$$

$$V_M^N = \theta \tau_M^N k_M^N + (1-\theta)\,(A - \overline{k}_M)\overline{k}_M, \tag{12}$$

$$V_S^N = \theta \tau_S^N k_S^N + (1-\theta)\left[(A - \overline{k}_S)\overline{k}_S + \frac{\varepsilon(2+3\theta)[3\theta\,(3+2\theta)\,\overline{k} + \varepsilon\,(4+\theta)]}{(3+2\theta)^2} \right], \tag{13}$$

which yield that $u_L^N > u_M^N > u_S^N$; that is, a resident in a capital-rich country always has a higher utility than that in a capital-poor one in the Nash equilibrium. While the ranking of the government's welfare exhibits the same; i.e., $V_L^N > V_M^N > V_S^N$, these welfare gaps become narrower as θ increases. That is, a higher weight on tax revenue θ reduces disparities in the equilibrium tax rates; it induces country L and S to regard the common problem (i.e., fiscal

externality) more than their residents' concerns (i.e., pecuniary externality). In other words, the extent to which policymakers weight on the benefits of capital owners (i.e., residents) is crucial for their equilibrium welfare, and hence the feasibility of tax coordination (see, Kawachi et al., 2016).

3   Tax Coordination

In this section, we consider the endogenous formation of coalitions (i.e., tax unions) that implement tax coordination. Let C represent a subset of countries, that is, $C \subseteq \{L, M, S\}$. We consider four possible coalitions, except for a singleton in the previous section, and hence, $C \in \{\{L, M\}, \{L, S\}, \{M, S\}, \{L, M, S\}\}$. Given these notations, the objective function of the government in country i can be rewritten as follows:

$$V_i^C = \theta g_i^C + (1 - \theta) u_i^C = \theta \tau_i^C k_i^C + (1 - \theta) \left[f(k_i^C) + r^C \left[\overline{k}_i - k_i^C \right] \right],$$

where we index all endogenous variables pertaining to tax union C by the superscript.

We assume that the bargaining rules are such that the governments that belong to a coalition receive equal weights. Knowing this, each country that belongs to a coalition has an incentive to set its capital tax rate that internalizes all externalities within the coalition.

3.1   Grand Coalition

First, consider the grand coalition $G = \{L, M, S\}$, wherein all three governments agree to jointly set their capital tax rates. By solving the following maximization problem:

$$\max_{\tau_i} \ W \equiv \sum_i V_i = \theta \sum_i \tau_i k_i + (1 - \theta) \sum_i f(k_i),$$

we obtain that a certain harmonized tax rate, i.e., $\tau_L = \tau_M = \tau_S$, is in equilibrium only when there exists no fiscal externality, i.e., $\theta = 0$, although its level is indeterminate due to the quadratic production and linear welfare function (see also, Peralta and van Ypersele, 2005, 2006; Itaya et al., 2008, 2016). This implies that the first best allocation in the case of benevolent
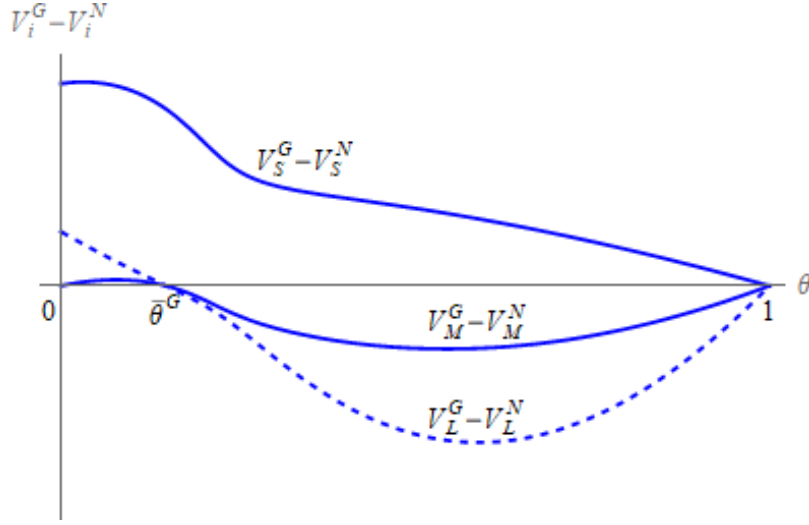
Figure 1: Welfare gains in the grand coalition for $\varepsilon = \overline{k}/2$

governments (i.e., $\theta = 0$) can be achieved by any tax level if it is the common tax rate, which leads to the equalization of the marginal productivity of capital in all countries (i.e., $k_L^* = k_M^* = k_S^* = \overline{k}$). In the presence of fiscal externality, i.e., $\theta > 0$, an instrument set comprising of capital tax rates and an international income transfer can suffice to sustain a certain first best allocation (see, DePater and Myers, 1994).

