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GLOBALIZATION, TAX COMPETITION AND FISCAL EQUALIZATION

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Globalization, tax competition and fiscal equalization

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Abstract

Recent empirical evidences suggest that the economic globalization has likely favored the emergence of harmful tax competition among major industrialized countries. This paper analyzes the ability of fiscal equalization to weaken the international tax competition when the economies are not perfectly integrated and the private sector is imperfectly competitive. We consider two types of transfer programs: tax base and tax revenue equalization. The framework developed yields results which agree with empirical evidences and exhibits two types of inefficiencies due to noncooperative behavior: the tax rates are too low in both regions and the difference in tax rates can be too high. Both externalities imply that the provision of public good is too low from an efficiency viewpoint. We show that fiscal equalization may imply more efficient tax policies and tax base allocation between regions, promoting a rise in corporate tax revenues.

Keywords: profit tax competition, economic integration, monopolistic competition, fiscal equalization.

JEL classification: F12, F15, H25, H87, R12

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1 Introduction

In this paper, we investigate the ability of fiscal equalization to mitigate the international tax competition when the economies are not perfectly integrated and the private sector is imperfectly competitive. We argue that inter-country transfers based on equalization can lead to more efficient tax policies and spatial allocation of tax base, promoting the rise in corporate tax revenue in each economy.

Policy-makers now seem to be concerned by the risk of wasteful tax competition among major industrialized countries, as suggested by the reports of the European Commission (1997) and of the OECD (2001). The potential sources of inefficiency arising from tax competition are well known since the seminal paper of Zodrow and Mieszkowski (1986). Because independent governments engage in a competition for a mobile tax base through reductions in tax rates, fiscal externalities emerge. Each government ignores the positive effect on other governments's budgets of its tax base outflows in response to higher taxes. For this reason, tax competition can imply too low corporate tax rates leading to an underprovision of public good from an efficiency viewpoint as well as to a weakening of the system of income redistribution.[1] The well documented description by Devereux, Griffith and Klemm (2002) of the development of taxes on corporate income over the last two decades gives a picture close to this scenario. Between 1982 to 2001 the statutory tax rates as well as effective average tax rates fell in most of the OECD countries. For example, the effective average tax rate for this group of nations fell from around 42% to around 33%. Even if it does not look like a real "race to the bottom", other stylized facts suggest a downward pressure on corporate income taxes. The mean of the ratio of corporate income tax revenues to total tax revenues has diminished during the last decade. In addition, Devereux, Lockwood and Redoano (2002) find evidence that OECD countries compete over the effective average tax rate.

Faced with this risk of harmful tax competition, a variety of reforms have been proposed to correct the negative effects of the international tax competition (harmonization tax, coordinated tax policy, a minimum corporate tax rate, ...). According to the traditional literature on tax competition, by raising their tax cooperatively, all jurisdictions would benefit from an increase in the level of public services. Sinn (1990) as well as Tanzi and Bovenberg (1990) among others stressed the importance to harmonize tax rates via collective agreements between the European governments. However, the efficiency of tax harmonization is

[1] See the surveys on this literature by Wilson (1999) as well as by Wilson and Wildasin (2003).

far from clear-cut. For instance, from a model of tax competition among asymmetric countries in population size with imperfect competition and trade costs, Baldwin and Krugman (2004) show that harmonization may not be desirable, a small country loosing some advantages from its low initial tax while the larger country with high tax would have to inefficiently reduce public service levels. In addition, with a similar model, Ottaviano and Van Ypersele (2004) show that there exists a differential tax rate, inferior to one obtained under tax competition, which maximizes the overall welfare. This suggests that the coordination in tax rates setting is needed. However, the authors do not provide mechanisms allowing to reach this outcome. Even though the coordination on differences in tax rates could be Pareto efficient, a coordinated tax policy is not necessarily a stable outcome. Countries may end up being trapped into a prisoner's dilemma. This can be illustrated by the proposition in 1992 of the EU-appointed Rudding committee to establish a minimum statutory corporation tax rate of 30%. In 1992, only Ireland had a lower tax rate than this threshold value. Ten years after, one third of member states have a rate below this level.

Recently, some theoretical works have shown that adequate fiscal equalization may reduce the tax competition and can lead to efficient tax rates (see Boadway, 2003, for a survey). Many countries have adopted equalization systems to correct different problems associated with the fiscal decentralization (Canada, Germany, Denmark among others as well a large number of developing countries). In its more standard form, an equalization scheme sets transfers to each local government equal to the difference between its per capita tax base and the average per capita tax base of all regions, multiplied by average tax rate. Smart (1998) shows that such an equalization system can induce inefficiently high tax rates when the tax base is elastically supplied and immobile. However, from traditional models of tax competition with a mobile tax base, Köthenbürger (2002) as well as Bucovetsky and Smart (2004) show that horizontal fiscal externalities can be corrected within such a system.[2] The negative effects of a higher tax rate on a region's tax base are compensated by higher equalizing transfers which reduce the marginal cost of public funds.

However, investigating the ability of fiscal equalization to mitigate the international tax competition requires to take into account some specificities characterizing major industrialized countries. Traditional models of tax competition does not seem to be adapted to describe two

[2]Evidence that equalization weakens tax competition between local governments are provided by Hayashi and Boadway (2001) and Esteller-Moré and Solé-Ollé (2002) whose studies are based on provincial governments in Canada.

main characteristics. The first characteristic is that the OECD as well as the EU are an imperfectly integrated economic spaces. Even though regional trade agreements have produced significant effects, Member States are not perfectly integrated. For instance, Head and Mayer (2000) estimate positive border effects in Europe which could be considered as positive transaction costs between European countries. The basic tax competition models do not allow to focus on this feature since they ignore trade costs (Zodrow, 2003). In addition, many evidences suggest that economic activities are not evenly distributed among developed countries (see the excellent survey of Combes and Overman, 2004, for the European space). If this reveals unequal natural advantages between countries, it also indicates that some agglomeration externalities due to increasing returns are at work when firms locate. By assuming that firms face perfect competition and constant returns, a traditional tax competition model does not allow to address this point and how it may affect tax competition.

The purpose of this paper is to analyze the ability of fiscal equalization to mitigate the international fiscal externality when the economies are not perfectly integrated and the private sector is imperfectly competitive. Recently, tax competition has been revisited with economic geography frameworks assuming monopolistic competition and trade costs. Kind, Midelfart-Knarvik and Schjelderup (2000), Baldwin and Krugman (2004) and Andersson and Forslid (2003) suggest that the existence of both increasing returns and trade integration favor the clustering of firms so that the country where agglomeration takes place may set relatively high tax without inducing relocation. Haufler and Wooton (1999) and Ludema and Wooton (2000) obtained similar results with two imperfectly integrated countries competing respectively for a monopolist and oligopolist firms. Finally, Ottaviano and Van Ypersele (2003) show that tax competition for mobile firms may be efficiency-enhancing with respect to the free market outcome. Nevertheless, these contributions do not consider explicit redistributive mechanisms and the potential distortions that it may induce on tax policies.

In section 2, we develop a model with two asymmetric countries, immobile labor and mobile monopolistically competitive firms. Governments tax positive profits in order to maximize the size of its public sector. For simplicity, we assume that governments are Leviathans. The case where governments are benevolent yields similar results (see Appendix B). We consider two types of transfer programs: tax base and tax revenue equalization. Both are representative of the equalization schemes used in many federations and often considered in the existing literature. Finally, we consider that each government chooses simulta-

neously the tax rate on profits taking as given the tax rate prevailing in the other country and anticipating the equilibrium location of mobile firms.

