Tax Harmonisation:
Does the Unanimity Rule Play a Role?

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Abstract

In this paper, we analyse tax harmonisation in the framework of two asymmetric countries, differing with respect to their capital-labour endowments. In the first part, we analyse how national fiscal policies are decided when countries play a non-cooperative game. At the Nash equilibrium, inefficiency arises because of the corresponding misallocation of resources. Some forms of fiscal policy coordination are then studied within the institutional framework of the European Community, where such policy reforms are decided by the unanimity rule. We show that, while the imposition of a minimum level of capital taxation can not pass, there exist some forms of tax convergence that can be accepted.

Non-technical abstract

The aim of the paper is to analyse how the growing process of economic integration within Europe affects the way national fiscal policies are decided and the possible tax reforms that could be introduced in order to lead to an increase in the welfare of all countries. The reduction of controls at the borders has implied an increase in the mobility of tax bases across countries. This factual issue seems to have led to a phenomenon of downward fiscal competition, at least for corporate tax rates, and it has been the object of many recent reports by the European Commission. In the first part of the paper, a formal analysis of this topic is provided within the setting of two asymmetric countries. With this respect, we show that, when countries act non-cooperatively, this leads to the adoption of inefficient fiscal policies: the economic resources are misallocated between the countries. In order to overcome such distortion, we analyse the welfare properties of two proposals: the imposition of a minimum capital tax rate, recently advocated by the European Commission for EEC and tax convergence, which has been suggested as a long run objective. The aim of the analysis is to verify if these proposals can be accepted by the unanimity rule used, at an European level, for policy reforms. On the basis of such a rule, a policy reform can pass if it increases the welfare of both countries (Pareto improvement). According to our model, while the imposition of a minimum level of capital taxation can not pass, there exist some forms of tax convergence that can be accepted.

1. Introduction

The purpose of this paper is to analyse fiscal harmonisation between asymmetric countries. Because of the ongoing process of the European economic integration,[1] fiscal policies are determined in countries that are politically sovereign but economically interdependent. The recently higher level of international economic integration, leading to an increase in mobility of factors of production (capital and labour) and of commodities, implies the free movement of tax bases. As a result a new international interdependence arises: the capacity of each country to pursue its national objectives, through taxation, is now constrained by the corresponding decisions of all the other countries. Since mobile factors and goods locate in a country rather than in another, depending on the national differences in tax and transfer policies, national governments have to take the reactions of the other countries into account when deciding such fiscal policies.

These issues are particularly evident in the European Community where the release of controls at the borders seems to have led to a phenomenon of tax competition between the member states, at least for corporate tax rates which fell from 46% in 1980 to 40.1% in 1991. This was the reason why, in 1990, the Commission set up a committee of experts who were asked to answer to the following questions:

- "Do differences in taxation among Member States cause major distortions in the internal market, particularly with respect to investment decisions and competition?
- In so far as such distortions arise, are they likely to be eliminated simply through the interplay of market forces and tax competition between Member States, or is action at the Community level required?
- What specific measures are required at the Community level to remove or mitigate these distortions?"[2]

In the economic literature, these kind of questions have been largely discussed by integrating elements from two distinct disciplines: Public Economics and International Trade. After a pionering contribution by Gordon (1983), Mintz and Tulkens (1986) have analysed fiscal competition through commodity taxation. In this paper, they show that Nash equilibrium taxes are not Pareto efficient, in general, and that Pareto improving policies never reduce taxes

[1] This analysis can be applied not only to Europe, but also to other interdepent economies, like the United States, Canada and, more recently, Mexico.
[2] Ruding Report, 31-3-92, pag. 9.

in both countries. As a consequence, the incentive of each country to lower its tax rates in order to increase its tax-bases, should lead to a general process of downward tax competition which, in its turn, could lead to a reduction in the levels of social protection and public good provision.

In particular, the more recent contributions have concentrated their attention to the analysis of fiscal competition with respect to capital taxation: indeed, this is the framework which seems to fit better the European reality, where capital is a very mobile factor of production. Persson and Tabellini (1992), by using a Political Economy approach, show that the tendency to lower capital tax rates because of economic integration, is in part offset by the voting behaviour of the agents: the distortions arising from tax competition are in part corrected by the political mechanism through which policymakers are elected in each country. By using a different methodology, namely, by means of a non-cooperative game between two social planners, Lopez, Marchand and Pestieau (1996) show that national governments are impeded in redistributing resources to workers through taxation of capital incomes and that, under some conditions, the imposition of a minimum capital tax rate will be beneficial to all countries.

Indeed recently, in order to overcome the factors' allocation inefficiencies, due to non-cooperative behaviours, some forms of coordination between the country members of the European Community have been proposed: in its original programme (1992), the European Commission advocated a full tax harmonisation, i.e. common tax rates; later (1992), the Ruding Report proposed a minimum level for companies taxation and nowadays, it is this last proposal that seems to find more political consensus. For this reason, our aim is firstly, to provide a positive description of the fiscal interdependencies between two countries when capital is assumed perfectly mobile and labour perfectly immobile and secondly, to analyse the normative implications of such a model when fiscal projects, as the ones proposed for the European setting, are put in the agenda of the Commission. Indeed, these kind of proposals are decided according to the unanimity rule and in order to be approved they need to lead to a Pareto improvement, namely both countries have to increase their welfare.

In order to analyse these issues we consider the case of asymmetric countries. Even if this seems an assumption that better describes the reality, in the literature, most models consider the case of symmetric countries (Wildasin (1988), Wilson (1986)). In particular, in

our model, countries differ with respect to their capital and labour endowments and this allows us to better understand the redistributive implications of the different proposals concerning tax harmonisation. Indeed, when countries are symmetric the analysis becomes not appealing. Differently from us, most papers deal with the asymmetry between countries with respect to the population size (Bucovetsky (1991), Kanbur and Keen (1993)) or the different political weight of capitalists and workers in the two countries (Haufler (1996)).

The assumption that each agent is endowed with both factors of production allows us to distinguish different individuals by means of their relative endowment. This implies that the agent preferred tax rates can be expressed as a monotone function of the individual relative endowment and, since the policy space we consider is one-dimensional, we can apply the median voter theorem to describe how, within each country, fiscal choices are made. According to this, we know that there exists a stable equilibrium to the political process, which corresponds to the fiscal policy preferred by the median voter. Furthermore, since we assume that elections take place simultaneously in the two countries, the fiscal interdependence between the two economies is described as a non-cooperative game between the two median voters. The case where fiscal policies are decided by a benevolent dictator within each country is obtained as a particular case of the previous framework.

