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International tax coordination: regionalism versus globalism

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Abstract

Tax competition for mobile capital can undermine the attempts of governments to redistribute income from rich to poor. I study whether international tax coordination can alleviate this problem, using a general equilibrium model synthesizing recent contributions to the tax competition literature. The model highlights the crucial distinction between global tax coordination and regional coordination. With high capital mobility between the tax union and the rest of the world, the welfare gain from regional capital income tax coordination is only a small fraction of the gain from global coordination, even if the tax union is large relative to the world economy.

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1. Introduction

The dramatic rise in international capital flows over the last two decades has fuelled the academic and public debate on the need for international coordination of capital income taxes. Many observers fear that lack of coordination will lead to a 'race to the bottom', as governments try to lure mobile capital into their jurisdiction by undercutting each others capital income taxes.

Much of the literature on tax competition supports the view that tax competition will drive source-based capital income taxes below their globally optimal level, and that an

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internationally coordinated rise in capital income taxes will, therefore, be welfare improving (see Wilson, 1999 for a survey). However, although standard models of tax competition have yielded important insights, they typically rely on a number of strong assumptions. For example, the canonical tax competition model of Zodrow and Mieszkowski (1986) assumes fixed factor supplies, perfect capital mobility, absence of pure profits, no foreign ownership of domestic firms, completely symmetric countries, and no endogenous fiscal instruments other than a source-based capital income tax. Standard analyses usually also assume that the alternative to tax competition would be global tax coordination among all countries in the world.

To serve as a more reliable guide to public policy, a model of tax competition and tax coordination must obviously relax these restrictive assumptions. The present paper develops a tax competition model, which allows for endogenous factor supplies, pure profits and foreign ownership, competition for mobile capital via several fiscal instruments, cross-country asymmetries, and imperfect capital mobility. The model also accounts for income inequality and redistributive taxation, thus allowing an analysis of the effect of tax competition on income distribution. Moreover, the model highlights the important distinction between global tax coordination versus coordination among of subgroup of countries, addressing the crucial question whether regional tax coordination within an area such as the European Union would simply divert capital from the coordinating region, thereby eroding the welfare gains from cooperation.

By setting up a model with these features, the paper offers a synthesis of the recent literature, which has gone beyond the standard tax competition model. To mention a few of these contributions, Bucovetsky and Wilson (1991) studied tax competition in a setting with two tax instruments and elastic supplies of capital and labor; Huizinga and Nielsen (1997) and Dickescheid (2000) analyzed how pure profits and foreign ownership of domestic firms affect the incentives for national governments to maintain positive capital income tax rates under tax competition; Fuest and Huber (2000) accounted for the possibility that capital tax coordination may lead to offsetting adjustments of other tax instruments; Bettendorf and Heijdra (1999) extended the model of Sørensen (1991) to study the effects of capital tax coordination under imperfect capital mobility; Bucovetsky (1991), Wilson (1991), Keen and Kanbur (1993) and Eggert and Haufler (1998) explored the consequences of differences in country size for the distribution of the gains from tax coordination; Keen and Marchand (1997) analyzed the effects of fiscal competition on the distribution of net fiscal burdens on mobile versus immobile factors; and Konrad and Schjelderup (1999) and Huizinga and Nielsen (2000) studied the effects of regional tax coordination among a subgroup of countries. In the present paper, all of these extensions of the basic tax competition model are incorporated in a single analytical framework.

A second main purpose of the paper is to offer quantitative estimates of the magnitude of the gains from tax coordination by simulating numerical versions of the model. For policy makers it is clearly important to know whether the gains from coordination could amount to several percent of national income rather than just a fraction of a percent. To answer such a question a quantitative analysis is needed. Wildasin (1989), Fuente and Gardner (1990) and Nødgaard and Nielsen (1999) have

previously provided quantitative estimates of the gains from capital tax coordination, but only within highly simplified models of the Zodrow–Mieszkowski type[1].

One important feature of my analysis should be noted from the outset: since taxes are levied on income which is unequally distributed, changes in the level of taxation achieved through tax coordination involve changes in income distribution. Hence the estimated welfare gains from tax coordination are not genuine Pareto efficiency gains, but include social gains from a more equitable distribution.

To preserve transparency, the model relies on simple functional forms. While this implies some loss of generality, it has several advantages. First, it avoids the black-box character of many applied general equilibrium models by allowing an analytical closed-form solution of the model. Second, it allows easy identification of the key parameters determining the quantitative properties of the model. Third, the simple functional forms allow a political economy interpretation of the process of fiscal policy making in the model.

In the sections below I will address the following questions: how does unfettered tax competition affect the level and structure of taxation? What is the likely magnitude of the welfare gains obtainable if all countries in the world could coordinate their tax policies? How are the size and distribution of the welfare gains affected if coordination only involves a subgroup of countries, and how are they influenced by asymmetries across countries?

I find that the gain from regional tax coordination is only a small fraction of the potential gain from global coordination if capital mobility is perfect. With imperfect capital mobility between the tax union and the rest of the world, there is greater scope for regional tax coordination, although the welfare gain will almost certainly be well below 1% of GDP and will accrue mainly to countries with high initial capital income tax rates.

The rest of the paper is structured as follows. In Section 2 I describe the general equilibrium model underlying my analysis and solve the model analytically for the fiscal policies emerging under tax competition, starting from the assumption of perfect capital mobility. Section 3 studies various forms of global tax coordination, while Section 4 focuses on the effects of regional coordination, comparing scenarios with perfect and imperfect capital mobility. In Section 5 I summarize my main conclusions[2].

2. A model of tax competition and tax coordination

My model of tax competition (called 'TAXCOM') is static, describing a stationary long-run equilibrium. Variations in endogenous variables may be interpreted as level

[1] Thalman et al. (1996) also studied the international spillover effects of capital taxation under imperfect capital mobility in a numerical model, but they did not allow for optimization of government policies. The recent paper by Mendoza (2001) analyzing tax harmonization in a numerical dynamic two-country model of capital accumulation also assumes exogenous policies as well as perfect capital mobility.

[2] An earlier version of the model was presented in a non-technical manner in Sørensen (2000). The present paper goes further by deriving optimal tax formulae, by studying the fiscal regimes of residence-based taxation and full global coordination, by discussing the regime of tax competition in greater depth, by incorporating cross-country differences in initial per-capita endowments, and by analyzing the case when tax competition leads to underprovision of public goods.

changes in a time path of exogenous steady-state growth. In each national economy firms combine internationally mobile capital with immobile labor and a fixed factor to produce a homogeneous internationally traded good[3]. Consumers have identical preferences, and each individual consumer is endowed with a predetermined stock of human as well as non-human wealth. These initial endowments are unevenly distributed, providing governments with a motive for redistributive taxation. A consumer may consume his initial non-human wealth immediately, or he may invest it in the capital market at a rising marginal transaction cost. In the latter case he accumulates a capital stock earning an interest which may be consumed along with the principal at the end of the period. The transaction cost may be thought of as the cost of financial intermediation; its role is analogous to the role played by consumer time preference in an explicitly intertemporal model. Weighing the transaction cost against the return to capital, the utility-maximizing consumer chooses to increase his capital supply ('savings') as the after-tax real rate of interest increases. While endowments are exogenous, the supply of productive capital is thus endogenous. Because of rising marginal disutility of work, utility maximization also implies that labor supply rises with the after-tax real wage rate.

An exogenous fraction of domestic firms is owned by foreign residents, so a fraction of domestic profits accrues to foreigners. Domestic residents likewise own a fraction of foreign firms, receiving a share of the profits generated in other countries. Within each country, the individual consumer's share of total profits equals his share of initial wealth.

Governments determine their fiscal policies by maximizing a social welfare function. Given our specification of preferences, this social welfare function may be interpreted as the indirect utility function of the median voter. Hence government policies may be seen as the outcome of a simple majority voting process.

The following sections provide a detailed description of the model. The equations refer to an individual country j, but the country subscript j is omitted to simplify notation when no misunderstanding is possible.