Instead, we introduce the Nash bargaining solution into a harmonized tax rate, denoted by τ^G as follows:

$$\tau^G = \arg\max_{\tau} W^G \equiv \left(V_L^G - V_L^N\right)\left(V_M^G - V_M^N\right)\left(V_S^G - V_S^N\right)$$

where the welfare for the respective governments in the grand coalition are as follows (see also the appendix A):

$$V_L^G = \theta\tau^G\overline{k} + (1-\theta)\left[(A - \overline{k}_L)\overline{k}_L + \varepsilon\left(\varepsilon - \tau^G\right)\right], \tag{14}$$

$$V_M^G = \theta\tau^G\overline{k} + (1-\theta)\left(A - \overline{k}_M\right)\overline{k}_M, \tag{15}$$

$$V_S^G = \theta\tau^G\overline{k} + (1-\theta)\left[(A - \overline{k}_S)\overline{k}_S + \varepsilon\left(\varepsilon + \tau^G\right)\right]. \tag{16}$$

The participation constraints, that is, $V_i^G \geq V_i^N$ for country $i = L$, M, S, confine a potential weight θ for the grand coalition to $0 < \theta < \overline{\theta}^G$ as in Fig.1.

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When governments are perfectly benevolent (i.e., $\theta = 0$), country M has no incentive to cooperate with other countries as in Itaya et al. (2016), who show that the perfectly median country will never join the grand coalition in a repeated game setting since it neither gains nor losses by doing so. That is, the median country is indifferent to the pecuniary externality associated with capital movements, and hence, it may well stand alone. However, this is not the case for the moderate Leviathan (i.e., $\theta > 0$) since tax coordination nullifies not only the pecuniary externality but also the fiscal externality, which benefits all governments, including country M, by increasing their tax revenue.

However, the potential range for θ is quite limited; $\overline{\theta}^G$ is at most 0.2638 when $\varepsilon \to \overline{k}$. This shows that the grand coalition may occur only if the pecuniary externality is relatively stronger than the fiscal externality. It is intuitive that capital-importing country S agrees to a higher coordinated tax rate τ^G; that is, the terms of trade effect. Although capital-exporting country L has an opposite incentive for that, it has an incentive to participate in the coalition as long as its gains dominates losses from its terms of trade disadvantage (i.e., the decrease in capital remuneration). This threshold value of country L becomes $\overline{\theta}^G$. The capital neutral country M has an incentive to be a member as long as $\tau^G > \tau_M^N$ since $V_M^G - V_M^N = \theta \left(\tau^G > \tau_M^N \right)$. If $\theta \to 0$, then $\tau^G \to \varepsilon / \left(9\sqrt{3} \right) > 0 = \tau_M^N$. As θ increases, it turns out that $\tau^G \leq \tau_M^N$ at $\overline{\theta}^G \leq \theta < 1$, thus country M may also stay in the the coalition when $0 < \theta < \overline{\theta}^G$. Notice that their objective function with a higher θ implies that governments put the highest priority on their tax revenues.

3.2 Partial Tax Unions

Next, consider a partial tax union $C = \{i, j\}$ consisting of countries i and j that agree to jointly choose their tax rates in a coordinated manner to maximize the sum of their objectives, represented by $W(ij) \equiv V_i + V_j$. The first-order condition of the tax union C with respect to τ_i for $i \in C, i \neq j, h \notin C$ are

$$\tau_i = \frac{2 \left(1 + 2\theta \right) \tau_j + (2 + \theta)\tau_h - 6 \left[(1 - 4\theta) \overline{k} - (1 - \theta) \overline{k}_h \right]}{7 + 5\theta},$$

which implies that $\tau_i = \tau_j$. On the other hand, the government in country $h \notin C$ that is outside the tax union chooses a tax rate that maximizes its welfare in accordance with (7). By solving

these best-response functions, we obtain the coordinated tax rate, denoted by τ^{ij} for $i \in C$ and $i \neq j$, and the tax rate of the outsider $h \notin C$, denoted by τ_h^{ij}, in the subgroup Nash equilibrium (see Konrad and Schjelderup, 1999), as follows:

$$\tau^{ij} = -(1 - 6\theta)\,\overline{k} + (1 - \theta)\,\overline{k}_h, \tag{17}$$

$$\tau_h^{ij} = \frac{(1 + 2\theta)(1 + 3\theta)\,\overline{k} - (1 - \theta)^2\,\overline{k}_h}{2 + \theta}. \tag{18}$$