In this non-cooperative setting, we show that the Nash equilibrium obtained implies a misallocation of factors of production and we analyse if both countries can increase their welfares by adopting some forms of policy coordination, namely a minimum capital tax rate or a tax convergence. The fact that both countries need to gain by the adoption of one of these proposals is linked to the fact that, within the European institution, such kind of decisions are taken by unanimity rule. We will show that while the minimum tax proposal can not be accepted according to such a rule, tax convergence can pass. These results are in contrast with the ones obtained by Kanbur and Kenn, even if we need to be careful in making such a comparison, given the differences between the two models: other than the difference in the definition of asymmetric countries, they consider a partial equilibrium approach while we use a general equilibrium framework.[3]

The structure of the paper is the following. After the description of the economy made in section 2, in section 3 we analyse how, in each country, fiscal policies are decided according

to the median voter theorem, by taking into account the interdependence between the two economies, described as a non-cooperative game between the two countries. The normative properties of some forms of fiscal coordination, i.e. the imposition of a minimum tax level and tax convergence, are discussed in section 4.

2. The Model

We consider a world economy composed of two countries, Home and Abroad. In each country, residents are endowed with both factors of production: capital and labour. In particular, we assume that capital is perfectly mobile across countries while labour is immobile. This implies that, in each country, the amount of capital invested will generally be different from its amount of capital endowment. Indicate with $\overline{K}$, $\overline{L}$ and $\overline{K}^*$, $\overline{L}^*$ the capital and labour endowment, respectively, at home and abroad[4] and with K and K^* the amount of capital invested. We assume that $\overline{K}^* = \lambda \overline{K}$ and $\overline{L}^* = \gamma \overline{L}$, where $\lambda > 0$ and $\gamma > 0$ indicate, respectively, the proportion of capital and labour in the abroad country with respect to home.

In both countries, the production sector is described by a large number of profit maximising firms, adopting the same constant return to scale technology, which is used to produce the only consumption good *y*, whose price is normalised to the unit, *p=1*. Writing the production function in intensive form, we assume the following quadratic specification,[5] respectively for home and abroad:[6]

$$f\left(\frac{K}{L}\right) = \left(a - b\frac{K}{L}\right)\frac{K}{L} \qquad \text{with } a>0,\ b>0 \qquad (1)$$

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[3] Other important contributions on tax harmonisation are Sinn (1990) and Keen (1987) for the case of commodity taxation.

[4] Hereafter, the variables denoting abroad are indicated by *.

[5] This specification of the production function has been already used, in the analysis of fiscal competition, by Bucovetsky (1991) and Haufler (1996).

[6] In order to have a positive level of production, at home, we need that $\frac{K}{\overline{L}} < \frac{a}{b}$. Furthermore, we also require a positive marginal productivity of capital, even when the capital endowments of both countries are used only in one of them -i.e. at home-. This requirement is satisfied if $\frac{\overline{K}}{\overline{L}} < \frac{a}{2b(1+\lambda)}$. Note that this last requirement also guarantees a positive level of production.

$$f\left(\frac{K^*}{L^*}\right)=\left(a-b\frac{K^*}{L^*}\right)\frac{K^*}{L^*} \tag{2}$$

By considering a competitive market, we know that firms' profit-maximising behaviour implies that the remuneration of each input is equal to its equilibrium price:

$$r=f'\left(\frac{K}{L}\right)=a-2b\frac{K}{L} \tag{3}$$

$$w=f\left(\frac{K}{L}\right)-f'\left(\frac{K}{L}\right)\frac{K}{L}=b\left(\frac{K}{L}\right)^2 \tag{4}$$

$$r^*=f'\left(\frac{K^*}{L^*}\right)=a-2b\frac{K^*}{L^*} \tag{5}$$

$$w^*=f\left(\frac{K^*}{L^*}\right)-f'\left(\frac{K^*}{L^*}\right)\frac{K^*}{L^*}=b\left(\frac{K^*}{L^*}\right)^2 \tag{6}$$

where r (r^*) is the gross return on capital and w (w^*) is the wage rate, at home (abroad).

In each country, the public sector is assumed to raise a certain amount of revenue $\overline{G}$ ($\overline{G}^*$), by levying *per unit taxes* on the factors of production. In particular, we assume that capital taxes are levied according to the *source-based principle*: all capital invested in a country is subject to the same tax rate, independently of the place of residence of the investor.[7] Indicate with t (t^*) the tax rate on capital and with t (t^*) the tax rate on labour. The government budget constraints in the two countries are given by:[8]

[7] An alternative principle of taxation is the *residence-based principle*, according to which incomes of residents of a country are taxed regardless of their source, domestic or foreign, while incomes of non-residents, originated in the country, are not taxed. It has been shown (see for example, Bucovetsky and Wilson (1991) and Mintz and Tulkens (1996)) that the residence-based principle would imply a more efficient allocation of the factors of production but such a principle is difficult to be implemented in reality, because it implies strong informational requirements: national fiscal authorities should be strongly coordinated in order to allow them to tax their residents on capital incomes invested abroad. Since such a coordination, in the actual international framework, is far from being achievable, the literature on fiscal competition has dealt, in most cases, with the source-based principle of capital taxation.

[8] In appendix B, conditions on $\overline{G}$ ($\overline{G}^*$) are imposed in order to have a positive remuneration of labour and conditions on $\overline{K}$ / $\overline{L}$ in order to have a positive capital remuneration, in both countries.

$$\overline{G} = tK + \tau \overline{L} \qquad \text{with } t \geq 0 \text{ and } \tau \geq 0 \tag{7}$$

$$\overline{G}^* = t^* K^* + \tau^* \overline{L}^* \qquad \text{with } t^* \geq 0 \text{ and } \tau^* \geq 0 \tag{8}$$

Note that, since the amount of public revenue to be raised is fixed, the policy problem faced by the government is one-dimensional: the choice of the tax rate on capital will automatically determine the tax rate on labour. Later on, this will allow us to apply the median voter theorem to solve the fiscal policy problem in each country.

The net remuneration of capital is determined on the international capital market. In particular, it should be noted that the presence of the capital tax implies that the cost of capital for firms, r (r^*) is different from the return on capital received by the investors, r-t ($r^* - t^*$). Furthermore, because of the assumption of perfect mobility of capital, arbitrage by capital investors insures that, in both countries, there will be an identical net return on capital (ρ):

$$\rho = r - t = r^* - t^* \tag{9}$$

Moreover, we assume full employment of production factors and so the clearing equation on the international capital market is given by:

$$K + K^* = (1+\lambda)\overline{K} \tag{10}$$

which implicitly defines $K = K(t, t^*)$ and $K^* = K^*(t^*, t)$. By using our specification of the production function (1) and (2) together with the arbitrage condition (9), the international capital market equilibrium condition (10) gives the following demands for capital in the two countries:

$$K = \frac{1+\lambda}{1+\gamma}\overline{K} + \frac{\gamma \overline{L}}{1+\gamma}\frac{t^* - t}{2b} \tag{11}$$

$$K^* = \frac{\gamma(1+\lambda)}{1+\gamma}\overline{K} - \frac{\gamma \overline{L}}{1+\gamma}\frac{t^* - t}{2b} \tag{12}$$

From these equations, we see that when $t = t^*$ there are not distortions in the allocation of capital between the two countries, since in both of them the capital-labour ratio is the same: $\frac{K}{\overline{L}} = \frac{K^*}{\overline{L}^*} = \frac{1+\mathsf{l}}{1+\mathsf{g}} \frac{\overline{K}}{\overline{L}}$. On the contrary, when the two tax rates are different, the larger the difference in taxation, the greater the distortion in the capital market:

$$\frac{K}{\overline{L}} - \frac{K^*}{\overline{L}^*} = \frac{t^* - t}{2b} \tag{13}$$

where (13) can be used as a measure of such a distortion.