2.1. Firms

In all countries the representative firm produces the same composite good Y by means of capital K, effective labor input L, and a fixed factor ('land'). The supply of the fixed factor to each country is proportional to the country's exogenous population N, with a proportionality factor of unity. This ensures that large countries have no inherent productivity advantage over small countries, or vice versa. Adopting a Cobb–Douglas production function with multifactor productivity A and constant returns to scale, we thus have:

$$Y = AK^{\beta}L^{\alpha}N^{1-\alpha-\beta}, \quad 0 < \alpha < 1, \ 0 < \beta < 1, \ 0 < \alpha + \beta < 1 \tag{1}$$

[3] A more elaborate model would allow for imperfect substitutability between domestic and foreign goods. However, Gravelle and Smetters (2001) have shown that imperfect substitutability of goods has the same effect as imperfect substitution between domestic and foreign assets in reducing international flows of capital. In a rough manner, the model with imperfect capital mobility presented in section 4 of this paper may, therefore, also capture the effects of imperfect substitutability of goods.

Worker i is endowed with a fraction θ_i of the predetermined total stock of human wealth eN, where e is the per-capita endowment. The working hours of worker i—the rate at which his human capital is utilized—are h_i. Hence the effective labor input supplied by worker i is $\theta_i eNh_i$, and aggregate effective labor input is:

$$L = \sum_{i=1}^{N} \theta_i eNh_i, \quad 0 < \theta_i < 1 \text{ for all } i, \ \sum_{i=1}^{N} \theta_i = 1 \tag{2}$$

The competitive firm chooses the inputs of capital and all of the N types of labor to maximize its profits. With the output price normalized at unity, this yields the following first-order conditions, where τ is the capital income tax rate, ρ is the after-tax interest rate, $k \equiv K/N$ is the capital stock per worker, $\ell \equiv L/N$ is average effective labor input per worker, and $w \equiv (1/L)\Sigma_i w_i h_i$ is the average return to human capital:

$$\text{Demand for capital}: \quad \beta A k^{\beta-1} \ell^{\alpha} = \frac{\rho}{1-\tau} \tag{3}$$

$$\text{Demand for labour}: \quad \alpha A k^{\beta} \ell^{\alpha-1} = w \tag{4}$$

$$\text{Real wage of worker } i: \quad w_i = \theta_i eNw \quad i = 1, 2, \ldots, N \tag{5}$$

2.2. Households

The utility of worker/consumer i is given by the utility function:

$$U_i = C_i - \theta_i eN \cdot \frac{h_i^{1+\varepsilon}}{1+\varepsilon} + \frac{\gamma_2}{\gamma_1} G^{\gamma_1}, \quad \varepsilon > 0, \ 0 < \gamma_1 < 1, \ \gamma_2 > 0 \tag{6}$$

where C_i is private consumption and G is public (non-rival) consumption[4], common to all consumers. The specification of the consumer's disutility from work assumes that his opportunity cost of time spent in the labor market various varies positively with his productivity, proxied by his stock of human capital $\theta_i eN$. As we shall see in (9) below, this implies a negative wealth effect on individual labor supply which means that all consumers will end up supplying the same number of working hours, despite differences in individual wage rates.

At the beginning of the period, the economy is endowed with a total stock of non-human wealth equal to vN, where v is non-human wealth per capita. The fraction of aggregate non-human wealth owned by consumer i is θ_i (equal for simplicity to his share of human wealth). The consumer may consume his non-human wealth directly, or he may invest it in the capital market at a transaction cost c_i, thereby building up a capital stock k^s earning the after-tax return ρ. In addition to capital income, labor income, and a government transfer T, the consumer receives profit income from domestic and foreign firms. An exogenous fraction δ of domestic firms is owned by foreigners. At the same time

[4] It is immaterial for our analysis of optimal tax policies whether G is a genuine public good or a publicly provided private good.

consumers in domestic country j receive a fraction $(s_j/1-s_z)\delta_z$ of the profits generated in foreign country z, where s_n $(n=j, z)$ is country n's share of total world population so that $1-s_z$ is the fraction of world population residing outside country z. The profits paid out from each country are thus allocated across all the other countries in proportion to their population shares. Consumer i receives a fraction θ_i of all profit incomes earned by domestic residents, whether from domestic or from foreign sources. Under pure tax competition with no international exchange of information among tax collectors, governments cannot monitor and tax income from foreign sources, but they can tax all domestic-source capital income and profit income. We assume that, for administrative reasons, both of these types of income are taxed at the same effective rate τ_n $(n=j, z)$. With these assumptions consumer i in country j will be subject to the budget constraint:

$$C_i = \underbrace{w_i h_i(1-t)}_{\text{after-tax labour income}} + \underbrace{\rho k_i^s}_{\text{after-tax capital income}} + \underbrace{\theta_i vN - c_i}_{\text{endowment net of transaction cost}} + \underbrace{T}_{\text{government transfer}} + \underbrace{\theta_i N(1-\delta)(1-\tau)\pi}_{\text{after-tax domestic-source profits}} + \underbrace{\theta_i N \sum_{z=1, z\neq j}^{m} \left(\frac{s_z\delta_z}{1-s_z}\right)(1-\tau_z)\pi_z}_{\text{after-tax foreign-source profits}} \tag{7}$$

where t is the effective labor income tax rate (which may include social security taxes and indirect taxes); π and π_z are the pre-tax profits per capita in the domestic country j and in foreign country z, respectively; and m is the total number of countries in the world[5].

When the consumer transforms (part of) his initial non-human wealth $\theta_i vN$ into business capital k_i^s, his transaction costs c_i relative to his stock of wealth increase more than proportionally with his investment rate $k_i^s/\theta_i vN$:

$$\frac{c_i}{\theta_i vN} = \frac{1}{1+\varphi}\left(\frac{k_i^s}{\theta_i vN}\right)^{1+\varphi}, \quad \varphi > 0 \tag{8}$$

The consumer chooses h_i and k_i^s to maximize utility (6) subject to the constraints (7) and (8). The first-order conditions for the solution to this problem imply that:

$$h_i = \left[\frac{w_i(1-t)}{\theta_i eN}\right]^{1/\varepsilon} = [w(1-t)]^{1/\varepsilon} \tag{9}$$

$$k_i^s = \rho^{1/\varphi} \cdot \theta_i vN \tag{10}$$

where the last equality in (9) follows from (5). Note that $1/\varepsilon$ is the net wage elasticity of labor supply, while $1/\varphi$ is the net interest elasticity of capital supply. Notice also how net trade in goods comes about, despite the fact that there is only one good and one time period: to the

[5] To derive the last term on the right-hand side of (7), I use the fact that consumer i's total profit income from foreign country z is $\theta_i(s_j/1-s_z)\delta_z(1-\tau_z)N_z\pi_z$, plus the definitions $N_j \equiv s_j N^w$ and $N_z \equiv s_z N^w$, where N^w is total world population.

extent that a country's aggregate 'saving' (the initial transformation of wealth into business capital) falls short of its aggregate investment, it must run a trade surplus over the period to service the foreign debt incurred at the start of the period, and vice versa.

2.3. Government

Governments spend their tax revenues on the public consumption good G, on 'infrastructure' Q (broadly interpreted to include all types of productive spending) and on a redistributive lump sum transfer paid out in an identical amount T to all citizens. Since tax competition implies that taxes can only be levied on income generated within the domestic economy, the government is subject to the budget constraint:

$$T + \frac{G}{N} + Q = \underbrace{twh}_{\text{labour tax revenue}} + \underbrace{\tau\left(\frac{\rho}{1-\tau}\right)k}_{\text{capital income tax revenue}} + \underbrace{\tau\pi}_{\text{profits}} \tag{11}$$

where all variables except the public good G are measured on a per-capita basis. Note from (9) that all workers will supply the same number of work hours $h_i = h = [w(1-t)]^{1/\varepsilon}$, so h is the average working time per worker. The amount of productive government spending per capita (Q) does not yield direct utility, but it increases factor productivity, albeit at a diminishing rate:

$$A = Q^{\mu}, \quad 0 < \mu < 1 \tag{12}$$

The government in each country is concerned about the average level of individual welfare $\bar{U}$ and about the dispersion of individual utilities around this mean, as reflected in the following social welfare function:

$$\mathrm{SW} = \bar{U} - a\sqrt{\frac{1}{N}\left[\sum_{i=1}^{N}(U_i - \bar{U})^2\right]}, \quad a \geq 0 \tag{13}$$

where the square root measures the degree of inequality by the standard deviation of individual utilities, and where the parameter a indicates the degree of government aversion to inequality[6]. Inserting (7) through (10) into (6), and noting from (11) that the government transfer may be expressed as a function of the other fiscal policy instruments, $T = T(t, \tau, G, Q)$, we may write the indirect utility of consumer i in country j as:

$$\begin{aligned} U_i = {} & T(t, \tau, G, Q) + \frac{\gamma_2}{\gamma_1} G^{\gamma_1} \\ & + \theta_i N\left\{\frac{\varepsilon e h^{1+\varepsilon}}{1+\varepsilon} + v\left[1 + \frac{\varphi\rho^{(1+\varphi)/\varphi}}{1+\varphi}\right] + (1-\delta)(1-\tau)\pi \right. \\ & \left. + \sum_{z=1, z\neq j}^{m}\left(\frac{s_z\delta_z}{1-s_z}\right)(1-\tau_z)\pi_z\right\} \end{aligned} \tag{14}$$

[6] Eq. (13) is similar in spirit to the social welfare function adopted by Dixit and Londregan (1998).