We show in section 3 that the impact of tax rates on spatial equilibrium varies according to the degree of economic integration. More precisely, the ability of tax policy to modify the location choice of firms declines when the mobility of commodities is favored. This result agrees with recent empirical findings by Bénassy-Quéré et al. (2004) on twelve OECD countries (ten countries belonging to European Union as well as Japan and United States). Indeed, the authors show that the impact of difference in tax rates between the host country and investor country on the location of foreign direct investment is significant but decreasing in recent years.

As shown in the section 4, our framework exhibits two types of inefficiency related to fiscal decentralization: the tax rates are too low in each country and the difference in tax rates can be too high.[3] The source of the first externality is well known. Each government ignores the positive effect on other governments's budgets of its tax base outflows in response to higher tax rate. The second one is specific to our framework. Countries competing for mobile tax base do not account for the level of aggregate gross profits, and, therefore, the tax revenues. This fiscal externality arises from the relationship between the spatial difference in tax rates, the degree of agglomeration of mobile firms and the level of total gross profits. Under fiscal decentralization, the tax gap is too high because it implies a suboptimal level of agglomeration. More precisely, tax competition reduces the degree of agglomeration while more spatial concentration is required to increase aggregate profits and, therefore, supply of public good. Hence, an unified tax policy can coordinate fiscal decisions in order to promote an optimal tax gap which maximizes the aggregate tax revenues.

In section 5, we show that two systems of fiscal equalization allow for reaching higher tax rates in each country, especially the scheme based on tax base. From a traditional model of tax competition, Köthenbürger (2002) obtained a similar result, even though mechanisms at work are different. In other words, *whatever the nature of competition and the degree of economic integration, fiscal equalization may increase efficiently the tax rates*. However, we have identified a second source of inefficiency arising from the difference in tax rates. We show that two systems of fiscal equalization are able to reduce the difference in tax rate, provided

[3] In our framework, there are two other sources of inefficiency: firms set a price above marginal costs and firms does not take into account the impact of location choice on consumers surplus and on profits of other firms.

that the governments can (or are aware that they can) manipulate the average tax rate. Hence, *fiscal equalization may implement more efficient tax rates and spatial allocation of tax base*, promoting a rise in the profit tax revenue.

The last section concludes.

2 Model

We consider an economy made of two asymmetric countries, labelled $r = 1, 2$. We assume that the population living in country 1 (L_1) is larger so that $L_1 = kL_2$ with $k > 1$ and where $L_2 \equiv L$ is the number of residents in country 2. Governments provide the same public good and participate in an inter-country transfer system. The private sector consists of a modern industry (M) and a traditional one (T). The M-sector produces a continuum of varieties of a horizontally differentiated product under increasing returns, using workers as the only input. The T-sector produces a homogenous good (the numéraire) under constant returns, using also workers as the only input. Firms of the M-sector are perfectly mobile between countries. Workers are not mobile between countries but are mobile between private sectors.

2.1 Consumption

Preferences are identical across workers and are given by:

$$U_r = u(.) + \theta(g_r)$$

where g_r is the level of the local public good. The function $\theta(g_r)$ measures the immobile workers preferences for the local public good and is increasing. Finally, $u(.)$ stands for the preferences for the private differentiated good. Following Ottaviano et al. (2002), $u(.)$ is captured by a quasi-linear quadratic utility function given by:

$$u(.) = \rho \int_0^N q\,(i)\,di - \frac{\beta - \delta}{2} \int_0^N [q\,(i)]^2\,di - \frac{\delta}{2}\left[\int_0^N q\,(i)\,di\right]^2 + q_O \quad (1)$$

where $\rho > 0$ and $\beta > \delta > 0$. In this expression, ρ measures the intensity of preferences for the differentiated product with respect to the numéraire. The condition $\beta > \delta$ implies that workers have a preference for variety. Finally, $q\,(i)$ is the quantity of variety $i \in [0, N]$ and q_O the quantity of the numéraire. Each worker and entrepreneur is endowed with $\overline{q}_O > 0$ units of the numéraire. The initial endowment is supposed to be large enough for her/his consumption of the numéraire to be strictly positive at the market outcome. Her/his budget constraint

can then be written as follows:

$$\int_0^N p(i)\, q(i)\, di + q_O = \overline{q}_O + y \tag{2}$$

where y is the workers's income and $p(i)$ is the consumer price of variety i. Given the assumption of symmetry between varieties, solving the consumption problem yields the demand functions for a representative variety located in r from country r (q_{rr}) and country s with $s \neq r$ (q_{rs}):

$$q_{rr} = a - (b + cN)\, p_{rr} + cP_r \quad q_{rs} = a - (b + cN)\, p_{rs} + cP_s \tag{3}$$

where

$$a \equiv \rho / \left[\beta + (N-1)\,\delta\right],\ b \equiv 1 / \left[\beta + (N-1)\,\delta\right],\ c \equiv \delta / (\beta - \delta)\left[\beta + (N-1)\,\delta\right]$$

and p_{rr} (resp., p_{rs}) is the price of a variety produced in country r to consumers of country r (resp., s). Finally,

$$P_r = N_r p_{rr} + N_s p_{sr} \quad P_s = N_r p_{rs} + N_s p_{ss} \tag{4}$$

are respectively the price indices (i.e., N times the average price) of varieties in country r and in country s with N_r and N_s the number of varieties/firms located in r and s.

2.2 Public sector

Each government chooses the unit tax on profit, t_r. We assume that governments are Leviathan, in order to simplify the analysis. We show in Appendix B that results are similar under benevolent governments.

Formally, the objective of each public authority is given by

$$\underset{t_r}{\text{Max}}\ t_r N_r + G_r \equiv g_r$$

where G_r^i measures the equalization grants. We study two different forms of transfer. Both equalization grants are budget-balancing. One country will be a recipient and the other one a contributor. The first scheme is guided by the principle of per capita tax revenue equalisation (*case A*). More precisely, a government enjoys positive transfer when its per-capita tax revenue is inferior to the average per-capita tax revenue. At the opposite, when the country's tax revenue is higher than the average tax revenue, the government incurs negative transfers. We also consider a transfer based on tax bases (*case B*). Tax base equalization is conditionned on the difference in the country's tax base relative to that of representative tax system. The representative tax base corresponds to

the sum of countries' tax base divided by the sum of countries' population and the representative tax rate is the average tax rate of the economy. Finally, in both cases, we consider a partial equalization. Only a fraction $0 < \alpha < 1$ of differences in local tax bases or revenues are equalized. Formally, we have:

$$G_r = \alpha G_r^i$$

with $i = A, B$ (labelling the two systems) and

$$G_r^A \equiv L_r \left(\frac{t_r \lambda_r N + t_s \lambda_s N}{L_r + L_s} - \frac{t_r \lambda_r N}{L_r} \right) \tag{5}$$

$$G_r^B \equiv L_r \bar{t} \left(\frac{N}{L_r + L_s} - \frac{\lambda_r N}{L_r} \right) \tag{6}$$

where $\bar{t}$ the average tax rate in the economy is given by

$$\bar{t} \equiv t_r \lambda_r + t_s \lambda_s$$

with λ_r is the share of firms located in country r and $\lambda_r + \lambda_s = 1$.

2.3 Private sector

The traditional sector produces a homogeneous good under perfect competition and constant returns to scale. One unit of output requires one unit of labor. The T-good is costlessly traded between countries so that its price is the same everywhere. This makes that good the natural choice for the numéraire, which implies that price of the T-good and, the equilibrium wage of immobile workers are equal to one everywhere. Therefore, the T-sector is not taxed since profits are zero.

The modern sector supplies varieties under increasing returns to scale and monopolistic competition. The production of any variety requires a fixed amount ϕ of labor L. There exists a one-to-one correspondence between firms and varieties. Firms of M-sector compete within a large group of firms. The total mass of firms in this sector is fixed and is equal to N.[4] We consider a market structure with monopolistic competition in which entry is restricted instead of being free. Thus, firms have a market power and will earn positive profits which will be taxed by governments.