Substituting (17) and (18) into (2) and (3) yields the following equilibrium net return, denoted by r^{ij}, and the amount of capital demanded for each union member, denoted by k^{ij} for $\forall i \in C$ and k_h^{ij} for the outside country $h \notin C$:

$$r^{ij} = A - \frac{(1 + 3\theta)(3 + 2\theta)\,\overline{k} + (1 + \theta)(1 - \theta)\,\overline{k}_h}{2 + \theta}, \tag{19}$$

$$k^{ij} = \frac{5\overline{k} - (1 - \theta)\,\overline{k}_h}{2(2 + \theta)} \text{ and } k_h^{ij} = \frac{(1 + 3\theta)\,\overline{k} + (1 - \theta)\,\overline{k}_h}{2 + \theta}. \tag{20}$$

The resulting welfare of the member country $i \in C$ and outside country $h \notin C$, denoted by V_i^{ij} and V_h^{ij}, are given as follows:

$$V_i^{ij} = \theta\tau^{ij}k^{ij} + (1 - \theta)\left[(A - \overline{k}_i)\overline{k}_i + \frac{\left[5\overline{k} - 2(2 + \theta)\,\overline{k}_i - (1 - \theta)\,\overline{k}_h\right]\Phi_i}{4(2 + \theta)^2}\right], \tag{21}$$

$$V_h^{ij} = \theta\tau_h^{ij}k_h^{ij} + (1 - \theta)\left[(A - \overline{k}_h)\overline{k}_h + \frac{\left[(1 + 3\theta)\,\overline{k} - (1 + 2\theta)\,\overline{k}_h\right]\Phi_h}{(2 + \theta)^2}\right], \tag{22}$$

where $\Phi_i \equiv (1 + 22\theta + 12\theta^2)\,\overline{k} - 2(2 + \theta)\,\overline{k}_i + (1 - \theta)(3 + 2\theta)\,\overline{k}_h$, and $\Phi_h \equiv 2(1 + \theta)(1 + 3\theta)\,\overline{k} - (2 + \theta^2)\,\overline{k}_h$.

From (11)-(13), (14)-(16), (21), and (22), we can compare each country's welfare levels in the respective tax unions. It is shown from Figure 2-4 that their gains from tax coordination pertaining to tax union $C = \{i, j\}$ or $G = \{L, M, S\}$ depend on both the values of ε and θ. Country M has no incentive to participate in any partial tax union if governments are completely benevolent (i.e., $\theta = 0$) since it imposes on non-capital-trade country M an indirect transfer to its partner through the harmonized tax rate; in this case, partial tax coordination may occur only to amend the terms of trade among members (Remember that there is no fiscal externality at $\theta = 0$). For
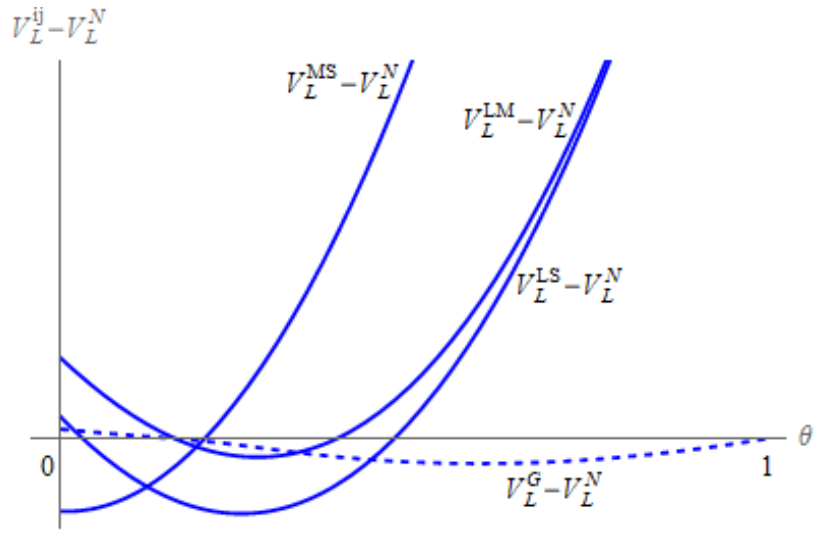
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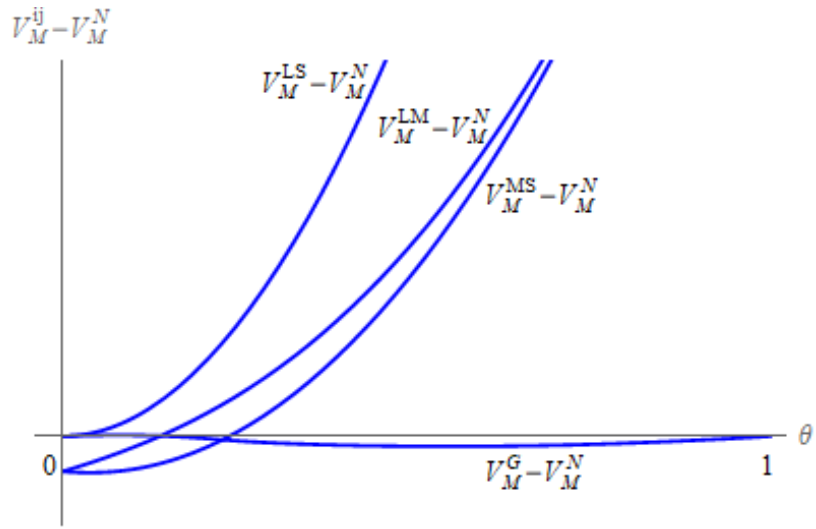Figure 2: Welfare gains of country L for $\varepsilon = \overline{k}/2$