Since $\bar{U} \equiv 1/N \sum_i U_i$ and $\sum_i \theta_i = 1$, it follows from (13) and (14) that:

$$\begin{aligned} \mathrm{SW} = {} & T(t,\ \tau,\ G,\ Q) + \frac{\gamma_2}{\gamma_1}\, G^{\gamma_1} \\ & + (1 - a\sigma)\left\{ \frac{\varepsilon e h^{1+\varepsilon}}{1+\varepsilon} + v\left[1 + \frac{\varphi \rho^{(1+\varphi)/\varphi}}{1+\varphi}\right] + (1-\delta)(1-\tau)\pi, \right. \\ & \left. + \sum_{z \neq j} \left(\frac{s_z \delta_z}{1 - s_z}\right)(1 - \tau_z)\pi_z \right\} \end{aligned} \tag{15}$$

$$\sigma \equiv \sqrt{\frac{1}{N} \sum_i (\theta_i N - 1)^2}$$

where σ is proportional to the standard deviation of individual wealth levels, reflecting the degree of inequality of the initial distribution of wealth. Comparing (14) and (15), we see that the fiscal policy implied by maximization of the social welfare function will coincide with the policy preferred by the consumer/voter with an initial wealth endowment satisfying $\theta_i N = 1 - a\sigma$. The indirect utility function (14) represents a case of so-called 'intermediate preferences', having the general form $U(t, \tau, G, Q, \theta_i) = J(t, \tau, G, Q) + f(\theta_i) Z(t, \tau, G, Q)$, where the functions $J(\cdot)$ and $Z(\cdot)$ are common to all consumers/voters, and the function $f(\theta_i) = \theta_i N$ is monotonic in θ_i. As demonstrated by Persson and Tabellini (2000) (pp. 25–26), when voters have preferences of this form, the policy package (t, τ, G, Q) preferred by the median voter (characterized by the median value of θ_i) will emerge as the Condorcet winner from a simple majority voting process. In other words, even though fiscal policy involves the choice of more than one policy instrument, voters' preferences for the multidimensional policy can be projected on a unidimensional space in which different voters can be ordered by their level of θ_i, ensuring that a version of the median voter theorem applies. Hence maximization of (15) is consistent with a democratic voting process if we set $a\sigma = 1 - \theta_m N$, where θ_m is the median value of θ_i[7]. Note that if we normalize the mean wealth levels by setting $e = v = 1$, the median voter's (human and non-human) wealth level $\theta_m N$ will always be less than one when the wealth distribution is skewed, implying $0 < a\sigma < 1$ for $a\sigma = 1 - \theta_m N$. According to (15) the restriction $a\sigma < 1$ will ensure that an increase in private factor income will always increase social welfare.

Before we proceed to describe the equilibrium with tax competition, a few remarks on the specification of capital income taxation are warranted. In a literal interpretation, the government budget constraint (11) and the capital demand function (3) assume that the source-based capital income tax τ is uniform, falling equally on debt-financed and equity-financed investment. Such uniformity would obtain under the so-called comprehensive business income tax proposed by the US Treasury (1992), or under a pure version of the Nordic-type dual income tax described in Sørensen (1994) and advocated by Cnossen

[7] As Michael Keen pointed out to me, under international tax competition voters in large countries with some influence on the world capital market might see a strategic interest in electing an 'atypical' policy maker whose preferred policy would induce other countries to undertake a favorable change in their fiscal policies. This theme is taken up by Persson and Tabellini (2000) (pp. 331–336) but will not be pursued here.

(2000) as a model for capital income taxation in the European Union. However, existing tax systems typically discriminate between debt and equity. Accounting for this, the capital income tax rate τ may be seen as a weighted average of the effective source tax on debt (which may be zero) and the effective source tax on equity, with the weight depending on an exogenous debt–equity ratio[8].

2.4. Equilibrium with tax competition

For given government policy instruments, a general equilibrium is attained when all private agents optimize their objective functions and national labor markets as well as the international capital market are clearing. In each country labor market equilibrium requires that the demand for effective labor input per worker $\ell \equiv L/N$ be equal to the effective labor supply per worker $(1/N)\sum_i \theta_i e N h_i = h = [w(1-t)]^{1/\varepsilon}$.

For the moment we assume that national capital markets are perfectly integrated into a single world capital market, so capital market equilibrium is realized when the global excess demand for capital is zero. According to (10) the per-capita supply of capital from country j is $1/N_j \sum_{i=1}^{N_j} k_{ij}^s = v_j \rho^{1/\varphi_j}$, since $\Sigma\, \theta_i = 1$. With perfect capital mobility and source-based taxation, the after-tax interest rate ρ will be equalized across countries, so ρ carries no country subscript. The global excess demand for capital per worker is the population-weighted average of the excess capital demand per worker $(k_j - v_j \rho^{1/\varphi_j})$ in individual countries, so the condition for global capital market equilibrium is:

$$\sum_{j=1}^{m} s_j (k_j - v_j \rho^{1/\varphi_j}) = 0 \tag{16}$$

Using (11) and noting from (9) that $w = h^{\varepsilon}/(1-t)$, we may write the government objective function (15) as:

$$\begin{aligned} \mathrm{SW}_j = {} & \left[(1-a_j\sigma_j)\left(\frac{\varepsilon_j}{1+\varepsilon_j}\right) + \left(\frac{t_j}{1-t_j}\right)\right][h_j(\rho,\ \tau_j,\ t_j,\ Q_j)]^{1+\varepsilon_j} + \frac{\gamma_{2j}}{\gamma_{1j}}\, G_j^{\gamma_{1j}} - \frac{G_j}{N_j} \\ & - Q_j + \left(\frac{\tau_j}{1-\tau_j}\right)\rho k_j(\rho,\ \tau_j,\ t_j,\ Q_j) + (1-a_j\sigma_j)\left[1 + \frac{\varphi_j \rho^{\varphi_j + 1/\varphi_j}}{1+\varphi_j}\right] \\ & + [(1-a_j\sigma_j)(1-\delta_j)(1-\tau_j) + \tau_j]\pi_j(\rho,\ \tau_j,\ t_j,\ Q_j) \\ & + (1-a_j\sigma_j)\sum_{z\neq j}\left(\frac{s_z\delta_z}{1-s_z}\right)(1-\tau_z)\pi_z(\rho,\ \tau_z,\ t_z,\ Q_z), \quad a_j\sigma_j < 1 \end{aligned} \tag{17}$$

[8] When applying the model to country-specific data in Section 4.2, I do not attempt to estimate the effective tax rates on debt and equity separately. Instead I rely on the estimates of Mendoza et al. (1994) of the total revenue from capital income taxes, assuming that (almost) all of this revenue stems from taxes on domestic-source capital income. In Sørensen (2002) I have developed a more elaborate simulation model allowing for an endogenous choice between debt and equity and for the different tax treatment of the two sources of finance.

where we have indicated that the equilibrium levels of employment (h), profits (π), and capital stock (k) will depend on fiscal policy.