Varieties of M-good are traded at a cost of τ units of the numéraire per unit shipped between the two countries. In addition, we assume that markets are internationally segmented so that each firm chooses a delivered price which is specific to the country in which its variety is sold.

[4] Picard et al. (2004) have the same assumption in a spatial version of Dixit-Stiglitz model.

As firms bear trade costs, profits of a representative firm in country r are as follows:

$$\pi_r = p_{rr} q_{rr} L_r + (p_{rs} - \tau) q_{rs} L_s - \phi - t_r \quad \text{with } r \neq s \tag{7}$$

where L_r (resp., L_s) is the number of workers located in country r (resp., s) and t_r the unit tax rate in country r. Note that because labor is mobile between sectors, the wage rate is fixed to 1 in the M-sector. Nevertheless, this will be verified only if the sector T is always active in both countries. Then, we have to ensure that a single location alone cannot supply the world demand in the homogeneous good. The condition is $1 < 2q_O$.[5].

When producers maximize profits, they take the price indices as given. Nevertheless, the market as a whole has a non negligible impact on each firm's choice in that each firm must account for the distribution of all firms' prices through an aggregate statistics (the price index) in order to find its equilibrium price. Thus, the market solution is given by a Nash equilibrium with a continuum of players in which prices are interdependent. The profit-maximizing prices are the same obtained by Ottaviano et al. (2002) and are given by

$$p_{rr} = \frac{1}{2} \frac{2a + \tau c(N - N_r)}{cN + 2b} \quad p_{rs} = p_{ss} + \frac{\tau}{2} \tag{8}$$

Freight absorption by firms located for instance in r is a decreasing function of their relative number. The reason is that as N_r falls, the market in country s becomes more crowded pushing down local prices. As a result, the elasticity of demand for firms located in r rises on foreign sales while falling on domestic ones. The result is that they find convenient to reduce their operating margins on foreign sales while increasing them on domestic sales (Brander and Krugman, 1983).

By inspection, it is readily verified that p_{rr} is increasing in τ because the local firms are more protected against foreign competition. By contrast, $p_{rs} - \tau$ is decreasing because it is now more difficult for firms to sell on the foreign market. As firms' prices net of trade costs are to be positive for any distribution of workers, we assume throughout this paper that

$$\tau < \tau_{trade} \equiv \frac{2a}{2b + cN}. \tag{9}$$

This condition also guarantees that it is always profitable for a firm to export to the other country.

[5] An other condition indicates that full agglomeration of the modern sector in one region is not sufficient to promote equilibrium in the labor market of this region, that is $L > 2\phi N$ where ϕN is the number of workers employed in the modern sector when a core-periphery configuration emerges.

2.4 Sequence of events

There are two types of actors in our model: firms and governments. In the first stage, each local government chooses simultaneously the unit tax on profits (t_r) taking as given the tax decision of the other local government, and anticipating the private sector outcomes and the resulting location equilibrium. In stage 2, given the tax policies announced by the two governments, firms choose their place of production. All players have perfect information and the game is solved by a sub-game perfect equilibrium involving backward induction beginning with the last stage.

3 Location equilibrium

We first study the spatial distribution of firms for given local taxes. The location of firms is governed by the spatial differences in net profits,

$$\pi_r = \Pi_r - \phi - t_r \tag{10}$$

where Π_r is the equilibrium gross profits earned by a firm established in r on the market of the country r and s with

$$\Pi_r \equiv (b + cN) (p_{rr})^2 L_r + (b + cN) (p_{rs} - \tau)^2 L_s$$

where we have introduced (3) and (4) in (7). Note that, given the trade costs, firms have an incentive to locate in the country where population is numerous (the so-called *home market effect*) in order to exploit increasing returns at a larger scale. However, an increasing agglomeration of firms in country r implies that equilibrium prices of all varieties sold in this country decrease (the *competition effect*). More generally, we have $d\Pi_r/dN_r < 0$.

The spatial differential of profits is then defined by

$$\Delta\pi(\lambda, t_1, t_2) \equiv (\Pi_1(\lambda) - t_1) - (\Pi_2(\lambda) - t_2) \tag{11}$$

where λ is now the share or firms located in country 1. As a result, each firm has an incentive to agglomerate in country 1 where workers are more numerous. In contrast, firms also have an incentive to disperse in order to avoid the price competition. Further, firms are prompted to set up in the country with the lowest tax. A spatial equilibrium is such that, in each country, no firm has an incentive to change its location, conditional upon the fact that the product markets clear at the equilibrium prices and the labor markets at the equilibrium wages. Formally, a *spatial equilibrium* arises at $\lambda \in (0, 1)$ when $\Delta\pi(\lambda, t_1, t_2) = 0$, or at $\lambda = 0$ if $\Delta\pi(0, t_1, t_2) \leq 0$, or at $\lambda = 1$ if $\Delta\pi(1, t_1, t_2) \geq 0$. Such an equilibrium always exists because π is a continuous function of λ. An

interior equilibrium ($\lambda \in (0,1)$) is stable if and only if the slope of the profits differential (11) is negative in a neighborhood of the equilibrium, whereas the two agglomerated equilibria ($\lambda = 0, 1$) are always stable whenever they exist.

The profit differential between the two countries $\Delta\pi\left(\lambda, t_1, t_2\right)$ is then defined by

$$\Delta\pi(\lambda, t_1, t_2) = \frac{\lambda - \lambda^*(t_1, t_2)}{-\Psi(\tau)}$$

where

$$\lambda^*(t_1, t_2) \equiv \Gamma(\tau) - \Psi(\tau)(t_1 - t_2)$$

and

$$\Gamma(\tau) \equiv \frac{[(cN(k+1) - 2b(k-1)]\tau + 4a(k-1)}{2cN(k+1)\tau} > 0$$

$$\Psi(\tau) \equiv \frac{2(cN + 2b)}{cN\tau^2 L(k+1)(b + cN)} > 0$$

Clearly, $\lambda = \lambda^*(t_1, t_2)$ is an equilibrium which is always stable. The impact of tax rates on spatial equilibrium varies according to the degree of regional integration. To analyze this, we determine how the tax base elasticity to taxation ($-\varepsilon_r$) reacts to a change in trade costs where

$$\varepsilon_r \equiv -\frac{d\lambda_r}{dt_r}\frac{t_r}{\lambda_r} > 0 \quad r = 1, 2 \tag{12}$$

It is straightforward to show that $d(-\varepsilon_r)/d\tau > 0$ with $r = 1, 2$. The sensitivity to tax rate variations decreases when regional integration is favored. *The ability of a tax policy to modify the spatial allocation of firms declines when the mobility of commodities is favored.* To attract the same amount of the tax base, the fall in the tax rate in a country must be higher when trade costs achieve low values. Indeed, in this case, the intensity of centripetal and centrifugal forces arising respectively from the home market and the price competition effects increases when trade barriers fall. Even though the former force dominates the latter one, the price competition on product markets is fiercer. Hence, the location choice is more sensitive to market mechanisms than to spatial differences in tax rates when trade barriers decrease. This result is consistent with empirical findings for twelve OECD countries (ten countries belonging to European Union as well as Japan and United States). Indeed, Bénassy-Quéré et al. (2004) have shown that the impact of difference in tax rates between the host and investor countries on the location of foreign direct investment is significant but decreasing in recent years which have been particularly important in terms of trade integration. This result highlights the declining role of the tax policy to attract mobile tax base when trade barriers decreases.