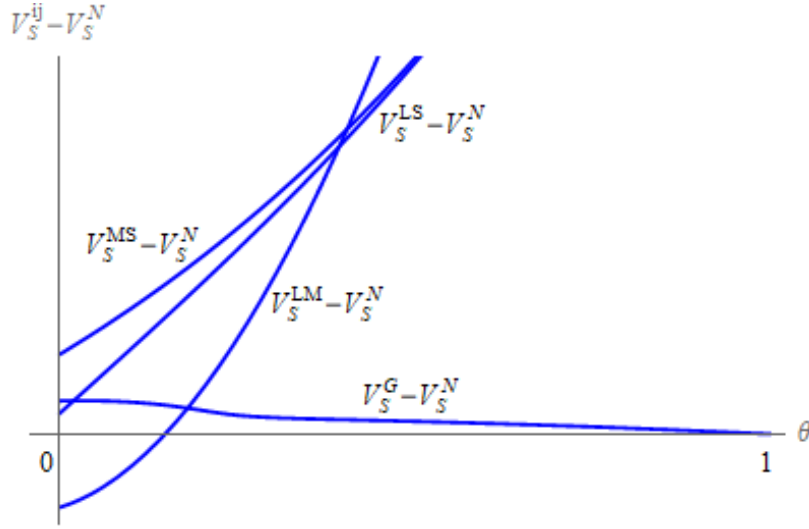Figure 3: Welfare gains of country M for $\varepsilon = \overline{k}/2$

Figure 4: Welfare gains of country S for $\varepsilon = \overline{k}/2$

$\theta > 0$, country M may find it beneficial to cooperate with another country since tax coordination corrects not only the pecuniary externality but also the fiscal externality. It is intuitive that the capital-importing country S has the incentive to participate in any partial tax union since it enhances its production efficiency and/or terms of trade through a higher coordinated tax rate, while the capital-exporting country L must be cautious toward partial tax coordination since an increase in θ might take away its capital advantage through a decreasing capital price; i.e., $dr^{LS}/d\theta < 0$, although it may increase its tax revenue as well.

It is obvious that country M has the incentive to stand alone as long as $\theta > 0$, since partial tax coordination between countries L and S internalizes not only their pecuniary externality completely but also the fiscal externality partially, and hence benefits country M through the resulting higher equilibrium tax rate. Furthermore, it follows from (9), (19), and (20) that the resulting lower capital price from tax union $\{LS\}$; i.e., $r^N > r^{LS}$, induces country M to change its capital trading position from neutral to an importer; i.e., $k_M^N - k_M^{LS} = -\theta\overline{k}/(2+\theta) < 0$. These positive spillover effects from partial tax union $\{LS\}$ are strong enough for country M to be outside. Accordingly, from the capital traders' viewpoint, standing alone as an outsider may be beneficial when the positive external effect from partial coordination (i.e., a tax union's partial correction for the fiscal externality) dominates the negative one (i.e., the tax union's

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manipulation of members' favorable capital price).