The regime of pure tax competition is modeled as a Nash equilibrium where the government (median voter) of country j chooses the policy instruments t_j, τ_j, G_j and Q_j to maximize (17), taking the fiscal policies of all other governments as given. The first-order conditions for the optimal national fiscal policies (given in an appendix available from the author) can be shown to imply the following national fiscal policy rules, where the expression for the capital income tax rate has been simplified by assuming that all countries are symmetric:

$$N \cdot \gamma_2 G^{\gamma_1 - 1} = 1 \tag{18}$$

$$\frac{N \cdot Q}{Y} = \mu \tag{19}$$

$$t = \frac{1}{1 + (\eta^s / a\sigma)}, \qquad \eta^s \equiv 1/\varepsilon \tag{20}$$

$$\tau = \frac{(\omega/\beta)[1 - (1 - a\sigma)(1 - \delta)] + \Omega/m}{(\omega/\beta)[1 - (1 - a\sigma)(1 - \delta)] + \Omega/m + [\epsilon^s + ((m-1)/m)\epsilon^d]/(\epsilon^s + \epsilon^d)}, \tag{21}$$

$$\omega \equiv 1 - \alpha - \beta, \qquad \Omega \equiv \frac{\alpha a \sigma}{(\epsilon^s + \epsilon^d)(\omega\eta^s + 1 - \beta)}, \qquad \epsilon^s \equiv \frac{1}{\varphi},$$
$$\epsilon^d \equiv \frac{1 + \eta^s(\omega + \beta)}{\omega\eta^s + 1 - \beta}$$

Eq. (18) is the Samuelson condition for efficient public goods provision requiring the sum of the marginal rates of substitution between public and private goods (the left-hand side) to equal the marginal rate of transformation (the right-hand side). In contrast to the standard models of tax competition developed by Zodrow and Mieszkowski (1986), Wilson (1986) and Wildasin (1989) where public goods are underprovided, the present model thus implies that public consumption is always at its first-best level. The reason is that, at the margin, the government may always choose to reduce the uniform lump sum transfer by one unit in order to provide one more unit of public consumption. Hence it is as if public consumption is financed by a non-distortionary lump sum tax, as required for first-best efficiency in public goods supply.

Using (1) and (12), one can also show that (19) is equivalent to the condition for first-best efficiency $\partial Y/\partial Q = 1$, stating that the marginal output gain from an increase in infrastructure spending should equal the marginal resource cost of additional spending. Again, the fact that decisions on public input provision are undistorted hinges on the possibility of reducing the lump sum transfer to finance additional infrastructure. Notice, though, that since infrastructure spending will always make up a constant fraction of GDP (equal to the elasticity of multifactor productivity with respect to infrastructure spending),

the absolute level of Q will deviate from the optimal level if output is distorted by tax competition. As we shall see, this will indeed be the case.

Eq. (20) states that the tax rate on labor income will be higher, the lower the net wage elasticity of labor supply (η^s), the greater the inequality of the distribution of human wealth (σ), and the greater the social aversion to inequality (a).

The optimal capital income tax rate under tax competition is given in (21), where ω is the share of pure profits in GDP, ϵ^s is the net interest elasticity of capital supply from domestic residents, and ϵ^d is the numerical interest elasticity of domestic capital demand[9]. Eq. (21) highlights the effects of economic integration on the level of capital income taxation. Under autarky there are no international capital flows, and each national economy functions like a closed economy. This case is obtained by setting the number of countries (m) equal to 1 and the foreign ownership share (δ) equal to zero. When countries allow their capital markets to integrate, the number of jurisdictions competing for capital will rise above one ($m>1$), and the foreign ownership share δ will rise above zero. According to (21) these changes will have two offsetting effects on capital income tax rates. On the one hand the rise in the foreign ownership share will tempt each government to raise its source-based capital income tax rate, since it can thereby capture some of the pure rents accruing to foreign owners whose welfare does not count in the domestic political process. This incentive for 'tax exporting' is illustrated by the fact that $\partial\tau/\partial\delta>0$ in (21). On the other hand the move to an integrated capital market means that a higher tax rate on domestic investment will generate an outflow of capital to foreign countries. Each national government, therefore, perceives an increase in the elasticity of capital supply to the domestic economy and a concomitant increase in the perceived distortionary cost of capital income taxation. Ceteris paribus, this tends to induce a fall in the capital income tax rate. The larger the number of countries in the world, the higher is the elasticity of capital supply to each individual country, and the stronger is the downward pressure on capital income tax rates (the reader may verify from (21) that $\partial\tau/\partial m<0$). Whether this 'tax competition effect' on the capital income tax rate will dominate the offsetting tax exporting effect arising from foreign ownership is not clear a priori, as emphasized by Mintz (1994). However, in the present model one can show from (21) that a move from a single jurisdiction (autarky) to two competing jurisdictions (raising m from 1 to 2) will reduce the capital income tax rate if and only if the foreign ownership share in the scenario with two jurisdictions satisfies the condition:

$$\delta < \left(\frac{a\sigma}{2\epsilon^s(1-a\sigma)}\right)\left(\frac{\omega+\beta}{\omega}\right) \tag{22}$$

Recall from (14) and (15) that $1-a\sigma$ indicates the social weight attached to unevenly distributed factor income relative to evenly distributed transfer income, and that it may be interpreted as the median wealth level relative to the mean wealth level. A reasonable

[9] Note that ϵ^d is a 'general equilibrium elasticity' which allows for the fact that, as the capital stock goes up, the resulting increase in real wages will stimulate labor supply which in turn will provide a further stimulus to investment by raising the marginal productivity of capital. This effect via the labor market explains why the labor supply elasticity η^s appears in the expression for ϵ^d.

value for this parameter might be $1-a\sigma=0.8$. Recall also that ϵ^s measures the interest elasticity of saving, while ω is the pure profit share of GDP and β is the share of GDP representing the normal return to capital. If, say, $\epsilon^s=0.4$, $\omega=0.10$ and $\beta=0.2$, the foreign ownership share would have to be as high as 94% to violate condition (22). With a lower interest elasticity of saving and/or a lower pure profit share, it is even more unrealistic that the foreign ownership share could exceed the expression on the right-hand side of (22). Since we know that $\partial\tau/\partial m<0$, we can be sure that a move to a free-trade regime with more than two jurisdictions ($m>2$) would make it even more likely that the tax competition effect of capital market integration will outweigh the incentive for exporting the tax burden to foreign owners.

At least in the present framework we may, therefore, conclude that economic integration will almost surely put downward pressure on source-based capital income taxes. It is instructive to consider the limiting case where the individual country becomes so small relative to the world capital market that it loses its ability to influence the world interest rate. This case of the small open economy is obtained from (21) by letting m tend to infinity, yielding:

$$\tau \to \frac{(\omega/\beta)[1-(1-a\sigma)(1-\delta)]}{(\omega/\beta)[1-(1-a\sigma)(1-\delta)]+1} \quad \text{for } m \to \infty \tag{23}$$

Abstracting from pure profits ($\omega=0$), Gordon (1986) and Razin and Sadka (1991) projected that source-based capital income taxes will vanish altogether in small open economies faced with perfect capital mobility. For $\omega=0$ Eq. (23) has the same implication. However, with positive pure profits ($\omega>0$) the capital income tax rate will also remain positive. The reason is that the capital income tax serves partly as a non-distortionary tax on pure rents. It is, therefore, optimal for a small country to maintain a positive capital income tax rate even if it faces a perfectly elastic supply of capital from the world market. It also follows from (23) that the incentive to maintain a source-based capital income tax is stronger, the greater the fraction of pure profits accruing to foreigners ($\partial\tau/\partial\delta>0$). This role of the capital income tax in the presence of pure profits and foreign ownership was stressed by Huizinga and Nielsen (1997). These authors also showed that if it is administratively feasible to impose a separate tax on pure rents, it will indeed be suboptimal for a small open economy to levy a source-based tax on the normal return to capital.

Let us now consider the implications of tax competition for social welfare. Assuming for the moment that all countries are symmetric, we may interpret our single-jurisdiction case with $m=1$ as a scenario where all countries in the world have fully coordinated all of their fiscal policies. The case of $m=1$ may thus be taken as a benchmark in which all potential distortions from fiscal competition have been eliminated. Measured against this benchmark allocation—which is second-best optimal from a global perspective, given the distributional goals of governments—we have seen that the level of capital income taxes will almost surely be too low under tax competition. This inefficiency may be explained as follows: for the world economy as a whole, the elasticity of capital supply is given by the interest elasticity of saving in the representative country (ϵ^s). From a global viewpoint, this is the elasticity, which ought to form the basis for evaluating the welfare cost of capital

income taxation. But under tax competition national governments face the possibility of capital flight to other jurisdictions. Hence they perceive a much higher elasticity of capital supply to the domestic economy, and consequently they set a lower capital income tax rate than a policy maker adopting a global perspective. Wildasin (1989) offered a complementary explanation in terms of fiscal externalities: if the domestic government lowers its source tax on capital, thereby increasing the marginal profitability of domestic investment, it will attract capital from abroad. This capital flow causes a fall in the foreign activity level which reduces foreign welfare, since the preexisting distortionary taxes on capital and labor imply that the marginal social (pre-tax) return to investment and employment exceeds the marginal private (after-tax) opportunity cost of increased investment and employment. Because each government neglects the negative effect of a lower domestic capital tax on foreign economic activity, governments tend to set their source-based capital taxes at an inefficiently low level in a Nash equilibrium with tax competition.