4 Tax policies without redistribution

The purpose of this paper is to determine if interregional transfers may constitute a mechanism correcting the fiscal externalities. In this section, we identify the sources of inefficiency arising from tax competition. Therefore, we need some benchmark cases. The first one investigates the tax policy of governments behaving non-cooperatively without redistributive mechanisms ($\alpha = 0$). Through the second one, we investigate what would be the policy of an unified government. By comparing the tax policies derived from these two cases, we evaluate the fiscal externalities.

4.1 Nash equilibrium

The authority of country r set non cooperatively a unit tax t_r on firms located in this country to maximize its tax revenue

$$t_r \lambda_r^*(t_r, t_s) N \equiv \Phi_r$$

taking as given the unit tax t_s chosen by country s. Clearly, countries face a trade-off. Raising the tax marginally implies a positive direct effect on the public funds but also a negative one by an outflow of capital expanding the tax base of the other country. The first order conditions for this problem gives $\varepsilon_r = 1$ since we have $d\Phi_r/dt_r = \lambda_r N (1 - \varepsilon_r)$. Hence, the best reply function for each country is given by:

$$t_1 = \frac{t_2}{2} + \frac{\Gamma(\tau)}{2\Psi(\tau)} \quad t_2 = \frac{t_1}{2} + \frac{1 - \Gamma(\tau)}{2\Psi(\tau)}$$

so that the expressions of Nash taxes are as follows

$$t_1^N = \frac{1 + \Gamma(\tau)}{3\Psi(\tau)} > 0 \quad t_2^N = \frac{2 - \Gamma(\tau)}{3\Psi(\tau)} \tag{13}$$

Evaluating the tax gap, we get

$$\Delta^N \equiv t_1^N - t_2^N = \frac{2\Gamma(\tau) - 1}{3\Psi(\tau)} > 0 \tag{14}$$

whereas the location of the tax base is as follows

$$\lambda^N(\Delta^N) = \frac{\Gamma(\tau) + 1}{3}$$

Before studying the impact of regional integration on the tax setting, we analyze the impact of trade costs on the location of tax base. It is straightforward to check that $\lambda^N(\Delta^N) = 1$ when $\Gamma(\tau) \geq \overline{\Gamma}(\tau) \equiv 2$.

Stated differently, full agglomeration occurs in the large country when $\tau < \overline{\tau}$ where

$$\overline{\tau} \equiv \frac{4a}{2b + 3cN\frac{k+1}{k-1}}$$

When trade costs are high enough ($\tau > \overline{\tau}$ or $\Gamma(\tau) \leq 2$), the mobile tax bases are located in both countries and the Nash tax rates are positive. In addition, we have $d\lambda^N(\Delta^N)/d\tau < 0$. The fall in trade costs favors the agglomeration of mobile activities. To ensure that dispersion of tax base is an outcome, we must have $\overline{\tau} < \tau_{trade}$. This is checked when

$$N > \overline{N} \equiv \frac{2b(k-1)}{c(k+5)}$$

which is assumed to be satisfied in the rest of the paper. This means that the mass of firms relatively to the asymmetry in population size is assumed to be high enough. Consequently, the centrifugal force arising from price competition is sufficiently strong and the centripetal force due to home market effect is weak enough to avoid full agglomeration.

To summarize,

Proposition 1 *Assume that the mass of firms in the economy is large enough ($N > \overline{N}$). When trade costs are high enough, the production of mobile activities takes place in both countries and Nash tax rates are positive. When trade costs become low, the full agglomeration of tax base occurs.*

Further, from (14), it appears that asymmetric tax competition leads to higher taxation in the larger country. This asymmetric tax equilibrium comes from the home market effect which makes the tax base less sensitive to a same rise in taxation in the large country than in the small one. Hence, because of increasing returns, the large country will compete less vigorously for firms through tax cuts[6]. A similar result is obtained by Ottaviano and Van Ypersele (2004) from an economic geography model but where tax competition is on the capital returns. Note also that Bucovetsky (1991) and Wilson (1991) derive the same result from a tax competition model with perfect competition (see Ottaviano and Van Ypersele, 2004, for a discussion).

It also follows from (13) and (14) that the tax policy in each country and the gap between them depend on trade costs values. More accurately,

[6]Observe also that this tax gap increases with the asymmetry since we have $d\Delta/dk > 0$ when $\tau < \tau_{trade}$.

Proposition 2 *Regional integration favors tax competition and the convergence in taxes between countries.*

Each government has an incentive to reduce its tax burden on firms when trade costs decline since we have $dt_r^N/d\tau > 0$ for all $\Gamma(\tau) \leq \overline{\Gamma}(\tau)$. Because the sensitivity to tax rate deviations decreases when regional integration is favored (see the previous section), the fall in tax rate in a country to attract the same amount of tax base must be higher when trade costs achieve low values. As a result, the tax equilibrium diminishes when trade costs decline.

However, due to the asymmetry in population size, the race to the bottom in taxation will be different among countries when the degree of regional integration rises. The strength of the incentive to lower the local tax burden is differently perceived in the small and the large country. To illustrate this consider the configuration where the trade costs are equal to τ_{trade}. In this case, the uneven distribution of tax base is low since $\lambda^*(t_1^N, t_2^N)$ achieves its minimum value. However, the mobile activities are mainly located in the large country. Assume now a small decline in trade costs. We have $d^2t_1^N/d\tau^2 > d^2t_2^N/d\tau^2 > 0$ when $\tau = \tau_{trade}$. In other words, the incentives to diminish the tax rate is stronger in larger country. Indeed, when trade barriers fall, the degree of agglomeration increases even if the tax rates keep constant. Because of the loss in tax base, the government of the small country is less prompted to decrease its tax rate in order to maintain a size of its public sector which is high enough**.** This result can be generalized for all admissible values of trade costs because we have $d\Delta^N/d\tau > 0$ when $\tau < \tau_{trade}$.

In addition, the increasing mobility of goods among countries decreases the provision of public goods in the small one since its tax rate and the tax base located there fall. In the large country, the rise in its tax base partly compensates the fall in its tax rate. Indeed, some calculations show that the supply of public good also declines in the larger country when trade costs decrease, provided that $N > \overline{N}$. In other words, *the regional integration and the profit tax competition lead to a decline in the profit tax revenue in each country.*

These results are consistent with some empirical evidences observed in European Union. Devereux et al. (2002) have shown that the statutory tax rates and effective average tax rates for projects earning positive profits have fallen over the 1980s and 1990s. In addition, they highlight that tax revenues on corporate income have declined as a proportion of total tax revenue since 1965. The mechanisms at work in our model may explain these tendencies.

Finally, trivial calculations show that

$$\lambda^N/L_1 > (1-\lambda^N)/L_2 \tag{15}$$

when trade costs take admissible values. This result contrasts with what is usually derived from asymmetric tax competition models (see Wilson, 1999). In these models, the small country always benefits from the highest tax base/immobile workers ratio because of its lower taxation. Our framework suggests an opposite result.[7]

4.2 Unified tax policy

To identify the fiscal externality, we now consider an unified government whose the objective is to maximize the overall size of public sector, Φ_T where

$$\Phi_T \equiv t_1\lambda N + t_2(1-\lambda)N$$

With this objective function, the unified tax policy has the purpose to be efficiency-enhancing and internalize the fiscal externality. Two sources of inefficiency arising from fiscal decentralization can be isolated.