Our result for $\theta = 0$ is the same as in Itaya et al. (2016), who show that partial tax coordination may generate winners and a loser since the different net exporting positions of a tax union and the outside country induce them to have opposite incentives to manipulate the capital price. On the other hand, for a sufficiently large $\theta > 0$, the result can be reverse such that the tax union's partial correction for the fiscal externality improves the welfare of not only the union members but also the outsider, as in Konrad and Schjelderup (1999) and Bucovetsky (2009). That is, as policymakers' attitudes become more Leviathan (i.e., $\theta \to 1$), they take the race-to-the-bottom issue more seriously and hence, their interests in the pecuniary externality decreases, which further benefits the outsider's welfare through the positive external effects of a partial tax union.

3.3   Stable Tax Coordination

Now, we investigate the stable coalition for our three-country setting. Following Burbidge et al. (1997), we employ the concept of a coalition-proof Nash equilibrium since coalition proofness rules out non-credible deviations in the sense that they are subject to further deviations (see also Bernheim, Peleg, and Whinston, 1987).

Proposition 1 *For an interval of sufficiently weak fiscal externalities, i.e., $\theta \in \left(0, \theta_1^M\right)$, the coalition-proof Nash equilibrium is the equilibrium for the grand coalition. As fiscal externalities become stronger, the coalition-proof Nash equilibrium are tax union {LS} for $\theta \in \left(\theta_1^M, \underline{\theta}^L\right)$, the grand coalition for $\theta \in \left(\underline{\theta}^L, \theta_3^M\right)$, tax union {LM} for $\theta \in \left(\theta_3^M, \theta_1^L\right)$, the singleton for $\theta \in \left(\theta_1^L, \theta_4^M\right)$, tax union {MS} for $\theta \in \left(\theta_4^M, \max[\theta_4^S, \theta_5^S, \theta_3^L]\right)$, tax union {LM} for $\theta \in \left(\max[\theta_4^S, \theta_5^S, \theta_3^L], \overline{\theta}^L\right)$, and tax union {LS} for $\theta \in \left(\overline{\theta}^L, 1\right)$.*

Proof. See the appendix B. ■

The result shows that full tax coordination can be an equilibrium structure, which is in contrast to the result of Burbidge et al. (1997) that the grand coalition among all jurisdictions is not stable when the economy consists of three or more jurisdictions, although possible intervals in our setting are narrower than the potential interval $\theta \in \left(0, \overline{\theta}^G\right)$; e.g., the intervals are at most $0 < \theta < 0.0235$ and $0.0576 < \theta < 0.2485$ for $\varepsilon \to \overline{k}$ and at least $0 < \theta < 0.0024$ and

$0.0062 < \theta < .0299$ for $\varepsilon = 0.1\overline{k}$. The former equilibrium is supported by the highest priority of country M, while the latter would be thought as a result of compromise. Full tax harmonization internalizes both the fiscal and pecuniary externalities among all the countries. However, this also encourages each country's incentive to deviate from that, provided the existence of partial tax union between remaining countries. That is, impossibilities of remaining partial tax unions prevent them from being a free-rider.

Furthermore, our result indicates that all possible coalitions including a singleton can be an equilibrium depending on the values of ε and θ. Thus, the degree of asymmetry and hence how strong pecuniary externality is significantly affect the stability of tax coordination. Most noteworthy finding is that the partial coalition between dissimilar countries is most likely to occur for $\theta \in (0, 1)$; e.g., the intervals for tax union $\{LS\}$ are at least $0.0235 < \theta < 0.0576$ and $0.629 < \theta < 1$ for $\varepsilon \to \overline{k}$ and at most $0.0024 < \theta < 0.0062$ and $0.167 < \theta < 1$ for $\varepsilon = 0.1\overline{k}$. Tax union $\{LS\}$ nullifies not only the common problem (i.e., fiscal externality) partially, which benefits country M, but also their conflict (i.e., pecuniary externality) completely, which not only enhances members' production efficiency through the equalization of marginal product of capital but also increases the amount of production in country M. However, this is not always good for capital exporter L, since it requires a higher coordinated tax rate, i.e., $\tau^{LS} > \tau_L^N$. Thus, an indirect income is transferred to capital importer S through a lower capital price, i.e., $r^N > r^{LS}$, which restricts the permissible asymmetry for partial tax coordination between countries L and S, i.e., ε. However, the intensity of fiscal externality θ can mitigate this restriction partially as follows:

Corollary 1 *For $\theta < \varepsilon/\overline{k}_L$ ($\theta > \varepsilon/\overline{k}_L$), the more intense fiscal externality is, the greater the maximum (minimum) permissible asymmetry for tax union $\{LS\}$ to prevail.*