3. Voting on fiscal policies

In order to describe the way fiscal policies are determined in each country, we represent fiscal decisions as the result of a political process. In particular, we assume that tax rates are decided through majority voting, inside each country. By the median voter theorem, we know that, when the issue space is one-dimensional and agents have single-peaked preferences, there exists an unique stable voting outcome, which corresponds to the one preferred by the median voter. We have already showed the one-dimensionality of the policy space. We will show in the following the single-peakdness of the agents' preferences. Furthermore, we will show that the case where, in each country, fiscal policies are decided by a benevolent dictator, can be obtained as a particular case of the median voter approach.

3.1. Agents preferences

To be able to describe the voting behaviour of each agent, we need to define more precisely his characteristics. Suppose that, in each country, all agents have identical preferences and they only differ in their factor endowment: every agent owns a k_i unit of capital and one unit of labour. Firstly, we consider the individual maximisation problem, or in other words, the capital tax rate preferred by an individual whose relative endowment is k_i. Then, after having showed that we can order the individual preferred tax rates as a monotone function of the individual relative endowment and that individual preferences are single-peaked, since the

policy problem is one-dimensional, we apply the median voter theorem: the chosen capital tax rate will be the one preferred by the voter with the median capital-labour endowment.

Consequently, in each country, we are allowed to assume that fiscal policies are decided on the basis of the preferences of the median voter. As the fiscal decision inside each country influences the welfare of the median voter in the other country, we formalise such a fiscal policy interdependence of the two economies as a non-cooperative game between the two countries. In particular, we assume that, in each country, the median voter chooses his preferred tax rate, given the fiscal policy of the other country. This means that, since we suppose that in the two countries elections take place at the same time, we analyse a non-cooperative game played by the two median voters. This game is such that the strategies of the two players are given by the capital tax rates and, since there is only one consumption good, their pay-offs are given by their disposable income. The Nash equilibrium of the game is given by any intersection of the best-reply functions of the two median voters.

In particular, at home, the agent's problem is described by the following maximisation of the individual disposable income:

$$\begin{aligned} &max \quad (r-t)k_i + (w-\tau) \\ &s.t. \;\; t \geq 0 \\ &\qquad \tau \geq 0 \end{aligned} \tag{14}$$

By considering the equivalent optimisation problem for an agent abroad and by using the Kuhn-Tucker conditions, since we restrict ourselves to the case where tax subsidies are not allowed,[9] we obtain, for each agent, the following best-reply functions:

$$t = \frac{t^*}{2+\gamma} + \frac{2b\left[(1+\lambda)\overline{K} - (1+\gamma)\overline{L}k_i\right]}{(2+\gamma)\gamma\overline{L}} \qquad \text{at home} \tag{15}$$

$$t^* = \frac{\gamma t}{1+2\gamma} + \frac{2b\gamma\left[(1+\lambda)\overline{K} - (1+\gamma)\overline{L}k_i^*\right]}{(1+2\gamma)\overline{L}} \qquad \text{abroad} \tag{16}$$

[9] The analysis would not change by allowing for tax subsidies.

The best-reply function describes how the individual policy preferences are a function of the individual relative endowment. In order to solve the previous maximisation problem, we also have to check that the second order condition is satisfied:

$$\text{s.o.c.:} \quad -\frac{\gamma(2+\gamma)}{2b(1+\gamma)^2} < 0$$

It is important to note that, since the second order condition is negative independently from the value of *t*, this automatically insures that the agents' preferences, on all the range of the capital tax rates, are single-peaked.[10] We have shown how the individual policy preferences are a function of the individual relative endowment and it is also easy to show that the preferred tax rate of an agent is a decreasing function of k_i, the individual relative endowment.[11] Thus, after having ordered the individual preferred tax rates as a monotone function of the agent's relative endowment, we can identify the median voter by means of his relative endowment, k_m, and restate the previous problem with respect to the agent with the median endowment.

3.2. The non-cooperative voting equilibrium

In each country, the voting procedure elects the fiscal policy preferred by the agent whose endowment is at the median of the endowment distribution. Thus, after having substituted in the previous problem k_i with k_m, we can rewrite the best-reply functions as follows:

[10] Equivalently, in the abroad country, the second order condition is $-\frac{(1+2\gamma)}{2b(1+\gamma)^2} < 0$, which also insures the single-peakdness of the agents' preferences , since it is negative independently from the values of *t**.

[11] We just have to derive the home (abroad) first order condition with respect to k_i (k_i^*) and show that it is negative:

$$\frac{\partial t(k_i)}{\partial k_i} = -\frac{2b(1+\gamma)}{(2+\gamma)\gamma} < 0 \text{ and } \frac{\partial t^*(k_i^*)}{\partial k_i^*} = -\frac{2b\gamma(1+\gamma)}{1+2\gamma} < 0.$$

$$t = \frac{t^*}{2+\gamma} + \frac{2b\left[(1+\lambda)\overline{K} - (1+\gamma)\overline{L}k_m\right]}{(2+\gamma)\gamma\overline{L}} \qquad \text{at home} \qquad (15a)$$

$$t^* = \frac{\gamma t}{1+2\gamma} + \frac{2b\gamma\left[(1+\lambda)\overline{K} - (1+\gamma)\overline{L}k_m^*\right]}{(1+2\gamma)\overline{L}} \qquad \text{abroad} \qquad (16a)$$