On the one hand, the level of the Nash taxes prevailing in each country can be inefficient. To identify this, we introduce the values of each Nash tax resulting from fiscal decentralization in $d\Phi_T/dt_r$. It is easy to check that the resulting derivative is always positive for each country. Indeed, we have

$$\left.\frac{d\Phi_T}{dt_1}\right|_{t_1=t_1^N,t_2=t_2^N} = \frac{2-\Gamma(\tau)}{3}N > 0 \quad \left.\frac{d\Phi_T}{dt_2}\right|_{t_1=t_1^N,t_2=t_2^N} = \frac{1+\Gamma(\tau)}{3}N > 0$$

Hence, because countries behave non-cooperatively and compete for the mobile tax base, Nash taxes are sub-optimally low. Therefore, this race to the bottom favors underprovision of public good in the economy. The basic tax competition models have largely investigated this point (see. for instance, Zodrow and Mierzkowski, 1986, Wildasin, 1988). The optimal tax policy of the unified government can be easily derived. The best strategy for an unified government is to tax all the positive profits in both countries.[8] Hence, we have $t_1^u = \pi_1(\lambda^*(\Delta^u))$ and $t_2^u = \pi_2(\lambda^*(\Delta^u))$ where $\Delta^u \equiv t_1^u - t_2^u$.

On the other hand, the unified government must take into account the spatial distribution of the tax base since the total amount of profits

[7] This result confirms the importance of being large when private sector is characterised by increasing returns and trade costs, as suggested by Ottaviano and Van Ypersele (2003).

[8] The result is identical when the local governments are benevolent. Indeed, since only firms incur the local tax and that only workers enjoy the local public good, a benevolent unified government taxes all the positive profits.

varies according to the interregional distribution of firms (see Appendix A). Countries competing for mobile tax base do not account for the level of aggregate profits. This is the second source of inefficiency. As location is governed by the difference in taxes between countries, the unified government has to internalize it. It follows that there exists an "optimal" gap between both tax rates which maximizes the total tax revenues. Formally, the objective of an unified authority is to set Δ^u in order to maximize $t_1^u \lambda^*(\Delta^u)N + t_2^u(1-\lambda^*(\Delta^u))N$. The first order condition gives the following result:

$$\Delta^u = \frac{\Gamma(\tau)}{8\Psi(\tau)} > 0 \quad \text{with } \frac{d\Delta^u}{d\tau} > 0$$

A simple analysis shows that $\Delta^N > \Delta^u$ when $\Gamma(\tau) > 8/13$ or, equivalently, when

$$\tau < \tau^\Delta \equiv \frac{4a}{2b + \frac{k+1}{13(k-1)} 3cN} > \overline{\tau}$$

Some calculations show that $\tau^\Delta > \tau_{trade}$ when $N > N^\Delta$ where[9]

$$N^\Delta \equiv \frac{26b(k-1)}{c(29-23k)}$$

Consequently, when the asymmetry in population is sufficiently important (for all $k > 29/23$), fiscal decentralization implies that the gap between tax rates is too high.[10] Even if regional integration favors the convergence in taxes, this convergence may not be strong enough to promote the optimal tax gap associated with the unified tax policy. By reducing the difference in tax rates, a unified government favors the agglomeration of the tax base in the large country and the value of the aggregate profits. Indeed, the level of profits, and so the level of tax bases, depends on the degree of spatial concentration. Some tedious calculations show that the level of agglomeration which maximizes the net-of-tax aggregate profit ($\pi_1\lambda + \pi_2(1-\lambda)$) is higher than the one resulting from the free market equilibrium (see Appendix A). Consequently, a coordinated policy works against the dispersion of mobile tax base.

To summarize,

Proposition 3 *Given our assumptions, fiscal decentralization gives rise to inefficient low levels of taxes whatever the degree of economic integration and to inefficient high difference in taxes, provided that the trade costs are not too high.*

[9] Note that $N^\Delta \geq \overline{N}$ when $k < 29/23$. Otherwise, $N^\Delta < \overline{N}$.

[10] When countries have a similar size ($k < 29/23$), the difference in taxes is relatively too high (resp., low) when trade barriers are low (resp., high) enough. In the rest of the paper, we only consider the case where $k > 29/23$.

In Appendix B, we show that this result keeps hold when governments are benevolent. Our results also underline that tax competition is fiercer when public authorities maximize the welfare of its residents.

The corollary of the coordinated fiscal policy is that correcting fiscal externality increases the share of mobile activities in the larger country. Indeed, we have $\lambda^u(\Delta^u) = 7\Gamma(\tau)/8 > \lambda^N(\Delta^N)$. This suggests that tax competition reduces the degree of agglomeration while more spatial concentration is required to increase the total supply of public good. Consequently, tax decentralization may have ambiguous and opposite effects on the regional supplies of public good. On the one hand, this favors a decrease in taxation in both countries. On the other hand, tax decentralization may reduce the uneven distribution of the mobile tax base. Unambiguously, both effects will produce a suboptimal supply of public good in the larger country under fiscal decentralization. In contrast, fiscal decentralization may raise the provision of local public good in the small country. For that, trivial calculations show that we must check the following inequality: $t_2^u < [8(2-\Gamma(\tau))^2]/[9\Psi(\tau)^2(8-7\Gamma(\tau))]$. Therefore, as in Bucovetsky (1991) and Wilson (1991), we find that although tax competition is inefficient, it may benefit some countries. Indeed, the smaller country may be better off at the inefficient Nash equilibrium since the provision of public good may increase in this country when the taxing power is decentralized. Finally, observe that contrary to the small country, workers living in the large country are always better off with the unified tax policy because they can enjoy higher levels of public good and surplus.

5 Tax policies under different rules of equalization

We now focus on the fiscal equalization ability to mitigate externalities emerging from both the gap and level of taxes. We first determine whether this fiscal equalization leads to higher tax rates. In a second sub-section, we turn on the other fiscal externality arising from the inefficient tax gap.

5.1 Does fiscal equalization increase tax rates?

In what follows, we evaluate if the equalization schemes based on tax revenue and tax base are able to increase tax rates in each country. Remember that, under the first system (tax revenue equalization), horizontal transfers are conditioned on the difference between per-capita tax revenue of the respective country and the average per-capita tax revenue. The second system -tax base equalization- corrects the difference between the per-capita tax base of a country and the average per-capita tax base in the economy as a whole.

1. *Tax revenue equalization.* We first assume a scheme conditioned on the difference between average and regional per-capita tax revenues. Subsequently, the objective of each government is given by:

$$\underset{t_r}{\text{Max}} g_r^A = \Phi_r + \alpha L_r \left(\frac{\Phi_T}{L_r + L_s} - \frac{\Phi_r}{L_r} \right) \tag{16}$$

This transfer scheme influences the choice of tax since following a tax rise it affects the revenues collected by governments. Since the redistributive policy is always budget-balancing, a perceived decline (increase) in transfer in one country always corresponds to higher (lower) transfers allocated to the other one.

Before giving more details on this point we must identify how the transfer part of the public fund (G_r^A) behaves in response to a change in t_r. To clarify the analysis, it is useful to distinguish the *direct* and *strategic effects* of a tax change on the transfer volume. Differentiation of G_r^A yields

$$\frac{dG_r^A}{dt_r} = \underbrace{\frac{L_r}{L_r + L_s} \frac{d\Phi_T}{dt_r}}_{\text{strategic effect}} - \underbrace{\frac{d\Phi_r}{dt_r}}_{\text{direct effect}} \tag{17}$$

Focusing on the *direct effect*, we consider the representative per-capita tax revenue as a parameter (first term in (17)). Thus in (17) the *direct effect* is given by the second term. The term $d\Phi_r/dt_r$ defines the marginal change of tax revenues following a rise in tax in country r. Depending on the sign of the tax revenue effect, the transfer system partially or fully reacts to the divergence between average and regional tax revenues by giving increasing or decreasing transfer to the country. Nevertheless, observe that the Nash tax equilibrium derived from the non redistributive system is also the tax equilibrium in the tax-revenue equalization scheme with no strategic effects. Indeed, taking the representative per-capita tax revenue as a parameter, we have:

$$\frac{\partial g_r^A}{\partial t_r} = (1 - \alpha) \frac{d\Phi_r}{dt_r} \tag{18}$$

This means that the transfer system, through the *direct effect* alone, has no specific impact on the incentives to tax compared with a fully decentralized tax system. Such configuration may occur if each country perceives the representative per-capita tax revenue to be unresponsive to its tax policy.