From the earlier contributions by Bucovetsky and Wilson (1991) and Fuest and Huber (1999) one might expect that tax competition would also put downward pressure on labor tax rates. Yet we see from (20) that the labor income tax rate is not affected by the number of jurisdictions (m). This is due to two special features of the present model. First, our specifications imply a constant net wage elasticity of labor supply and zero cross factor price effects on factor supplies (see (9) and (10)). Hence the labor supply elasticity determining the distortionary effect of the labor tax is not affected by the change in the equilibrium interest rate which occurs as tax competition intensifies. Second, because the redistributive transfer adjusts endogenously to balance the budget, there is no need to change the labor tax rate even if tax competition forces a change in the capital income tax rate. Because of these two facts the government has no need and no incentive to change the labor income tax rate as the number of jurisdictions goes up. Intuitively, because the capital income tax rate is a more direct and hence more effective instrument for affecting capital flows, the government will only wish to use this instrument to attract mobile capital and will set the labor tax rate solely with a view to trading off the desire for redistribution against the distortions to labor supply (which are unaffected by capital mobility in the present model). However, if tax coordination prevents the government from using the capital tax, it will indeed wish to reduce the labor tax in order to stimulate labor supply and attract mobile capital, as we shall see in the next section.

From (18) and (19) we have also seen that tax competition will neither distort the level of public consumption nor the ratio of infrastructure spending to GDP. However, since tax competition stimulates investment by driving down the capital income tax rate, it will raise GDP above the level, which would prevail under full global coordination. Relative to this benchmark, the absolute level of infrastructure spending will, therefore, also be too high under tax competition[10]. With excessive spending on infrastructure and inadequate capital taxation, we may conclude that redistributive transfers will be too low under tax competition. In short, the problem with tax competition is not that it leads to underprovision of public goods, but rather that it generates too little redistribution, given our

[10] This result is in line with Keen and Marchand (1997) who also found that fiscal competition will tend to raise the level of infrastructure spending relative to government consumption. For a further analysis of public input provision under fiscal competition, see Arnold and Fuest (1999) and Haufler and Schjelderup (1999).

egalitarian social welfare function. The next section will present an estimate of the resulting welfare loss.

3. Global tax coordination

An influential writer like Tanzi (1999) has argued that we need a World Tax Organization as an institutional forum for global tax coordination. Although policy makers may not yet be prepared to go that far, it is of interest to study the gains, which might be reaped if all countries in the world could coordinate their tax policies. As a benchmark, this section will focus on global coordination among symmetric countries. The unrealistic symmetry assumption is made deliberately to isolate the effect of capital mobility on tax policies in a world without policy coordination. By considering the tax competition effects of capital mobility within a group of identical countries, we may gain a better understanding of the implications of the cross-country asymmetries to be considered later on.

The first column in Table 1 summarizes the equilibrium with tax competition emerging for a set of plausible parameter values reported in the note to the table. To evaluate the plausibility of the calibration, note that, in equilibrium, α is the labor income share of GDP, β is the normal return to capital relative to GDP, and μ is the share of GDP absorbed by public infrastructure spending, broadly interpreted to include all forms of productive government spending. The level of the various macroeconomic variables in this initial equilibrium is set at index 100[11]. The second column in Table 1 shows the equilibrium obtained in the hypothetical case of full global coordination ($m=1$ and $\delta=0$). This scenario illustrates the maximum potential gains from international fiscal cooperation.

The first thing to note from Table 1 is that the tax rate on labor income is not affected by the switch from tax competition to full coordination, for the reason already explained above. The effective tax rate on capital income, however, is raised almost to the level of the labor income tax, suggesting that a uniform comprehensive income tax would be close to optimal from a global perspective, given the calibration of the model.

In the previous section we noted that tax competition generates too much spending on infrastructure measured in absolute terms. A regime shift to full fiscal coordination, therefore, involves a cut in infrastructure spending, as shown in Table 1. The combination of lower infrastructure spending and higher capital taxation enables governments to increase their redistributive transfers significantly in the cooperative equilibrium. The higher level of capital taxation causes some fall in economic activity, and by increasing the relative scarcity of capital via lower savings, it raises the real interest rate and lowers real wages. Despite the fall in GDP, the representative country enjoys a social welfare gain of almost 1% of initial GDP, because the gain from a more equitable income distribution outweighs the fall in aggregate income.

The regime with full global coordination is extremely demanding in terms of international cooperation, so it is obviously relevant to consider other forms of tax coordination

[11] Since the level of public consumption will be the same under all fiscal regimes, this variable is not recorded in the tables.

Table 1
Tax competition vs. global tax coordination among symmetric countries

	Tax competition	Full global coordination	Global residence principle	Global minimum capital tax rate
Policy variables				
Tax rates on capital income and profits (%)	12.7	42.3	40.0	43.4
Labor income tax rate (%)	44.4	44.4	47.2	36.4
Transfers	100.0	177.0	183.0	143.0
Infrastructure spending	100.0	95.0	89.0	113.0
Other variables				
Capital stock	100.0	88.0	88.0	88.0
Employment	100.0	99.0	98.0	103.0
Profits	100.0	95.0	94.0	99.0
GDP	100.0	95.0	94.0	99.0
Average real wage rate	100.0	96.0	96.0	97.0
Real interest rate	100.0	109.0	107.0	112.0
Welfare gain from coordination (% of GDP)	–	0.94	0.90	0.76

Source: Simulations with the TAXCOM model. Calibration: $\alpha = 0.6$; $\beta = 0.3$; $\delta = 0.25$; $1 - a\sigma = 0.8$; $1/\varepsilon = 0.25$; $1/\varphi = 0.4$; $\mu = 0.1$; $e = v = 1$; $s = 1/17$.

leaving more fiscal autonomy to national governments. The third column in Table 1 shows the implications of enforcing the residence principle of capital income taxation on a global basis. This requires coordination in two ways. First, governments must engage in international exchange of information enabling each country to monitor and tax the foreign investment income of its residents. Second, to avoid international double taxation, source countries must give up their right to tax domestic-source income accruing to foreigners. To facilitate tax enforcement, source countries might impose a preliminary withholding tax on inward foreign investment. The revenue would be transferred to the residence country (possibly via an international clearing union), and the residence country would grant the taxpayer a credit for the foreign withholding tax against his home country tax bill (see Giovannini, 1989 for an elaboration of such a proposal).

Under a pure residence principle perfect capital mobility will ensure a cross-country equalization of pre-tax interest rates at the common global level r, since each individual investor will be taxed at the same rate on his foreign-source and his domestic-source interest income. The government budget constraint for country j then becomes:

$$T_j = \overbrace{t_j w_j h_j}^{\text{labour tax revenue}} + \overbrace{\tau_j \left[r k_j^s + (1-\delta_j)\pi_j + \sum_{z \neq j} \left(\frac{s_z \delta_z}{1 - s_z} \right) \pi_z \right]}^{\text{revenue from taxation of interest and profits}} - Q_j - \frac{G_j}{N_j} \qquad (24)$$

Furthermore, the social welfare function (15) must be slightly modified to account for the fact that foreign-source profits are now subject to domestic rather than foreign capital income tax. Accounting for (24), each national government will maximize the modified social welfare function with respect to the four policy instruments G_j, Q_j, t_j, and τ_j. For a

world of small symmetric economies, the first-order conditions for the solution to this problem can be shown to imply that:

$$\tau = \frac{1 + (\omega/\beta)}{1 + (\omega/\beta) + (\epsilon^s/a\sigma)} \tag{25}$$

Eq. (25) illustrates how optimal tax policy must trade off the tax distortions to saving (determined by the savings elasticity ϵ^s and the ratio of rents to normal returns ω/β) against the desire to redistribute income (captured by $a\sigma$). As the ratio ω/β of pure profits to interest income increases, the capital income tax falls to a larger extent on the fixed factor and will, therefore, be less distortionary. According to (25) this will raise the level of capital income taxes. In contrast to the regime with source-based taxation, we see that the capital income tax rate in the small open economy will be positive (and possibly quite high) even in the absence of pure profits ($\omega = 0$). The reason is that a switch to residence-based taxation eliminates tax competition by enabling individual governments to raise their capital income tax rate without provoking a capital flight to foreign tax havens outside the reach of the domestic fisc. As shown in the third column of Table 1, capital income tax rates would then be raised almost to the level that would be chosen under full global coordination, and countries would reap practically all of the potential welfare gains from coordination without sacrificing the right to set their capital income tax rate independently of each other (compare the welfare figures in the second and third columns of Table 1). The failure to reap the full gains from coordination would mainly arise from the fact that national governments do not account for the welfare of foreign owners of domestic firms. Thus labor would be overtaxed, because the loss of profit resulting from lower employment would fall partly on foreigners. Moreover, governments would spend too little on infrastructure, because part of the increase in domestic profits resulting from a better infrastructure would accrue to foreigners, and because source countries could no longer tax that part of profits, just as they could no longer tax the normal return to the increased inward foreign investment. However, according to Table 1 the negative welfare effects of these fiscal externalities would be miniscule.