The Nash equilibrium is given by the intersection of these best-reply functions. More specifically, the equilibrium values of t and t^* will depend on the values taken by k_m and k_m^* with respect to $\frac{(1+\lambda)\overline{K}}{(1+\gamma)\overline{L}}$. In particular, we can distinguish the following cases:

k_m \ k_m^*	$\frac{1+\lambda}{1+\gamma}\frac{\overline{K}}{\overline{L}}$
$\frac{1+\lambda}{1+\gamma}\frac{\overline{K}}{\overline{L}}$	*case* 1 $t = \frac{b\left\{\overline{K}(1+\gamma)(1+\lambda) - \overline{L}\left[k_m(1+2\gamma) + \gamma^2 k_m^*\right]\right\}}{\gamma(1+\gamma)\overline{L}}$ $t^* = \frac{b\left\{\overline{K}(1+\gamma)(1+\lambda) - \overline{L}\left[k_m + \gamma k_m^*(2+\gamma)\right]\right\}}{(1+\gamma)\overline{L}}$
	case 2 $t = \frac{2b\left[\overline{K}(1+\lambda) - k_m(1+\gamma)\overline{L}\right]}{\gamma(2+\gamma)\overline{L}}$ $t^* = 0$
	case 3 $t = 0$ $t^* = \frac{2b\gamma\left[\overline{K}(1+\lambda) - k_m^*(1+\gamma)\overline{L}\right]}{(1+2\gamma)\overline{L}}$
	case 4 $t = 0$ $t^* = 0$

Table 1

Apart from the first case where both k_m and k_m^* are not larger than $\frac{1+\lambda}{1+\gamma}\frac{\overline{K}}{\overline{L}}$ and, at the Nash equilibrium, capital tax rates are set both positive, in all the other cases, at least one of the country fixes a zero tax rate. This is due to the non-negativity constraint we impose in the maximisation problem: consider case 2, the reaction functions intersect at a point where t^* is

negative,[12] since this value is not allowed, abroad will set a zero tax rate, to which the home best-reply is positive. Because of the non-negativity constraint the abroad reaction function present a kink and the Nash equilibrium (*A*) is given by the intersection of the two reaction functions:[13]

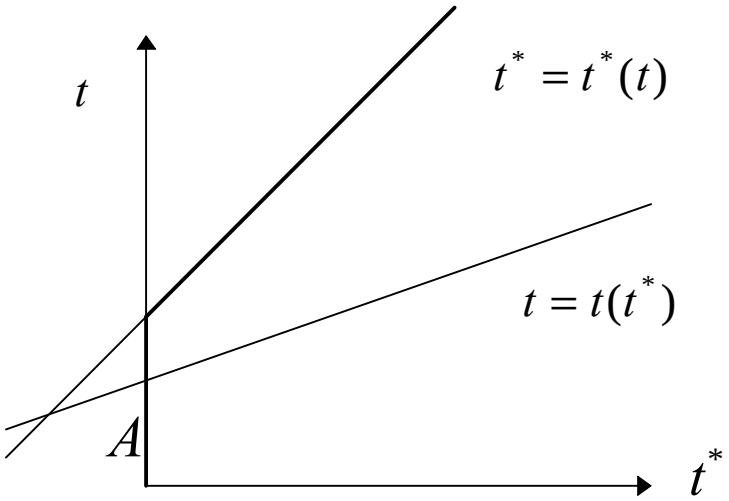

Fig. 1 (case 2a)

Case 4, where both countries set a zero tax rate arises when the reaction functions intersect at the origin or at a point where both *t* and t^* are negative. The interpretation of these different cases will be given in the following.

3.3. Benevolent dictator case

From each of the previous cases we can obtain, as a particular case, the setting where, in each country, an utilitarian benevolent dictator chooses the tax rates. The benevolent dictator's objective function is the same, up to a monotone transformation, of the one of an agent owing the average relative endowment, $\overline{K}/\overline{L}$ ($\overline{K}^*/\overline{L}^*$). For example, at home such a problem is given by:

[12] Note that $t^* = t^*(t)$ has always an higher slope than $t = t(t^*)$ since $\frac{1+2\gamma}{\gamma} > \frac{1}{2+\gamma}$ for every $\gamma > 0$.

[13] Case 3 is simply the opposite but on the orizontal axis.

$$max \quad (r-t)\overline{K}+(w-\tau)\overline{L} \equiv \left[(r-t)\frac{\overline{K}}{\overline{L}}+(w-\tau)\right]\overline{L} \tag{17}$$

$$s.t. \quad t \geq 0$$

$$\tau \geq 0$$

In this set-up, by solving the optimisation problems in the two countries, we consider a Nash equilibrium of the non-cooperative game between the two benevolent dictators.[14] In order to obtain the benevolent dictator setting as a particular case of the previous one, we need to distinguish different possibilities, depending on the fact that, in each country, the average relative endowment is equal to the median one and that they can be either equal in both countries or different. Only the corresponding of cases 2, 3 and 4 of the median voter setting, can be obtained in the benevolent dictator case: either both countries set a zero tax rate on capital and finance their public expenditure by taxing only labour or one country fixes a positive capital tax rate and the other country sets a zero capital tax rate, where the positive or zero tax rate country depends on the values of λ and γ .Thus, the case where both countries set positive capital tax rates can not arise in the benevolent dictator framework.

More specifically, both from case 1, if $k_m = k_m^* = \frac{\overline{K}}{\overline{L}}$ and from case 2, if $k_m = \frac{\overline{K}}{\overline{L}}$ and $k_m^* = \frac{\lambda}{\gamma}\frac{\overline{K}}{\overline{L}}$, we obtain that $\lambda > \gamma$, which means that the capital-labour ratio is greater abroad than at home and which leads to a Nash equilibrium where home sets a positive tax rate and abroad a zero tax. The opposite case is obtained, both from case 3, if $k_m = \frac{\overline{K}}{\overline{L}}$ and $k_m^* = \frac{\lambda}{\gamma}\frac{\overline{K}}{\overline{L}}$ and from case 4 (when the conditions hold with inequality), if $k_m = k_m^* = \frac{\overline{K}}{\overline{L}}$. In this case $\lambda < \gamma$ - i.e. the capital-labour ratio is lower abroad than at home. Finally, from case 4 (when the conditions hold with equality) both when $k_m = k_m^* = \frac{\overline{K}}{\overline{L}}$ and when $k_m = \frac{\overline{K}}{\overline{L}}$ and $k_m^* = \frac{\lambda}{\gamma}\frac{\overline{K}}{\overline{L}}$,

[14] In particular, the reaction funcions are: $\tau = \frac{t^*}{2+\gamma} + \frac{2b(\lambda-\gamma)\overline{K}}{(2+\gamma)\gamma\overline{L}}$ and $t^* = \frac{\gamma\tau}{1+2\gamma} + \frac{2b(\gamma-\lambda)\overline{K}}{(1+2\gamma)\overline{L}}$ and the second order conditions hold.

we obtain that $\lambda = \gamma$ (the countries are symmetric in the sense that they have the same capital-labour ratio) and, at the Nash equilibrium, both of them fix a zero tax rate. These results are summarised in the following table:

$\gamma < \lambda$	$\gamma > \lambda$	$\gamma = \lambda$
case 2*a*	*case* 3*a*	*case* 4*a*
$t = \frac{2b(\lambda - \gamma)\overline{K}}{(2+\gamma)\gamma\overline{L}}$ $t^* = 0$	$t = 0$ $t^* = \frac{2b(\gamma - \lambda)\overline{K}}{(1+2\gamma)\overline{L}}$	$t = 0$ $t^* = 0$