Proof. See the appendix C. ■

Although country M only has to consider the fiscal externality in the noncooperative Nash equilibrium, countries L and S must overcome the other problem as well. With a larger capital asymmetry ε, their production inefficiency due to their different capital tax rates becomes serious and hence, their incentives to form tax union $\{LS\}$ increases in order to internalize their pecuniary externality, which brings positive spillover effects to the outsider M through their revision

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for both fiscal and pecuniary externalities. However, for a sufficiently weaker fiscal externality $\theta < \varepsilon/\overline{k}_L$, a larger ε compels country L to pay a larger indirect income transfer simultaneously, which restricts the upper permissible asymmetry that country L accepts to form the coalition. On the contrary, for a strict fiscal externality $\theta > \varepsilon/\overline{k}_L$, their common problem (i.e., pecuniary externality) should be serious in comparison with fiscal externality, since a larger θ means that governments pursue their tax revenue rather than the utility of residents, which mitigates the disadvantage of capital-export country L in tax union $\{LS\}$. This requires the lowest asymmetry to form the coalition. Accordingly, country L's thresholds for tax union $\{LS\}$, i.e.,$\underline{\theta}^L$ and $\overline{\theta}^L$, increase in ε. Then strict fiscal externality makes the former interval of tax union $\{LS\}$ wider but the latter one narrower. However, there always exists an interval $\theta > \overline{\theta}^L$ that the equilibrium coalition structure is the partial tax union between countries L and S even if $\varepsilon \to \overline{k}$.

Although our results show that it is difficult for even three countries to form the grand coalition as a self-enforcing equilibrium in the case with a strict fiscal externality, the resulting partial coalition structure has a validity in a sense that it brings about a Pareto improving allocation compared to the noncooperative Nash equilibrium allocation; i.e., $\sum_{i=L,M,S} \left(V_i^{LS} - V_i^N \right) > 0$, as shown in Fig. 2-4. From the social point of view, partial tax coordination between dissimilar countries and hence partial elimination of production inefficiency owing to their larger tax differential overcomes tax competition to some extent.

4   Concluding Remarks

In this study, we have examined how capital tax coordination is formed by governments who are neither entirely benevolent nor wholly self-serving in an asymmetric three-country model. The existence of multiple externalities has important implications for tax coordination. Although tax coordination internalizes both fiscal and pecuniary externalities among member countries, it encourages members' incentives to deviate from the tax union. In most cases, the medium country is well-off when outside of the tax union since partial tax coordination consisting of the other countries internalizes not only the pecuniary externality among members but also the common fiscal externality partially, which benefits the outsider as well through the resultant higher equilibrium tax rate. We show that the more inclined governments' attitudes is toward

Leviathan (i.e., tax revenue maximizer), the easier it is for the partial tax union comprising dissimilar countries to be stable.

Undoubtedly, our results must be interpreted in light of the limitations of our approach. Most importantly, one may ask why heterogeneous countries would agree on a common maximization problem. To ascertain the robustness of our results, the same analysis must be conducted under a more general sharing rule, as in Burbidge et al. (1997). Furthermore, we introduce countries' asymmetry in a rather restrictive form. Allowing for a more generalized heterogeneity, as in Itaya et al. (2016), might bring about different characteristics in the equilibrium. Finally, an introduction of an arbitrary number of countries in this direction is another interesting agenda for future work.

Appendices

Appendix A

Maximizing W^G with the Nash bargaining rule yields the following coordination tax for the grand coalition:

$$
\tau^G = \frac{\left\{ \begin{array}{l} \theta\overline{k}\left[9\theta^2\overline{k}^2\left(3+2\theta\right)^2 - \varepsilon^2\left(1-\theta\right)^2\left(77+106\theta+36\theta^2\right)\right] + \\ \varepsilon(1-\theta)\sqrt{\begin{array}{l}\varepsilon^2\left(1-\theta\right)^2\left[3\varepsilon^2\left(1-\theta\right)^2\left(1+\theta\right)^2 - \theta^2\overline{k}^2\left(14+26\theta+11\theta^2\right)\right]\\ +3\theta^4\overline{k}^4\left(3+2\theta\right)^2\end{array}} \end{array} \right\}}{3\left(3+2\theta\right)^2\left[\theta\overline{k}+\varepsilon\left(1-\theta\right)\right]\left[\theta\overline{k}-\varepsilon\left(1-\theta\right)\right]},
$$

which exhibits monotonic increasing in θ for all $\overline{k}$ and ε. By inserting τ^G into (14)-(16) and evaluating at $\varepsilon = 0.5\overline{k}$, we obtain Figure 1.