Despite the attractive features of the global residence principle, this tax regime may be difficult to sustain, since it relies on the willingness of source countries to assist in collecting revenues, which end up in the coffers of foreign residence countries[12]. The fourth column in Table 4, therefore, considers an alternative type of tax coordination taking the form of a minimum source-based capital income tax rate which is binding for all countries. This minimum tax rate is chosen so as to maximize the population-weighted sum of social welfare for all countries, accounting for the fact that national governments will set their remaining fiscal instruments to maximize their own welfare, given the binding minimum capital tax rate. In game-theoretic terms, the coordinating world tax authority plays the role of a Stackelberg leader, with national governments acting as followers in the fiscal policy game. Table 1 shows that this form of coordination will ensure a capital income tax rate roughly equal to the one chosen under full global coordination. However, as capital income tax competition is neutralized, governments will

[12] As pointed out by Tanzi and Zee (1998), international information exchange is hampered by administrative, judicial and political problems, including the tradition of bank secrecy in several countries.

use other fiscal instruments more aggressively in their efforts to attract mobile capital: to boost the profitability of domestic investment, they will increase infrastructure spending and seek to stimulate labor supply by cutting the tax rate on labor. Indeed, the incentive to cut the labor income tax rate is strengthened as higher infrastructure spending raises the marginal productivity of labor, thereby increasing the attractiveness of boosting labor supply through lower labor taxes. Despite these added distortions to other fiscal variables, the coordination of capital income tax rates nevertheless enables countries to reap the bulk of the potential gain from full coordination.

The important and encouraging message from Table 1 is that even if countries can only coordinate their tax policies to a limited extent, by exchanging information or agreeing on a common minimum capital income tax rate, they can apparently realize most of the maximum potential gains from coordination.

4. Regional tax coordination

4.1. Regional coordination with symmetry countries

Yet, although governments have taken some faltering steps towards global coordination of trade and environmental policies, at the present stage of international integration they would hardly be able to agree on tax coordination at a global level. Indeed, if one goes beyond the present paper by assuming endogenous coalition formation, the theoretical analysis of Burbidge et al. (1997) has shown that global tax coordination does not arise in equilibrium when the notion of coalition-proofness is chosen as an equilibrium concept. This section, therefore, considers the implications of regional tax coordination within a subgroup of the world's countries which I will denote the 'union' for convenience. To what extent will regional coordination of capital income taxation be welfare-improving, given that tax competition will continue to dominate the relations between the union and the rest of the world? Except for the contribution by Konrad and Schjelderup (1999), this important issue has been subject to very little formal analysis.

In the first two columns in Table 2, I consider the effects of regional coordination in a world economy with symmetric countries and perfect capital mobility. Parameter values are identical to those underlying Table 1, so the results are directly comparable to the effects of global coordination. The first column restates the initial equilibrium with tax competition. The second column considers the effects of introducing a binding minimum source-based capital income tax within a tax union consisting of nine countries which in total represent a little over half the world population. The world outside the tax union consists of eight countries of equal size. The union's capital income tax rate is chosen to maximize the sum of the social welfare for union countries, taking the fiscal policies of the rest of the world as given, but accounting for the optimal fiscal policy response of union member states to the mandated minimum capital tax[13]. The union as a whole has an impact

[13] In other words, when setting the union's capital tax rate, the union authority anticipates how the union member states will optimally adjust their remaining national fiscal policy instruments. At the same time the union plays Nash vis á vis the rest of the world.

Table 2
Effects of a regional minimum capital tax rate (figure for union countries/figure for rest of the world)[a]

	Perfect capital mobility between tax union and ROW		Imperfect capital mobility between tax union and ROW[b]	
	Tax competition[c]	Regional tax coordination[d]	Tax competition[e]	Regional tax coordination
Policy variables				
Tax rate on capital income and profits (%)	12.7	18.6/12.9	13.0/26.7	31.6/30.2
Labor income tax rate (%)	44.4	42.9/44.4	44.4/44.4	39.5/44.4
Transfers	100	106.4/103.5	100/100	121/109
Infrastructure spending	100	101.3/101.5	100/100	107/113
Other variables				
Capital stock	100	94.4/104.1	100/100	87/108
Employment	100	100.3/100.3	100/100	101.1/100.8
GDP	100	98.6/101.5	100/100	97.3/104.2
Welfare gain from coordination (% of GDP)	–	0.075/0.191	100/100	0.426/0.558

Source: Simulations with the TAXCOM model.

[a] The common parameter values for all scenarios are as follows: $\alpha = 0.6$; $\beta = 0.3$; $\delta = 0.25$; $1 - a\sigma = 0.8$; $1/\epsilon = 0.25$; $1/\varphi = 0.4$; $\mu = 0.1$; $e = v = 1$.

[b] Elasticity of substitution between union and non-union assets (ξ) = 6; degree of home bias (Ψ) = 0.75.

[c] The world economy consists of 17 countries each comprising 1/17 of world population.

[d] The tax union consists of 9/17 of world population.

[e] The world economy consists of 12 potential union countries each comprising 4.66% of world population and a non-union country comprising 44% of world population.

on world capital demand and supply which is much larger than the impact of each individual union country. In setting the capital income tax rate, the union authority accounts for its stronger impact on the world interest rate which implies a lower elasticity of capital supply to the union as a whole, compared with the elasticity faced by the individual member state. Hence regional coordination involves some increase in capital income taxes within the union. A comparison between Tables 1 and 2 reveals that, due to capital flight to the non-union area, regional coordination of capital income taxation will generate only one tenth of the welfare gain which could be reaped if all countries in the world could agree to a binding minimum capital tax. The reallocation of capital towards non-union countries increases activity levels, tax revenues and public transfers outside the union. Ironically, the rest of the world, therefore, enjoys a larger welfare gain than the union, although the gains relative to GDP are modest for both regions.

According to the theoretical analysis of Konrad and Schjelderup (1999), regional coordination of capital income taxation is sure to improve the welfare of all countries in the world if capital income taxes are strategic complements, since a rise in one country's capital tax rate will then induce tax increases in other countries, thereby helping to bring the general level of taxation closer to the global optimum. The simulations presented here indicate that such strategic complementarity will indeed prevail, since the higher capital tax rate in the union induces non-union countries to raise their own capital tax rates a bit. To understand this complementarity, note that under source-based taxation a lower interest

rate raises domestic welfare by raising domestic activity. A large country or region can drive down the world interest rate by lowering the world demand for capital through a rise in its capital income tax rate. In the present model, the rise in domestic welfare generated by a fall in the interest rate is larger, the lower the initial interest rate[14]. Thus, when the union countries drive down the world interest rate by raising their capital income tax rate, they increase the incentive for non-union countries to raise their capital tax in order to benefit from a further fall in the world interest rate.