Table 2

On the basis of these results we can give the following interpretation to the non-cooperative game played by the two countries. Firstly, consider the case of two asymmetric countries: suppose that home is the country with the lower capital-labour ratio ($\lambda > \gamma$, see case 2a), this means that home imports capital from abroad so that, when taxes are levied on capital income, a share of the tax burden is bearded by the capital owners living abroad. This implies that home is exporting part of the capital tax burden abroad. For this reason home has an incentive to set a positive capital tax rate, even if it induces an inefficient capital allocation. On the contrary, abroad is a capital exporter country and thus a tax importer. As a consequence, abroad has an incentive to put all the tax burden on labour, i.e. to set a zero capital tax rate, in order to minimise its capital exports.[15]

It should be remarked that, within each country, the fiscal problem consists in deciding the share of the tax burden imposed on capital and labour, without any concern for equity problems related to this choice. Indeed, the government, from a distributional point of view, is indifferent between taxing labour or capital: the only difference is that, while the taxation of labour, the immobile factor of production, is not distorsive, the taxation of capital influences its allocation in the two countries.[16]

[15] An equivalent reasoning holds for the case where $\lambda < \gamma$ (case 3a).

[16] This is a limit of the model. For an analysis of such redistributive issues see for example Lopez, Marchand and Pestieau (1996) where capitalists are taxed in order to make lump-sum transfers to workers.

Secondly, consider the case of symmetric countries ($\lambda = \gamma$). In this setting, countries are identical in all respects and they do not have any incentive to set positive capital tax rates: capital is allocated efficiently.

As far as the comparative static is concerned, consider again the case ($\lambda > \gamma$) where, at equilibrium, home fixes a positive capital tax rate and abroad a zero tax rate. Suppose now an increase in λ: the abroad capital-labour ratio increases with respect to the home capital-labour ratio. As a consequence, home will import more capital and this, in its turn, implies an higher amount of capital taxes exported abroad. As the elasticity of the capital import function decreases with λ,[17] it will be easier to tax the capital at home and then to export the capital tax burden. Thus, home will be willing to increase its capital tax rate $\left(\frac{\partial t}{\partial \lambda} > 0\right)$ while abroad, which has become more tax importer, would like to decrease its tax rate $\left(\frac{\partial t^*}{\partial \lambda} < 0\right)$ but, since, by assumption, it can not set a negative tax rate, abroad will keep the same zero tax rate as before. In the case where γ increases, the abroad capital-labour ratio decreases and the effects are exactly the opposite of the previous ones $\left(\frac{\partial t}{\partial \gamma} < 0; \frac{\partial t^*}{\partial \gamma} > 0\right)$.

4. Tax harmonisation

In the previous section, we have seen how, the decision on fiscal policies, made by two benevolent dictators, within a non-cooperative game between two asymmetric countries leads to the adoption of a zero capital tax rate at least for one of them. As soon as the capital tax levels are different, capital-labour ratio is not equalised in the two countries, inducing a misallocation of resources. In other words, the tax competition arising between the countries leads to an inefficient Nash equilibrium. For this reason, we are interested in analysing the properties of some coordination mechanisms, as the imposition of a minimum level of capital taxation or the reduction of the tax differential between the two countries (tax convergence). It should be noted that a limit case of this last proposal is the full harmonisation of the two tax

[17] The elasticity of the capital importing country is defined as: $\varepsilon = \frac{\partial \left(K - \overline{K}\right)}{\partial t} \frac{t}{K - \overline{K}}$. Thus, $\frac{\partial \varepsilon}{\partial \lambda} < 0$.

systems. In the following, such a framework will be considered as a sort of benchmark, since whenever the capital tax rates in the two countries are set equal, this maximises the sum of the welfares of the two countries (both in the case where they are asymmetric and symmetric). The analysis on these kind of normative proposals will proceed by taking into account the European institutional setting, i.e. the unanimity rule which is used to decide on such topics. Indeed, any kind of proposal will be approved according to such a rule, only if it implies a Pareto improvement, i.e. both countries increase their welfare.

4.1. Minimum tax

The imposition of a minimum level of taxation has been already used to harmonise the indirect tax system of the European member states and, at the moment, it is in the agenda of the Commission also for the capital taxation.[18] In order to evaluate the welfare properties of such a normative proposal, firstly we will consider its effects on the welfare of each countries, since to be implemented at an European level it has to imply a Pareto improvement, otherwise it will not be approved by unanimity. Secondly, we will consider the effects of the proposal on the aggregate welfare, i.e. on the sum of the welfares of both countries.

In the benevolent dictator framework, consider the case 2a[19] where, behaving non-cooperatively, at equilibrium, home sets a positive capital tax rate ($\tilde{t}$ >0) and abroad a zero tax rate ($\tilde{t}$ *=0). Suppose that, at a sovranational level, a level $t_{\min} < \tilde{t}$ of capital tax rate is imposed. Then, abroad will have to increase its tax rate at least until the value of $t_{\min}$. This level of tax will be binding for abroad while home will react along its best-reply function in response to such a change. This is represented in the following figure, where *A* is the Nash equilibrium and *B* is the new equilibrium resulting after the imposition of the minimum tax rate.

[18] Commissione delle Comunità Europee, 20-3-1996.

[19] An equivalent reasoning holds for the case where $\lambda < \gamma$ (case 3a).

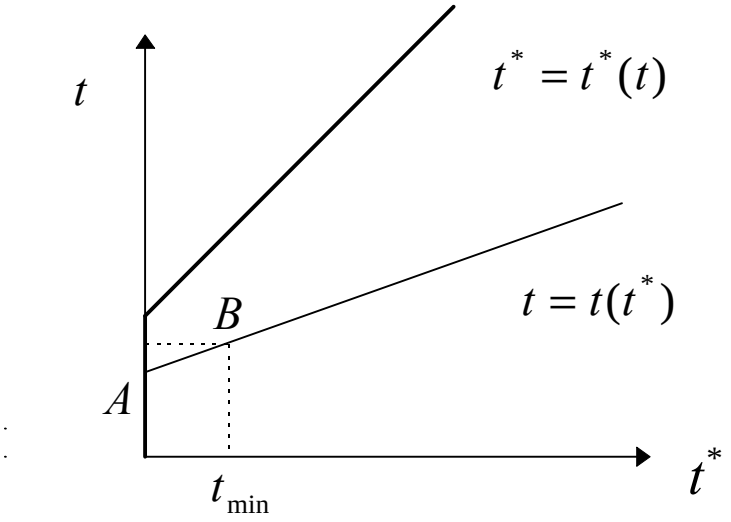

Fig. 2 (case 2a)

The first question in which we are interested in is whether passing from *A* to *B* increases or decreases the welfare of each country. In order to evaluate this effect, we analyse how the home and the abroad welfares, evaluated along the home best-replay function, vary when abroad increases its tax rate. The second question in which we are interested in is to verify which is the effect of the imposition of a minimum level of capital tax rate on the aggregate welfare with respect to the aggregate welfare obtained at the Nash equilibrium.