Turning now to the *strategic effect*. Its expression is given by

$$\frac{L_r}{L_r + L_s} \frac{d\Phi_T}{dt_r} = \frac{L_r N}{L_r + L_s} \lambda_r \left(1 - \varepsilon_r + \varepsilon_r \frac{t_s}{t_r} \right) \tag{19}$$

This captures the effect of a change in country r's tax revenues on the average level of tax revenues. The strategic effect is positive for each government when Nash taxes (or equivalently when $\varepsilon_r = 1$) are introduced in (19). Because of this strategic effect, each government internalizes the impact of its tax rate on the per-capita tax revenue of the other country (via the term $\varepsilon_r t_s/t_r$ in (19)). In other words, the strategic effect enables each public authority to internalize the negative fiscal externality leading to a rise in tax rates.

Combining the *strategic* and *direct effects*, the overall response of regional public funds to a tax change becomes

$$\frac{dg_r^A}{dt_r} = \frac{L_r + (1-\alpha)L_s}{L_r + L_s}\lambda_r N\left(1-\varepsilon_r\right) + \frac{\alpha L_r}{L_r + L_s}\lambda_r N\varepsilon_r \frac{t_s}{t_r} \qquad (20)$$

From this total effect, it is straightforward to show that this equalization scheme allows for raising tax rates. By introducing the Nash taxes in (20), it appears that the first term is null while the second one is positive. Hence, public authorities have an incentive to increase their taxes when a tax-revenue equalization scheme is introduced. Therefore, such scheme enables government to internalize the fiscal externality. The intuition for this result is straightforward. Because the equalization degree is imperfect, all positive deviation from (13) which maximizes local tax revenues, implies a loss of resources for countries. Nevertheless, this loss is more than compensated by the positive variation of the representative per-capita tax-revenue induced by such deviation. By lowering the marginal cost of public funds, this sustains a positive incentive to increase taxation which comes to an end at the new Nash tax equilibrium. Thus, whatever their role -recipient or contributor- in the equalization system, both countries have incentives to decide higher taxes than in the absence of transfer. The contributor has an incentive to rise the average per-capita tax revenue in order to reduce its contribution while the recipient is also prompted to increase it in order to attract additional funds.

However, (20) does not enable us to determine how tax reacts to an increase in the fiscal equalization degree (α). The first-order conditions of (20) give the best response function for each country:

$$t_1 = \frac{\Omega_1^A(\alpha)t_2}{2} + \frac{\Gamma(\tau)}{2\Psi(\tau)} \quad t_2 = \frac{\Omega_2^A(\alpha)t_1}{2} + \frac{1-\Gamma(\tau)}{2\Psi(\tau)} \qquad (21)$$

where

$$\Omega_1^A(\alpha) \equiv \frac{k+1+\alpha\left(k-1\right)}{k+1-\alpha} \in (1,2) \quad \Omega_2^A(\alpha) \equiv \frac{k+1-\alpha\left(k-1\right)}{k+1-\alpha k} \in (1, \Omega_1^A(\alpha))$$

When $\alpha = 0$, the best-reply function is identical to one reported in previous section and in this case the tax equilibrium maximizing the public funds is the Nash tax of the system without transfer. When $\alpha \in (0,1)$, it is readily to check that $d\Omega_r^A(\alpha)/d\alpha > 0$. In other words, the slope of the best-reply function of each government increases when the degree of redistribution (α) increases. Given that reaction curves are increasing and $\Omega_r^A(\alpha)/2 \in (0,1)$, then a rise in α increases both taxes. In other words, a higher degree of fiscal equalization (captured by α) counteracts tax competition. Hence,

Proposition 4 *Assume a tax revenue-equalization scheme. By increasing the level of taxes in both countries, this transfer system mitigates the inefficiency arising in a fully decentralized tax system. In addition, the tax rates prevailing in each country are increasing with the degree of fiscal equalization.*

2. *Tax base equalization.* We now focus on a tax base equalization scheme. This scheme is conditioned on the difference in the country's tax base relative to that of a national representative tax system. Formally, the objective of the government of country r is now to set t_r in order to maximize

$$t_r \lambda_r^*(t_r, t_s) N + \alpha G_r^B \equiv g_r^B$$

The first order conditions is given by $dg_r^B/dt_r = d\Phi_r/dt_r + \alpha dG_r^B/dt_r = 0$ where

$$\frac{dG_r^B}{dt_r} = \underbrace{\frac{L_r}{L_r + L_s} \frac{d\bar{t}N}{dt_r}}_{\text{strategic effect}} - \underbrace{\lambda_r N \left(\frac{d\bar{t}}{dt_r} - \frac{\bar{t}}{t_r} \varepsilon_r \right)}_{\text{direct effect}} \tag{22}$$

As in the previous analysis, we can investigate how this scheme distorts incentives to tax by isolating strategic and direct effects. First, note that the strategic effect is identical in both equalization schemes since $\bar{t}N = \Phi_T$. Indeed, if the tax base equalization modifies the incentives to tax compared to the tax-revenue equalization scheme, it will only come from the direct effect. By comparing the second term in (22) with direct effect in (20), a difference appears. Assuming no strategic effects ($d\bar{t}/dt_r = 0$), the direct effect of a tax rise on the transfer received by country r is given by:

$$\frac{dG_r^B}{dt_r} = \lambda_r N \frac{\bar{t}}{t_r} \varepsilon_r$$

Remember that by making the same assumption for the tax-revenues equalization scheme, we get $dG_r^A/dt_r = -\lambda_r N (1 - \varepsilon_r)$. Contrary to the

latter scheme, the sense of the direct effect in the tax base equalization is unambiguously positive. By increasing the local tax burden, governments reduce their tax base but benefit from an increasing transfer. The story is quite different when we consider a tax revenue equalization scheme. While there also exist incentives to rise taxation to attract funds from transfer, these incentives are counteracted by a positive effect on tax revenues due to higher level of tax. Thus the net effect is ambiguous and depends on the magnitude of the tax base effect. For this reason, if we only consider the direct effect, the tax base equalization scheme sustains the marginal cost of public funds at a lower level than the former system.

Now we can investigate the tax setting when both direct and strategic effects play on the incentives to tax. Since the strategic effect is identical in both equalization schemes, difference between the two systems only arises from the direct effect, where $d\bar{t}/dt_r$ is now different from 0. Thus, the key question is to determine whether the direct effect is higher when this equalization scheme is applied. After some arrangements, the direct effect under tax base equalization can be written as follows

$$-\lambda_r \frac{d\Phi_r}{dt_r} + \frac{N}{t_r}\left(\bar{t} - \lambda_r t_s\right)\varepsilon_r$$

whereas the direct effect is equal to $-d\Phi_r/dt_r$ when the transfer scheme is based on tax revenue. Because $\bar{t} - \lambda_r t_s > 0$ for both countries and $\lambda_r < 1$, trivial comparison shows that the direct effect is higher under the former scheme. Therefore, this equalization scheme seems to exhibit better efficiency properties than tax revenue equalization. By lowering the marginal cost of public fund, the direct effect from tax base equalization gives more incentives to tax mobile firms. Indeed, this scheme works like a real insurance coverage for public authorities. Similarly, by compensating countries for reductions in their fiscal capacities, this grant system increases an authority's incentives to engage in a policy that may reduce its tax base following a high tax burden. Such behavior is strengthened when the fiscal equalization degree (α) is high since countries perceive it as a greater guarantee for compensation. Finally, as mentioned above, this effect is more ambiguous in a tax revenue equalization scheme and gives no more incentives to tax than in the absence of a transfer system. In this case, the strategic effect appears to be the only determinant for countries to raise taxation. In contrast, both strategic and direct effects have an active role when tax base equalization is considered.