Despite the strategic complementarity of source-based capital income taxes, the first two columns of Table 2 carry the disappointing message that the welfare gains from regional tax coordination are likely to be very modest when capital is perfectly mobile throughout the world. However, regional coordination may be motivated by the fact that the coordinating countries are more integrated with each other than with the rest of the world. For example, in the context of Economic and Monetary Union in Europe, it seems reasonable to assume that the EU countries are particularly deeply integrated. In the last two columns of Table 2, I therefore consider regional tax coordination in a world economy with perfect capital mobility within the tax union, but imperfect capital mobility between the union and the rest of the world. In the present model which does not explicitly allow for uncertainty, an incentive for portfolio diversification can be generated by assuming that the total capital stock supplied by consumer i in the representative union country is a CES-aggregate of capital supplied to the union area, k_i^{su}, and capital supplied to the non-union area, k_i^{sn}:

$$k_i^s = [\Psi^{-(1/\zeta)}(k_i^{su})^{(\zeta+1)/\zeta} + (1-\Psi)^{-(1/\zeta)}(k_i^{sn})^{(\zeta+1)/\zeta}]^{\zeta/(\zeta+1)},$$
$$\zeta > 0, \quad 0 < \Psi < 1 \tag{26}$$

With a finite substitution elasticity ζ between the two asset types, this specification implies that the total capital stock tends to be more productive if it is spread across the two regions rather than concentrated in one region[15]. The consumer's total income from capital is $\rho k_i^s = \rho_u k_i^{su} + \rho_n k_i^{sn}$, where ρ_u is the after-tax interest rate prevailing within the union (which is common to all union countries due to perfect intra-union capital mobility), and ρ_n is the after-tax interest rate in the non-union area, and where ρ is the 'average' net rate of return on capital. Having optimized his aggregate capital stock k_i^s in accordance with (10), the consumer allocates this stock between union and non-union assets so as to maximize his total net income from capital $\rho_u k_i^{su} + \rho_n k_i^{sn}$, subject to (26). The first-order conditions for the solution to this problem imply that:

$$k_i^{su} = \left(\frac{\rho_u}{\rho}\right)^{\zeta} \Psi k_i^s, \qquad k_i^{sn} = \left(\frac{\rho_n}{\rho}\right)^{\zeta} (1-\Psi) k_i^s \tag{27}$$

$$\rho = [\Psi \rho_u^{\zeta+1} + (1-\Psi)\rho_n^{\zeta+1}]^{1/(\zeta+1)} \tag{28}$$

[14] The specifications of tastes and technology imply that each country's demand for capital is iso-elastic. Hence the capital demand curve is convex to the origin in (K, r)-space. When the interest rate falls, the welfare-improving rise in domestic investment will, therefore, be larger the lower the initial interest rate.

[15] For a simpler way of modeling imperfect capital mobility by introducing exogenous transactions costs in the arbitrage condition, see Lee (1997).

The portfolio allocation of non-union residents is described by similar equations, and the single capital market equilibrium condition (16) is now replaced by two separate equilibrium conditions; one requiring balance between capital demand and supply within the union, and another one requiring clearing of the non-union capital market. Note that the empirically observed 'home bias' in investor portfolios can be modeled by setting $\Psi>0.5$ in (27) and (28).

In the last two columns of Table 2, I assume that the non-union area is represented by a single country ('United States') whereas the union ('European Union') consists of 12 identical countries representing a total of 56% of world population (corresponding roughly to the actual economic weight of the EU relative to the US). While perfect capital mobility implies that the elasticity of substitution between union and non-union assets is infinitely high, this substitution elasticity is set equal to 6 in the last two columns of the table. Since the lower degree of asset substitutability reduces the elasticity of capital supply to the union area, regional tax coordination is seen to imply a much larger increase in the union capital income tax rate, compared with the scenario with perfect capital mobility throughout the world. As a result, the non-union area will also raise its capital income tax by a larger amount, so the whole world will move considerably closer to the second-best optimal level of capital income taxation which would prevail under full global coordination. Given the assumed parameter values, the welfare gains from regional coordination will amount to about half of the potential gain from full global coordination. Of course the estimated gain from coordination will depend on the elasticity of substitution between union and non-union assets. The lower this elasticity, the more the union will function like a closed economy, and the smaller the difference between the gains from regional rather than global coordination. In the next section we shall present an empirical application of the model in which the assumed substitution elasticity of 6 seems to be plausible.

4.2. Regional coordination with asymmetric countries

To focus on the tax policy implications of capital mobility, I have so far abstracted from cross-country asymmetries in economic structures. Is it possible that such asymmetries could generate a highly uneven distribution of the gains from coordination? To investigate this issue, Table 3 presents a calibration which enables the model to roughly replicate the observed level and pattern of taxation in Western Europe and the United States as an equilibrium with tax competition by assuming differences in pure profit shares, foreign ownership shares, initial endowments, and social preferences for redistribution. The figures in brackets are empirical estimates of average effective tax rates, produced by Volkerink and de Haan (1999) using the methodology of Mendoza et al. (1994). Western Europe can be naturally divided into the Nordic countries, Continental Europe, and the United Kingdom. Within each of these subregions the level and pattern of taxation is fairly homogeneous, as documented by Sørensen (2001), Table 1.

For the model to reproduce the observed level of capital income taxation, it is necessary to assume a fairly high pure profit share of GDP. Profits are interpreted to

Table 3
Calibration of the TAXCOM model with asymmetric countries

	Nordic countries[a]	Continental Europe[b]	United Kingdom	United States
Wage share of GDP (α)	0.70	0.70	0.70	0.70
Capital income share of GDP (β)	0.13	0.16	0.12	0.12
Pure profit share of GDP ($1-\alpha-\beta$)	0.17	0.14	0.18	0.18
Foreign ownership share (δ)	0.33	0.31	0.33	0.17
Social weight given to factor income relative to transfer income ($1-a\sigma$)	0.69	0.73	0.85	0.89
Wage elasticity of labor supply ($1/\varepsilon$)	0.25	0.25	0.25	0.25
Interest elasticity of capital supply $1/\varphi$)	0.5	0.5	0.5	0.5
Elasticity of factor productivity w.r.t. infrastructure spending (μ)	0.1	0.1	0.1	0.1
Elasticity of substitution between union and non-union assets (ξ)	6	6	6	6
Degree of home bias[c]($\Psi/(1-\Psi)$)	75/25	75/25	75/25	75/25
Per-capita endowment of human wealth (e)	0.4	0.9	0.52	1
Per-capita endowment of non-human wealth (v)	0.85	0.78	0.65	1
Share of world population[d](s)	0.04	0.42	0.10	0.44
Model equilibrium with tax competition[e]				
Tax rate on labor income (%)	55.4 (55.8)	51.9 (53.0)	37.5 (35.6)	30.6 (31.1)
Tax rate on capital income (%)	41.6 (42.2)	32.3 (28.1)	40.9 (45.3)	41.8 (41.1)
Real GDP per capita	78 (79)	75 (75)	68 (69)	100 (100)
Ratio of GNP to GDP	96.9 (97.0)	99.8 (99.5)	99.7 (99.5)	100.4 (100.4)
Transfers in percent of GDP	32.2	27.0	19.5	14.9
Infrastructure spending in percent of GDP	10.0	10.0	10.0	10.0
Public consumption in percent of GDP	9.0	9.0	9.0	9.0

Source: Empirical estimates of average effective tax rates were taken from Volkerink and de Haan (1999); estimates of real PPP-adjusted GDP (for 1997) and of the ratio of GNP to GDP were based on OECD National Income Accounts.

[a] Denmark, Finland, Norway and Sweden.

[b] Defined here as Austria, Belgium, France, Germany, Italy, Netherlands and Spain.

[c] A degree of home bias equal to 75/25 means that union (nonunion) residents will invest 75% (25%) of their capital within the union and the remaining 25% (75%) in the rest of the world if the after-tax rate of return is the same in the two regions.

[d] The Nordic region is divided into four equally large countries each comprising 1% of world population. Continental Europe is divided into seven countries each including 6% of world population.

[e] The figures in brackets are empirical estimates for 1991–1995.

include all quasi-rents in addition to conventional natural resource rents. While quasi-rents in any given firm or sector are wiped out by competition in the long run, new quasi-rents keep popping up as a result of continuing technological and structural change. Hence quasi-rents are never eliminated at the macro level in a dynamic economy. Assuming a high pure profit share in the present static model is a pragmatic way of accounting for this. The assumed interest elasticity of capital supply (0.5) may also seem quite high. The justification is that this elasticity must capture not only the effect of taxation on aggregate saving, but also the distorting effects of capital income taxation on the allocation of capital. In practice it has turned out to be impossible to

ensure a uniform tax treatment of all types of investment, so capital income taxes reduce the total effective supply of capital by driving wedges between the marginal value products of capital across sectors. Setting a high interest elasticity of aggregate capital supply in a one-sector model is a rough way of allowing for this intersectoral distortion.