Proposition 1*: When countries are asymmetric, a minimum capital tax policy will never be accepted by unanimity rule.*

Proof: see the appendix.

The intuition behind this result is that the capital importer country will gain from a minimum tax policy, binding for the capital exporter country because, the importer country will be able to increase its capital imports and so to increase its export of the capital tax burden. On the contrary, it is obvious that the capital exporter country will loose from an increase in its tax rate since it will increase its imports of capital taxes. Thus, setting a minimum tax level is not a Pareto improvement and it will not be accepted according to the unanimity rule.

Nevertheless, we have to note that, from the aggregate point of view, the imposition of a minimum tax level increases the sum of the welfares of both countries with respect to the

Nash equilibrium. The reason for this is the following: since the slope of the reaction function of the capital importer country is less than one, an increase of the minimum tax level will decrease the tax spread between the countries, which in its turn implies a decrease of the capital-labour ratio spread, leading to an increase in the efficiency of the factors allocation.

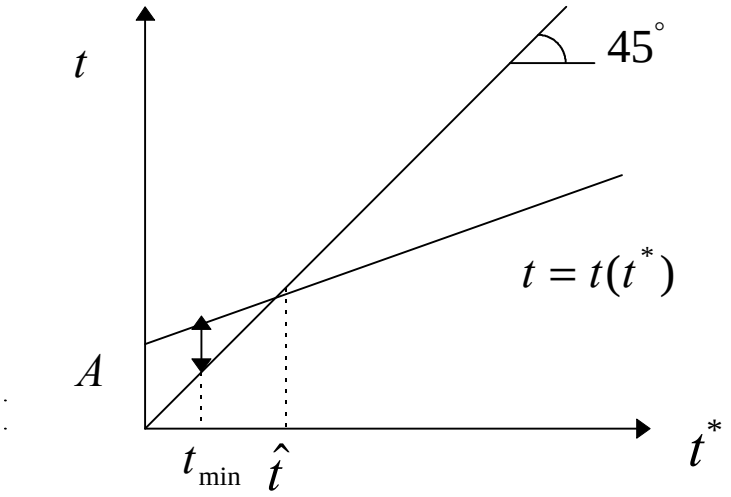

Fig. 3 (case 2a)

As we can see in figure 3, as $t_{\min}$ increases, the difference between the home tax rate and the abroad tax rate decreases up to the point where $t_{\min} = \hat{t}$. After this point, the minimum tax level is binding for both countries -i.e. complete harmonisation- leading to an optimal allocation of the factors of production: the sum of the welfares of the two countries is maximised.

On the contrary, when we consider the case of symmetric countries, the previous conclusion is modified:

Proposition 1 *: When countries are symmetric, they will be indifferent between the Nash solution and any level of minimum taxation.*

Proof: The symmetry of countries implies that when a minimum tax level is binding for one country is also binding for the other. This means that the imposition of a minimum tax level coincides with full harmonisation. We know that any kind of full harmonisation solution implies the maximisation of the aggregate welfare, i.e. the sum of the welfares of the two countries. Consequently, as soon as the two tax rates are set equal, the two countries maximise the sum

of their welfares, independently of the value of such a tax rate: at full harmonisation, capital will not have any incentive to move so that no country will be able to export its tax burden. As the aggregate welfare is the same for any tax level corresponding to full harmonisation, countries will be indifferent among these levels.

Surprisingly, in the symmetric framework, for both countries, the welfare obtained at the Nash equilibrium is equal to the welfare obtained with any value of minimum tax rate: the competitive solution does not imply a loss of efficiency.

In conclusion, we can state that the minimum tax proposal advocated for the European Community would be unanimously accepted only if countries were symmetric; as soon as they are asymmetric, with respect to their capital-labour endowment, such a proposal implies a welfare improvement for the capital importer country and a welfare loss for the capital exporter one.

4.2. Tax convergence

The second proposal, that we are interested in evaluating, concerns a reduction in the capital tax rate differential between the two countries, namely a capital tax convergence. This proposal, at the moment, is not in the agenda of the European Commission but it has been advocated as an objective to be implemented in the long run, within a more comprehensive project of full tax harmonisation.

In order to analyse if such a proposal implies a Pareto improvement with respect to the Nash equilibrium so that both countries will approve it under unanimity rule, we verify if, starting from a Nash equilibrium, there exists the possibility of increasing the welfares of both countries by mean of a tax convergence. With this respect, we state the following:

Proposition 2*: Starting from the Nash equilibrium, there exists Pareto improving tax reforms characterised by a tax convergence.*

Proof: see the appendix.

The intuition behind this result is the following: as the tax differential decreases, there is a convergence of the capital-labour ratio used in the production sector of both countries. This implies an improvement of the efficiency in the allocation of factors of production and consequently, an increase in the level of production, which leads to an increase in the total fiscal revenue. Indeed, this is exactly the minimum requirement in order to have a Pareto improvement: the size of the cake increases and this is why fiscal reform should induce a tax convergence. The level at which this convergence takes place defines the way the cake is shared. We have already seen that the optimum solution is the full convergence, where the level of the common capital tax rate can be interpreted as a side payment. Putting a high capital tax rate is equivalent to a large side payment from the capital importier country to the capital exporter country. Due to the unanimity rule, the capital tax level will be such that both countries will obtain at least the same welfare as the one corresponding to the Nash equilibrium.

Consequently, a reduction in the tax differential is Pareto improving and, more specifically, the range of tax rates corresponding to the Pareto set can be determined by the intersection of the two indifference curves with the contract curve. Call $\overline{welf}$ and $\overline{welf}^*$ the welfares, respectively, of home and abroad, at the Nash equilibrium. By solving the equations $welf\left(t,t^*\right)=\overline{welf}$ and $welf^*\left(t,t^*\right)=\overline{welf}^*$, we implicitly obtain the indifference curves of the two countries passing through the Nash equilibrium: $t^H=t^H\left(t^*\right)$ and $t^A=t^A\left(t^*\right)$, where *H* refers to home and *A* to abroad. It is easy to show that the home indifference curve is convex and that the abroad indifference curve is concave, on the relevant range:

$$\frac{\partial^2 t^H\left(t^*\right)}{\partial t^{*2}}>0 \qquad \frac{\partial^2 t^A\left(t^*\right)}{\partial t^{*2}}<0$$

By equalising the two marginal rates of substitution between *t* and t^* :

$$\frac{\partial t^H\left(t^*\right)}{\partial t^*}=\frac{\partial t^A\left(t^*\right)}{\partial t^*}$$

we can explicitly obtain the contract curve $t = t\left(t^*\right)$, which, in our case, is given by the 45° line. The level of the common tax rate which would be Pareto optimal depends on the bargaining power of the two countries. On the contract curve capital income taxation is fully harmonised. This means that, independently of the level of *t*, the capital-labour ratio is equal in the two countries, the capital flow is fixed and the aggregate welfare is maximised. The tax level chosen will determine the tax burden exported such that, if the capital importer country has a larger bargaining power than the other, the common capital tax rate will be set at a higher level than in the case where the capital exporter country has a larger bargaining power (see fig. 4 in the appendix). This is due to the fact that the larger *t*, the larger the tax burden that the capital importer country can export.