Appendix B

From (11), (12), (13), and (21), we obtain participation constraints (i.e., gains from a tax union if it is positive) for the respective partial tax unions as follows:

$$V_L^{LM} - V_L^N = \frac{\Omega_1 - 2\varepsilon\theta\left(1-\theta\right)\left(3+2\theta\right)\left(5+3\theta\right)\left[7+2\theta\left(5+2\theta\right)\right]\overline{k}}{4\left(2+\theta\right)^2\left(3+2\theta\right)^2},$$

$$V_M^{LM} - V_M^N = \frac{\left(1+\theta\right)\left[\theta^2\left(13+8\theta\right)\overline{k}^2 - 3\varepsilon^2\left(1-\theta\right)^2\right] + 2\varepsilon\theta\left(1-\theta\right)^2\left(3+2\theta\right)\overline{k}}{4\left(2+\theta\right)^2},$$

$$V_M^{MS} - V_M^N = \frac{\left(1+\theta\right)\left[\theta^2\left(13+8\theta\right)\overline{k}^2 - 3\varepsilon^2\left(1-\theta\right)^2\right] - 2\varepsilon\theta\left(1-\theta\right)^2\left(3+2\theta\right)\overline{k}}{4\left(2+\theta\right)^2},$$

$$V_S^{MS} - V_S^N = \frac{\Omega_1 + 2\varepsilon\theta\left(1-\theta\right)\left(3+2\theta\right)\left(5+3\theta\right)\left[7+2\theta\left(5+2\theta\right)\right]\overline{k}}{4\left(2+\theta\right)^2\left(3+2\theta\right)^2} > 0,$$

$$V_L^{LS} - V_L^N = \frac{\Omega_2 - 4\varepsilon\theta\left(1-\theta\right)\left(2+\theta\right)\left(3+2\theta\right)\left[11+\theta\left(13+4\theta\right)\right]\overline{k}}{4\left(2+\theta\right)^2\left(3+2\theta\right)^2}, \tag{A.1}$$

$$V_S^{LS} - V_S^N = \frac{\Omega_2 + 4\varepsilon\theta\left(1-\theta\right)\left(2+\theta\right)\left(3+2\theta\right)\left[11+\theta\left(13+4\theta\right)\right]\overline{k}}{4\left(2+\theta\right)^2\left(3+2\theta\right)^2} > 0,$$

where $\Omega_1 \equiv (1+\theta)\left[\theta^2\left(3+2\theta\right)^2\left(13+8\theta\right)\overline{k}^2 + \varepsilon^2\left(1-\theta\right)^2\left(61+8\theta\left(14+\theta(9+2\theta)\right)\right)\right] > 0$ and $\Omega_2 \equiv (1+\theta)\left[\theta^2\left(3+2\theta\right)^2\left(13+8\theta\right)\overline{k}^2 + 4\varepsilon^2\left(1-\theta\right)^2\left(2+\theta\right)^2\right] > 0$. Substituting some values into $\varepsilon \in (0, \overline{k})$ for these equations and comparing yields Table 1-3 as follows:

$0 - \underline{\theta}^L$	$V_L^{LM} > V_L^{LS} \gtrless V_L^G$	$\varepsilon \backslash \theta^L$	$\underline{\theta}^L$	θ_1^L	θ_2^L	θ_3^L	$\overline{\theta}^L$
$\underline{\theta}^L - \theta_1^L$	$V_L^{LM} > V_L^G \gtrless V_L^N$	$0.1\overline{k}$	.0062	.0355	.0455	.1206	.1670
$\theta_1^L - \theta_2^L$	V_L^N	$0.3\overline{k}$	.0182	.1009	.1294	.2825	.3570
$\theta_2^L - \theta_3^L$	V_L^{MS}	$0.5\overline{k}$	.0299	.1592	.2033	.3906	.4707
$\theta_3^L - \overline{\theta}^L$	$V_L^{MS} > V_L^{LM}$	$0.7\overline{k}$	.0421	.2114	.2679	.4692	.5485
$\overline{\theta}^L - 1$	$V_L^{MS} > V_L^{LM} > V_L^{LS}$	$\overline{k}$	.0576	.2794	.3497	.5545	.6290