Hence,

Proposition 5 *Assume a tax base-equalization scheme. This scheme leads to higher tax rates than under tax revenue equalization.*

The propositions (4) and (5) suggest that the two systems of fiscal equalization can mitigate fiscal externalities by giving incentives to tax at a higher level than in the absence of a transfer scheme. This result is analogous to one obtained in a traditional model of tax competition by Köthenbürger (2002). However, mechanisms at work are different. In Köthenbürger (2002), the more populated region is potentially the recipient since its tax base is below the average tax base. Hence, *the ability of fiscal equalization to increase the tax rates does not depend on the type of competition prevailing in the private sector.*

5.2 Does fiscal equalization decrease tax gap?

Now, the interesting question is to study if the new incentives to tax induced by the transfer systems are equally distributed between countries. To address this point, we must calculate tax rates in order to evaluate the tax gap under the two systems of fiscal equalization. Trivial calculations yield

$$t_1^A - t_2^A = t_1^B - t_2^B = \frac{(2-\alpha)(k+1)\Gamma(\tau) - k(1-\alpha) - 1}{(k+1)(3-\alpha)\Psi(\tau)} \equiv \Delta^E > 0 \quad (23)$$

where t_1^A, t_2^A, t_1^B and t_2^B are given in Appendix C. Hence, the tax gap is identical regardless of the two equalization systems. This means that *the difference in tax rates is only influenced by the strategic effect.* Since both schemes lead to an unique tax gap while the direct effect contributes to higher taxation with a tax base equalization, this indicates that the direct effect has no impact on the fiscal externality arising from the gap in taxation. To demonstrate this, we study the case of tax base equalization by considering $\bar{t}$ as exogenous so that the strategic effect is neutralized. In this case, the expressions of the best-response functions would be as follows

$$t_1 = \frac{t_2}{2} + \frac{\Gamma(\tau)}{2\Psi(\tau)} + \frac{\alpha\bar{t}}{2} \quad t_2 = \frac{t_1}{2} + \frac{1-\Gamma(\tau)}{2\Psi(\tau)} + \frac{\alpha\bar{t}}{2}$$

Clearly, a change in α would affect the two-best reply functions in the same proportion. In other words, the direct effect does not modify the difference in tax rates. This also means that the direct effect only corrects the fiscal externality due to the level of taxation. Hence, we can conclude that the tax gap variation only arises from the strategic effect which is identical under the two equalization schemes. Therefore, from consumers viewpoint, transfers conditioned on tax base is preferred to tax revenue equalization since for an equivalent gap in taxes, it yields higher taxation and supply of public goods. In other words, f*rom consumers' viewpoint, equalization based on tax revenue is Pareto dominated*

by the equalization conditioned on tax base. Since both systems have the same effect on the tax gap, in what follows, we take tax base equalization as the benchmark case.

Now, we can compare the tax gap Δ^E with the gap resulting from the decentralized tax system (Δ^N) and from a unified tax policy (Δ^u). Some calculations give:

$$\Delta^E - \Delta^N = -\alpha \frac{(k+1)\,\Gamma(\tau) - 2k + 1}{3\,(k+1)\,(3-\alpha)\,\Psi(\tau)}$$
$$\Delta^E - \Delta^u = \frac{(k+1)\,(13-7\alpha)\Gamma(\tau) - 8[k(1-\alpha)+1]}{8\,(k+1)\,(3-\alpha)\,\Psi(\tau)}$$

We must rank Δ^E, Δ^N and Δ^u in order to determine whether tax equalization schemes correct the fiscal externality arising from inefficient tax gap. The outcome depends on the asymmetry in population size. We develop here the most interesting case where the asymmetry is large enough ($k > 29/23$) or when the number of firms is high enough ($N > N^{\Delta}$) so that $\Delta^N > \Delta^u$ always holds, regardless of trade costs.

We determine whether this fiscal equalization leads to a decrease in tax gap relatively to the decentralized tax policy without interregional transfers. Formally, we have $\Delta^E < \Delta^N$ when

$$\tau < \tau^+ \equiv \frac{4a}{3b + 2cN} > \tau_{trade}$$

Since $\tau^+ > \tau_{trade}$, the difference in tax rates is lower under fiscal equalization than without interregional transfers, whatever the admissible values of trade costs. In addition, it follows immediately from this result that Δ^E negatively responds to a change in the equalization degree since we have

$$\frac{d\Delta^E}{d\alpha} = \frac{3\left(\Delta^E - \Delta^N\right)}{\alpha\,(3-\alpha)} < 0 \text{ when } \tau < \tau_{trade}$$

Hence, the interregional grants may correct the fiscal externality arising from the difference in tax rates, regardless of the degree of economic integration. In other words, the incentive to raise the tax rate is stronger for the small country.

To explain this result, remember that the smaller country is potentially the net recipient and the larger country is potentially net contributor. Indeed, at the Nash tax equilibrium without interregional transfers, we have $\lambda^N/L_1 > (1-\lambda^N)/L_2$ (see (15)) so that $G_1 < 0$ and $G_2 > 0$. In addition, we know that each country does not use the direct effect in order to manipulate the spatial distribution of tax base via a change

in tax gap. As a result, in order to enjoy more interregional transfers, the less populated country has an incentive to increase the average tax rate (see the expression of transfers under tax base equalization (6)). Because $d\bar{t}/dt_2$ is positive (for $\Delta = \Delta^N$), the small country is prompted to increase its tax rate.[11] At the opposite, the more populated country, which is a net contributor, has an incentive to decrease its tax rate in order to decrease the average tax rate (because $d\bar{t}/dt_1 > 0$ for $\Delta = \Delta^N$). As a result, a rise in the extent of fiscal equalization leads to a decreasing tax gap.

We now must check that the tax gap under the equalization grants is not too low relative to the unified tax policy. Some tedious calculations show that Δ^E is always superior to Δ^u when $k > 29/23$. Indeed, we have $\Delta^E > \Delta^u$ when

$$\tau < \tau^- \equiv \frac{4a}{2b + \frac{3+7\alpha+3k-9k\alpha}{(13-7\alpha)(k-1)}cN} > \tau_{trade}$$

In other words, when the asymmetry in population size is high enough, the difference in tax rates keeps too high when this equalization schemes are introduced.

Hence,

Proposition 6 *Assume that the asymmetry in population size is sufficiently high. A rise in the degree of fiscal equalization partly corrects the fiscal externality.*

In addition, observe that the asymmetry in population size influences the effect of fiscal equalization on tax gap. Indeed, the higher the asymmetry in the endowment of workers is, the more the gap in taxation converges toward the gap emerging from a decentralized tax system. Thus, we have:

$$\frac{d\left(\Delta^E - \Delta^N\right)}{dk} > 0 \text{ when } \tau < \tau_{trade}$$

Explaining this result requires once again to focus on the major role played by the strategic effect. Recall that this effect explains why countries have incentives to raise their taxation when tax revenue equalization takes place. It is straightforward to see that the magnitude of this effect for country r increases with its population size. This relationship is intuitive since the higher is the share of population located in country

[11] Remember that $d\bar{t}/dt_2 = 1 - \lambda + (t_1 - t_2)\Psi(\tau)$ and that $t_1 > t_2$, $\lambda < 1$ and $d\lambda/dt_2 > 0$.

r, the higher is the effect of the positive variation of its tax revenues on the national representative per-capita tax revenues.