Obviously, in the case of symmetric countries, tax convergence already arises at the Nash equilibrium: as for the minimum tax proposal, full tax harmonisation takes place and the competitive solution does not imply a loss of efficiency.

5. Conclusions

The aim of this paper has been to analyse the inefficiencies arising because of fiscal competition between countries and the normative implications of some forms of policy coordinations aiming at increasing the welfares of both in order to be approved at the European level, by the unanimity rule. These issues have become particularly important since the European economic integration has reduced the barriers to the mobility of factors of production. If, on the one hand, this liberalisation should have improved the allocation of resources, on the other hand, the corresponding higher mobility of tax bases across the borders of the countries could have created new distortions: economic resources could be allocated only according to the principle of tax minimisation rather than to the principle of comparative advantage. In order to overcome these inefficiencies, due to tax competition arising in a non-cooperative institutional framework, some forms of tax cooperation have been proposed at an European level and analysed in the literature. Surprisingly, while a lot of work has been done to understand the normative properties of fiscal harmonisation with respect to commodity

taxation,[20] there have been only few attempts to analyse such issues in the case of capital taxation, even if capital is a particularly mobile factor of production.[21]

In order to evaluate the welfare properties of capital tax harmonisation, we have considered a model describing a world economy composed of two large asymmetric countries. After having analysed the Nash equilibrium arising in a non-cooperative setting, we have compared it with a cooperative framework. According to our results, under the assumption that countries are asymmetric, the minimum tax proposal will not be unanimously accepted while tax convergence can pass, since, in this case, there exists a range of tax rates for both countries, which implies a Pareto improvement. Consequently, the minimum tax project, recently proposed by the Committee of independent experts on company taxation (Ruding Report), will be difficulty approved by unanimity since countries, which are capital exporters and so tax importers, will decrease their welfare from such a proposal. On the contrary, the reduction of the tax differential between countries leads to a corresponding reduction of the capital-labour spread between countries, which increases the efficiency in the allocation of resources.

[20] Keen (1987), Sinn (1990), Kanbur and Keen (1993).
[21] See for example Lopez, Marchand and Pestieau (1996) where they evaluate the minimum tax proposal.

Appendix A

Proposition 1*: When countries are asymmetric, a minimum capital tax policy will never be accepted by unanimity rule.*

Proof:

The proposition will be proved for case 2a (an equivalent proof can be provided for case 3a). We prove that an increase in the abroad capital tax rate is not a Pareto improvement. Call $\hat{t} = \hat{t}(t^*)$ the home best-reply function, then the change in the home welfare ($welf$) is given by:

$$\frac{\partial\, welf\left(\hat{t}\left(t^*\right), t^*\right)}{\partial\, t^*} = \frac{2b(\lambda - \gamma)K + \gamma t^* \bar{L}}{2b(2+\gamma)} > 0$$

which is always positive since we are in the case where $\lambda > \gamma$. On the contrary, the abroad welfare ($welf^*$) is given by:

$$\frac{\partial\, welf^*\left(\hat{t}\left(t^*\right), t^*\right)}{\partial\, t^*} = \frac{2b(1+\gamma)(\gamma - \lambda)K - (3+2\gamma)\gamma t^* \bar{L}}{2b(2+\gamma)^2} < 0$$

which is always negative because $\lambda > \gamma$. €

Proposition 2*: Starting from the Nash equilibrium, there exists Pareto improving tax reforms characterised by a tax convergence.*

Proof:

Again the proof will be only made for case 2a. Recall that, by solving the equations $welf\left(t, t^*\right) = \overline{welf}$ and $welf^*\left(t, t^*\right) = \overline{welf}^*$, we implicitly obtain the indifference curves of

the two countries passing through the Nash equilibrium: $t^H = t^H\left(t^*\right)$ and $t^A = t^A\left(t^*\right)$, where *H* refers to home and *A* to abroad. We can represent these indifference curves in the following figure:

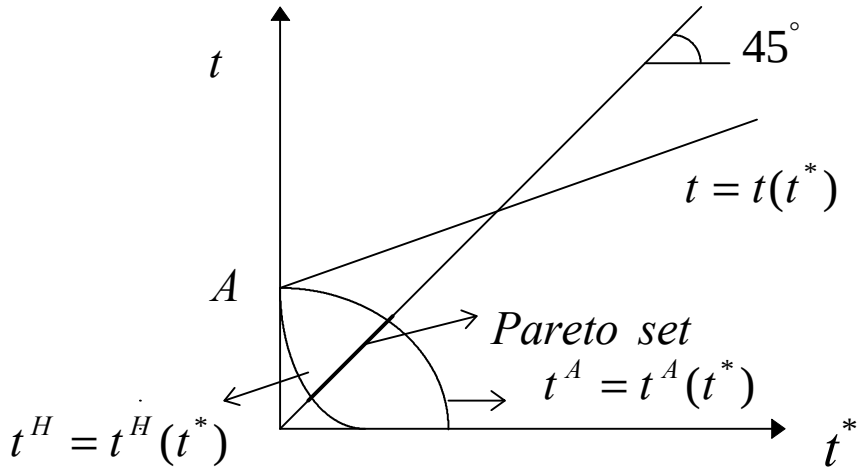

Fig 4 (case 2a)

Consider the home country. By definition of best-reply function and by the single-peakdness of the preferences, we know that, $\forall\ t^*$:

$$\frac{\partial\ welf\left(t,t^*\right)}{\partial\ t} > 0 \qquad \text{when } t < t(t^*)$$

$$\frac{\partial\ welf\left(t,t^*\right)}{\partial\ t} < 0 \qquad \text{when } t > t(t^*)$$

Analogously, for abroad, $\forall\ t$:

$$\frac{\partial\ welf^*\left(t,t^*\right)}{\partial\ t^*} > 0 \qquad \text{when } t^* < t^*(t)$$

$$\frac{\partial\ welf^*\left(t,t^*\right)}{\partial\ t^*} < 0 \qquad \text{when } t^* > t^*(t)$$

This implies that, the direction of increasing welfare for home is by movements on the right. By applying the same kind of reasoning to abroad, we can show that the direction of increasing welfare for abroad is by movements on the left. All the tax rates pairs within the two indifference curves, through the Nash equilibrium, correspond to Pareto improvements with respect to the competitive solution.