Table 1: Ranking of welfare levels for country L

			$\varepsilon \backslash \theta^M$	θ_1^M	θ_2^M	θ_3^M	$\overline{\theta}^G$	θ_4^M
$0 - \theta_1^M$	$V_M^G > V_M^{LS}$							
$\theta_1^M - \theta_2^M$	$V_M^{LS} > V_M^G$		$0.1\overline{k}$	.0024	.0297	.0299	.0326	.0667
$\theta_1^M - \theta_2^M$	$V_M^{LS} > V_M^G > V_M^{LM}$		$0.3\overline{k}$	.0072	.0856	.0862	.0933	.1641
$\theta_3^M - \overline{\theta}^G$	$V_M^{LS} > V_M^{LM} > V_M^G$		$0.5\overline{k}$	.0119	.1370	.1379	.1483	.2354
$\overline{\theta}^G - \theta_4^M$	$V_M^{LS} > V_M^{LM}$		$0.7\overline{k}$	.0166	.1841	.1852	.1980	.2918
$\theta_4^M - 1$	$V_M^{LS} > V_M^{LM} > V_M^{MS}$		$\overline{k}$	.0235	.2472	.2485	.2637	.3587

Table 2: Ranking of welfare levels for country M

			$\varepsilon \backslash \theta^S$	θ_1^S	θ_2^S	θ_3^S	θ_4^S	θ_5^S
$0 - \theta_1^S$	$V_S^{MS} > V_S^G > V_S^{LS}$							
$\theta_1^S - \theta_2^S$	$V_S^{MS} > V_S^{LS} > V_S^G$		$0.1\overline{k}$	.0039	.3259	.0415	.1063	.1048
$\theta_2^S - \theta_3^S$	$V_S^{MS} > V_S^{LS} > V_S^G > V_S^{LM}$		$0.3\overline{k}$	.0116	.0933	.1157	.2734	.2775
$\theta_3^S - \theta_4^S$	$V_S^{MS} > V_S^{LS} > V_S^{LM} > V_S^G$		$0.5\overline{k}$	.0192	.1483	.1800	.3939	.4048
$\theta_4^S - \theta_5^S$	$V_S^{MS} > V_S^{LM} > V_S^{LS} > V_S^G$		$0.7\overline{k}$	.0266	.1980	.2361	.4826	.4982
$\theta_5^S - 1$	$V_S^{LM} > V_S^{MS} \gtrless V_S^{LS} > V_S^G$		$\overline{k}$	.0374	.2637	.3076	.5777	.5966

Table 3: Ranking of welfare levels for country S

Note that there are exceptions about ranking of country S; i.e., $V_S^{LS} > V_S^{MS} > V_S^{LM} > V_S^G$ for $\theta_5^S - \theta_4^S$ and $V_S^{LM} > V_S^{LS} > V_S^{MS} > V_S^G$ for $\theta_4^S - 1$, since locus of $V_S^{LS} - V_S^N$ intersects that of $V_S^{MS} - V_S^N$ for a sufficiently small ε. Figure 2-4 illustrate the results for $\varepsilon = 0.5\overline{k}$. These results are summarized as Proposition 1.

Appendix C

From (A.1), it turns out to be positive; i.e., $V_L^{LS} > V_L^N$, if

$$\varepsilon \lessgtr \frac{\theta \left(3 + 2\theta\right)\overline{k} \left[11 + 13\theta + 4\theta^2 + 2\left(3 + 2\theta\right)\sqrt{3 + 3\theta + \theta^2}\right]}{2\left(1 + \theta\right)\left(1 - \theta\right)\left(2 + \theta\right)} \equiv \varepsilon^* \quad \text{for} \quad \theta \lessgtr \frac{\varepsilon}{k + \varepsilon}.$$

As long as $V_L^{LS} > V_L^N$, country L has an incentive to form tax union $\{LS\}$, while the participation constraint of country S always holds, i.e., $V_S^{LS} > V_S^N$, irrespective of the values of ε and θ.

Differentiating ε^* with respect to θ yields

$$\frac{d\varepsilon^*}{d\theta} = \frac{\left[\begin{array}{c} 108 + 450\theta + 783\theta^2 + 648\theta^3 + 205\theta^4 - 42\theta^5 - 44\theta^6 - 8\theta^7 + \\ \left(66 + 244\theta + 355\theta^2 + 206\theta^3 + 9\theta^4 - 32\theta^5 - 8S\theta^6\right)\sqrt{3 + 3\theta + \theta^2} \end{array}\right]\overline{k}}{2\left(1+\theta\right)^2\left(1-\theta\right)^2\left(2+\theta\right)^2\sqrt{3 + 3\theta + \theta^2}} > 0.$$

That is, for $\theta < \varepsilon/\overline{k}_L$ ($\theta > \varepsilon/\overline{k}_L$), the more intense the fiscal externality is, the greater the maximum (minimum) permissible asymmetry for country L, i.e., ε^*, which leads to Corollary 1.

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