Finally, we have shown that fiscal equalization leads to more efficient tax rates and tax gaps and, thus, to higher aggregate consumption of public goods. In addition, some simulations reveal that the provision of public goods increases in each country when the extent of fiscal equalization grows. Hence, even though the tax base declines in the small country when α increases (remember that $d\Delta^E/d\alpha < 0$ and, therefore, $d\lambda(\Delta^E)/d\alpha > 0$), this is more than compensated by both positive transfers ($dG_2^B/d\alpha > 0$) and higher taxation ($dt_2^B/d\alpha > 0$). Similarly, despite an increasing contribution in transfers, the larger country enjoy an increasing tax base and tax rate when α increases.[12]

6 Conclusion

The globalization has likely intensified tax competition among major industrialized countries. The competition in corporate income taxation in order to attract mobile tax bases may lead to underprovision of public services and weaken the system of income redistribution. To avoid a harmful international tax competition, a coordination policy in tax setting seems needed at the European Union and OECD scale. However, even though the coordination on differences in tax rate could be Pareto efficient, this tax policy is not necessarily a stable outcome, as suggested by the recent experience in the EU. Some countries can be prompted to adopt an other strategy.

In this paper, we have studied inter-country transfers based on fiscal equalization which may weaken the international tax competition and lead to more efficient tax rates. We have considered two types of transfer programs: tax base and tax revenue equalization. Both are representative of the equalization schemes used in many federations. We have analyzed the ability of fiscal equalization to mitigate the fiscal externality when the economies are not perfectly integrated and the private sector is imperfectly competitive.

The framework used yields results which agree with empirical evidence and exhibits two types of inefficiencies related to fiscal decentralization: the tax rates are too low in each country and the difference in tax rates can be too high. Both externalities imply that provision of public good is too low. We have shown that two systems of fiscal equalization may implement more efficient tax rates and spatial allocation of tax base. This result suggests that solutions other than fiscal harmonization can be explored for the European Union. However, note that

[12] Simulations are available upon request.

implementing a fiscal arrangement based on fiscal equalization should require a common tax base definition (see. Mintz and Weiner, 2003). Moreover, observe that if fiscal equalization allows for internalizing fiscal externalities, it is also largely designed and implemented to serve equity and redistribution across regions (Boadway, 2003). This is an important feature in the European context where more and more observers have doubt about the ability of the actual structural and cohesion funds to limit spatial inequalities between Member states (see, Martin, 1999, Overman and Midelfart-Knarvik, 2002).

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Appendix A- total profits

The expression of aggregate profits is given by

$$\sum_{i}^{N} \pi_i = \frac{\tau^2 cNL(b+cN)(k+1)(cN+4b)}{4(2b+cN)^2}\lambda(\lambda-\lambda^o) + const$$

where

$$\lambda^o \equiv \frac{[N^2c^2(k+1)+4bcN(k+1)-(k-1)4b^2]\tau + 8ab(k-1)}{\tau cN(k+1)(cN+4b)} > 0$$

The share of the tax base in the large country maximizing the aggregate profit is λ^o. Some tedious calculations show that $\lambda^o > \lambda(t_1 = t_2 = 0)$ when

$$\tau > \tau^O \equiv \frac{4a(k-1)}{(k+1)(2b+cN)+4bk}$$

Note that $\lambda(t_1 = t_2 = 0) < 1$ requires that

$$\tau > \frac{4a(k-1)}{(k+1)(2b+cN)-4b} > \tau^O$$

Hence,

Proposition 7 *When production takes place in both countries, the market forces leads to an insufficient degree of agglomeration.*

Appendix B. Benevolent governments

The objective of the benevolent government of country r is given by

$$\underset{t_r}{\text{Max}}\ S_r L_r + \theta(g_r) + const$$

where S_r is an increasing function with respect to λ_r (for admissible values of trade costs). Therefore, the introduction of the surplus in the objective function increases the incentive to diminish the tax rate in order to attract firms. The establishment of firms in a country not only

raise the tax base but also the surplus. For simplicity, we assume that $\theta(g_r) = g_r = t_r\lambda_r^*(t_r, t_s)N$. The Nash tax rates are given by

$$t_{1B}^N = t_1^N - \frac{L\tau(b+cN)\Lambda}{6(7cN+12b)(cN+2b)^2(1+k)}$$
$$t_{2B}^N = t_{1B}^N - \frac{3L\tau(b+cN)(k-1)(2a-b\tau)}{2(7cN+12b)} < t_{1B}^N$$

where

$$\Lambda \equiv 12(1+k)(2k+1)b^2+2c(8+16k^2+33k)Nb+(bcN)^2(2k+5)(5k+1) > 0$$

However, less obvious, it appears that the tax gap is lower when governments are benevolent. Indeed,

$$\Delta_B \equiv t_{1B}^N - t_{2B}^N = \Delta^N - \frac{L\tau(b+cN)(k-1)(2a-b\tau)(5cN+6b)}{6(7cN+12b)(cN+2b)} < \Delta^N$$

As a result, the economy is more agglomerated under benevolent governments than under leviathan governments. In terms of well-being, the former objective leads to a decline in welfare of residents living in the small country whereas the change of welfare in the larger country is uncertain. Indeed, if the tax base increases, the tax rate in larger country declines.

To summarize,

Proposition 8 *Given our assumptions, a benevolent government leads to lower tax rate and to higher regional inequality (in terms of mobile tax base) than a leviathan government.*

We now determine the"unified" tax policy under Benevolent objective given by

$$\underset{\Delta_B^u}{\text{Max}} t_{1B}^u\lambda^*(\Delta_B^u)N + t_{2B}^u(1-\lambda^*(\Delta_B^u))N + S_1(\Delta_B^u)kL + S_2(\Delta_B^u)L + const \tag{24}$$
$$\text{with } \; t_{1B}^u = t_{2B}^u + \Delta_B^u \quad t_{1B}^u = \pi_1^*(\lambda^*(\Delta_B^u)) \quad t_{2B}^u = \pi_2^*(\lambda^*(\Delta_B^u))$$

We first derivative (24) with respect to Δ_B^u. The first order condition gives the optimal tax gap between tax rates:

$$\Delta_B^u = \frac{L\tau(b+cN)[Nc(k+1)-b(k-1)\tau+2a(k-1)]}{2(5cN+8b)} < \Delta_B \tag{25}$$

Hence,

Proposition 9 *Assume that local governments are benevolent. As under leviathan governments, fiscal externality implies that tax rates are too low and that the difference in tax rates is too high.*

Appendix C. Nash tax rates

Under tax revenue-equalization scheme, Nash tax rates are given by

$$t_1^A = \frac{[k(1-\alpha)+1][(1-\alpha)(k+1)\Gamma(\tau)+(k+1)+\alpha(k-1)]}{\Psi(\tau)(1-\alpha)(3-\alpha)(k+1)^2} > 0$$
$$t_2^A = \frac{(k+1-\alpha)[-(1-\alpha)(k+1)\Gamma(\tau)+2(k+1)-\alpha 2k]}{\Psi(\tau)(1-\alpha)(3-\alpha)(k+1)^2}$$

whereas under tax base-equalization scheme, Nash tax rates are given by

$$t_1^B = \frac{\gamma_0+\gamma_1\Gamma(\tau)+\gamma_2\Gamma(\tau)^2}{\Psi(\tau)(1-\alpha)(3-\alpha)^2(k+1)^2} \tag{26}$$
$$t_2^B = t_1^B - \Delta^E \tag{27}$$

where

$$\gamma_0 \equiv (k-\alpha k+1)(-\alpha^2+5\alpha k-\alpha+3k+3) > 0$$
$$\gamma_1 \equiv (k+1)(-3k+10\alpha k-7\alpha^2 k+\alpha^3-3-3\alpha^2+7\alpha)$$
$$\gamma_2 \equiv \alpha(k+1)^2(3-2\alpha) > 0$$

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