Further, at the Nash equilibrium, we can calculate the slope of the two indifference curves, by using the implicit function rule:

$$\left.\frac{\partial t^{H}\left(t^{*}\right)}{\partial t^{*}}\right|_{Nash} = -\frac{\dfrac{\partial welf\left(t,t^{*}\right)}{\partial t^{*}}}{\dfrac{\partial welf\left(t,t^{*}\right)}{\partial t^{H}}} = -\infty \qquad (1)$$

$$\left.\frac{\partial t^{A}\left(t^{*}\right)}{\partial t^{*}}\right|_{Nash} = -\frac{\dfrac{\partial welf^{*}\left(t,t^{*}\right)}{\partial t^{*}}}{\dfrac{\partial welf^{*}\left(t,t^{*}\right)}{\partial t^{A*}}} = -g \qquad (2)$$

Note that (1) is the maximum marginal decrease in t that home will accept in response to a marginal increase in t^{*}. This implies that every lower decrease in t will be welfare improving for home in response to a marginal increase in t^{*}:

$$\frac{\Delta t}{\Delta t^{*}} > \left.\frac{\partial t^{H}\left(t^{*}\right)}{\partial t^{*}}\right|_{Nash}$$

where Δt is the marginal tax reform at home and Δt^{*} the marginal tax reform abroad. Moreover, (2) is the maximum marginal increase in t^{*} that abroad will accept in response to a marginal decrease in t. This implies that every lower increase in t^{*} will be welfare improving for abroad in response to a marginal decrease in t:

$$\frac{\Delta t}{\Delta t^*} < \left.\frac{\partial t^A(t^*)}{\partial t^*}\right|_{Nash}$$

Thus, all tax pairs which satisfy the following:

$$\left.\frac{\partial t^H(t^*)}{\partial t^*}\right|_{Nash} < \frac{\Delta t}{\Delta t^*} < \left.\frac{\partial t^A(t^*)}{\partial t^*}\right|_{Nash}$$

are Pareto improvements. •

Appendix B

Sufficient conditions on G and G^* are provided to insure a positive net remuneration of labour.

The labor remuneration:

We have to find conditions on G and G^* such that:

$w(K(t,t^*),\bar{L},G) - t(t,t^*,G) \geq O$ and

$w^*(K^*(t^*,t),\bar{L},G^*) - t^*(t^*,t,G^*) \geq O$.

At home:

It is easy to show that $w(K(t,t^*),\bar{L},G) - t(t,t^*,G)$ is an increasing function of t^*. If the condition holds for t^*=0, it will holds for all t^*. It is also easy to see that $w(K(t,0),\bar{L},G) - t(t,0,G)$ is a single peaked function of *t*. Given that the optimal t will always be lower than the one corresponding to the maximum of the Laffer curve: $t^{\max}$ such that $t^{\max}K(t^{\max},0)$ is maximum ($t^{\max} = \frac{b(1+l)\bar{K}}{b\bar{L}}$), $w(K(t,0),\bar{L},G) - t(t,0,G)$ will have minimal values at *t=0* and at $t = t^{\max}$. Hence, we have to impose conditions on G insuring that those minimal values of $w(K(t,0),\bar{L},G) - t(t,0,G)$ are still positive. We have two conditions on G, one of those only will be binding:

G such that $w(K(0,0),\overline{L},G)-\tau(0,0,G)\geq 0 \Leftrightarrow G\leq b\left(\frac{1+\lambda}{1+\gamma}\frac{\overline{L}}{\overline{K}}\right)^{2}\overline{L}$.

G such that $w(K(t^{\max},0),\overline{L},G)-\tau(t^{\max},0,G)\geq 0 \Leftrightarrow G\leq b\frac{2+3\gamma}{4\gamma}\left(\frac{1+\lambda}{1+\gamma}\frac{\overline{L}}{\overline{K}}\right)^{2}\overline{L}$.

Abroad:

Following the same approach, we have the following sufficient conditions on G^{*} for the abroad country:

$G^{*}\leq b\gamma\left(\frac{1+\lambda}{1+\gamma}\frac{\overline{L}}{\overline{K}}\right)^{2}\overline{L}$ and

$G^{*}\leq b\gamma\frac{2+3\gamma}{4\gamma}\left(\frac{1+\lambda}{1+\gamma}\frac{\overline{L}}{\overline{K}}\right)^{2}\overline{L}$.

The capital remuneration:

Sufficient conditions on $\frac{\overline{K}}{\overline{L}}$ ensuring positive net capital remuneration will be provided only for equilibrium values of t and t^{*}. Those conditions are derived by solving the following inequations $r(K(t,t^{*}),\overline{L})-t\geq O$ and $r^{*}(K(t,t^{*}),\overline{L})-t^{*}\geq O$ for the equilibrium values of t and t^{*} with respect to $\frac{\overline{K}}{\overline{L}}$. We present the conditions referring to the previous tables 1 and 2, which show the different cases for the equilibrium of the fiscal game. In all cases, we only present the more binding conditions.

The median voter case (the equilibrium capital tax rates are presented in table 1 page 12):

k_m \ k_m^*	$\frac{1+\lambda}{1+\gamma}\frac{\overline{K}}{\overline{L}}$
$\frac{1+\lambda}{1+\gamma}\frac{\overline{K}}{\overline{L}}$	*case* 1 $\frac{\overline{K}}{\overline{L}} \le \frac{a\gamma}{b(1+\gamma+\lambda+\lambda\gamma)}$
	case 3 $\frac{\overline{K}}{\overline{L}} \le \frac{a(1+2\gamma)}{2b(1+\gamma+\lambda+\lambda\gamma)}$

case 2 $\frac{\overline{K}}{\overline{L}} \le \frac{a\gamma(2+\gamma)}{2b(1+\gamma+\lambda+\lambda\gamma)}$	
case 4 $\frac{\overline{K}}{\overline{L}} \le \frac{a(1+\gamma)}{2b(1+\lambda)}$	

Table 1'

The benevolent dictator case (the equilibrium capital tax rates are presented in table 2 page 15):

$\gamma < \lambda$	$\gamma > \lambda$	$\gamma = \lambda$
case 2*a* $\frac{\overline{K}}{\overline{L}} \le \frac{a\gamma(2+\gamma)}{2b(\gamma+\lambda+\lambda\gamma)}$	*case* 3*a* $\frac{\overline{K}}{\overline{L}} \le \frac{a(1+2\gamma)}{2b(1+\gamma+\lambda)}$	*case* 4*a* $\frac{\overline{K}}{\overline{L}} \le \frac{a(1+\gamma)}{2b(1+\lambda)}$

Table 2'

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