Turning to asymmetries, the model assumes perfect capital mobility within Europe combined with imperfect capital mobility across the Atlantic. The observed differences in the level of labor taxation are assumed to reflect cross-country differences in the social preference for redistribution. Hence policy makers in the Nordic countries and in Continental Europe are taken to be more egalitarian than policy makers in the Anglo-Saxon countries, in line with popular perceptions. The differences in the level of capital income taxation are reproduced by appropriate choice of pure profit shares, foreign ownership shares, and the degree of asset substitutability between Europe and the United States. In particular, the asset substitution elasticity is very important for the level of capital taxation in the United States, so the substitution elasticity of 6 has been chosen so as to generate a realistic value for the American capital income tax rate[16]. The relatively low foreign ownership share in America reflects that foreign ownership tends to be less important in a large economy. Because debtor countries and creditor countries will be affected differently by changes in the international level of interest rates, the initial international distribution of net foreign assets will matter for the cross-country distribution of the gains from tax coordination, as explained by Sørensen (2000a). The initial per-capita endowment of non-human wealth (v) is chosen so as to produce the empirically observed sign of the net foreign asset position, while the initial per-capita endowment of human wealth (e) is chosen to reproduce the observed differences in the level of PPP-adjusted real GDP per capita.

Given the calibration in Table 3, Table 4 shows how a shift from tax competition to a regional minimum source-based capital tax within all of Western Europe would affect resource allocation and welfare in the 'world' economy. The European minimum capital income tax rate is set to maximize the population-weighted average social welfare for Western European countries, taking the fiscal policy of the United States as given, but accounting for the fact that national governments in Europe will optimally adjust their remaining fiscal instruments, given the binding minimum capital income tax. From Table 4 we see that the bulk of the gains from regional tax coordination will accrue to those countries which have the highest initial capital income tax rates. By contrast, European countries with low initial capital taxes will gain practically nothing, because they will suffer from a capital outflow to the rest of Europe and to the United States, as they are forced to undertake a relatively large increase in their capital income tax rates.

Indeed, using a more elaborate model including more countries and allowing for country-specific asymmetries, Sørensen (2001) finds that several small countries with low initial capital taxes will actually lose from regional coordination of capital taxes within the

[16] In their simulation analysis of international spillover effects of capital income taxation, Thalman et al. (1996) also assume a substitution elasticity of 6 between US and European assets in one of their scenarios.

Table 4
Effects of a regional minimum capital tax rate in an asymmetric union with imperfect capital mobility between the union and the rest of the world[a]

	Tax competition				Regional tax coordination			
	Nordic countries	Continental Europe	United Kingdom	United States	Nordic countries	Continental Europe	United Kingdom	United States
Policy variables								
Capital income tax (%)[b]	41.6 (42.2)	32.3 (28.1)	40.9 (45.3)	41.8 (41.1)	47.5	47.5	47.5	44.1
Labor income tax (%)[b]	55.4 (55.8)	51.9 (53.0)	37.5 (35.6)	30.6 (31.1)	54.7	49.9	36.6	30.6
Transfers	100	100	100	100	105	109	108	105
Infrastructure spending	100	100	100	100	102	103	102	104
Other variables								
Capital stock	100	100	100	100	101.8	85.3	100.2	104.6
Employment	100	100	100	100	100.4	100.4	100.4	100.2
GDP	100	100	100	100	100.8	97.9	100.5	100.8
Welfare gain from coordination[c]	–	–	–	–	0.95	0.03	0.63	0.13

Source: Simulations with the TAXCOM model.

[a] The simulations are based on the parameter values stated in Table 3.

[b] The figures in brackets are empirical estimates of average effective tax rates for the period 1991–1995, taken from Volkerink and de Haan (1999).

[c] Measured in percent of initial GDP.

European Union. This is consistent with the theoretical finding of Wilson (1991) that small countries gain from tax competition. The fact that small economies facing a very elastic supply of capital from the world market will benefit from tax competition probably also explains why the European Union—which includes many small countries—has made very little progress in coordinating capital income taxes.

4.3. Do we underestimate the gains from tax coordination?

In the model analyzed above where marginal public revenue is spent on redistributive transfers, the provision of public consumption goods was seen to be efficient, essentially because the government can finance public consumption in a nondistortionary manner by accepting a lower lump sum transfer. It may be argued that this assumption 'stacks the deck' against finding large welfare gains from tax coordination, because it precludes the possibility that tax competition causes underprovision of public goods. To investigate this, I now freeze the transfer and assume instead that public consumption and infrastructure spending must be financed by distortionary taxes on income from capital and labor. This scenario may have some practical policy relevance, since transfer programs such as the social security system may be difficult to change in the short and medium run due to their quasi-constitutional character or their character as implicit social contracts. If tax competition puts downward pressure on public revenue, it may therefore be politically easier for the government to adjust via changes in discretionary spending on public goods.

To focus attention on the importance of public goods provision, I will return to the case of fully symmetric countries. Assuming a constant transfer T, and recalling from (9) that $wh = h^{1+\varepsilon}/(1-t)$, it follows from the government budget constraint (11) that:

$$G = G(\rho,\ \tau,\ t,\ Q) \equiv N\left\{\left(\frac{t}{1-t}\right)[h(\rho,\ \tau,\ t,\ Q)]^{1+\varepsilon} + \left(\frac{\tau\rho}{1-\tau}\right)k(\rho,\ \tau,\ t,\ Q) + \tau\pi(\rho,\ \tau,\ t,\ Q) - Q - T\right\} \tag{29}$$

The modified social welfare function applying when marginal public revenue is spent on public goods may now be found by setting T equal to a constant in (15) and inserting $G = G(\rho,\ \tau,\ t,\ Q)$, where the G-function is given by (29). Maximizing the social welfare function with respect to the policy instruments τ, t and Q, and combining the resulting first-order conditions with the factor supply and demand functions, the government budget constraint, and the equilibrium conditions for labor and capital markets, one obtains a tax competition model with underprovision of public goods.

Table 5 reports the quantitative properties of this model, assuming the same parameter values as those used in Table 1. To ensure full comparability with our earlier simulations, Table 2 assumes that the exogenous transfer T is fixed at the level which emerges under full global coordination in our earlier model with endogenous redistributive transfers. According to our utility function (6) the utility of public consumption depends on the parameters γ_1 and γ_2. The value of γ_1 has been set at 0.05, giving an implicit price elasticity of demand for public goods close to unity, in accordance with the benchmark scenario in Wildasin (1989). The scale parameter γ_2 was then calibrated to generate a realistic ratio of public consumption to GDP.

For convenience, the first two columns in Table 5 reproduce our earlier simulations in Table 1 of tax competition and full global coordination in the model with endogenous transfers. The third and fourth columns compare the scenarios with tax competition and full global coordination in the model where the marginal public revenue is spent on public goods. We see that the calibration ensures the same outcome in the two models under full global coordination ($m = 1$). However, when adjustment in public spending must take place via public absorption rather than via transfers, we see that tax competition leads to a smaller drop in the capital income tax rate and an increase in the labor income tax rate. For these reasons total public spending falls by much less than in our earlier scenario. Nevertheless, the welfare loss from tax competition is seen to be roughly 1.5 times as large when adjustment takes place via public goods provision rather than via transfer payments. This suggests that the marginal use of public funds may be quite important for the magnitude of the welfare gains from tax coordination and that our model with endogenous redistributive transfers may underestimate these gains.

On the other hand, the present model abstracts from several factors which tend to reduce the efficiency gains from tax coordination such as imperfect and asymmetric information on the part of the coordinating authority, emphasized by Dhillon et al. (1999), and the Leviathan government behavior studied by Edwards and Keen (1996) and others[17].

[17] See Wildasin and Wilson (2001) for a recent survey of all the factors, which may undermine the potential gains from tax coordination.

Table 5
Tax competition with underprovision of public goods

	Marginal public revenue spent on transfers		Marginal public revenue spent on public goods	
	Tax competition	Full global coordination	Tax competition	Full global coordination
Tax rate on capital income and profits (%)	12.7	42.3	16.1	42.3
Labor income tax rate (%)	44	44.4	59.1	44.4
Transfers (% of GDP)	13.3	24.7	24.8	24.7
Public consumption (% of GDP)	8.5	8.9	7.1	8.9
Infrastructure spending (% of GDP)	10	10	10	10
GDP	100	95	94.4	95
Welfare gain from coordination (% of GDP)	–	0.94	–	1.42

Source: Simulations with the TAXCOM model. Calibration: $\alpha=0.6$; $\beta=0.3$; $\delta=0.25$; $1/\varepsilon=0.25$; $1/\varphi=0.4$; $\mu=0.1$; $e=v=1$; $s=1/17$.

4.4. Tax coordination and income distribution

The model presented here allows a systematic analysis of the sensitivity of the results to changes in the various structural parameters. Such a sensitivity analysis is performed in Sørensen (2000) (section 5.3), using the version of the model where transfers are the marginal use of public funds. According to this analysis, the most important parameters are the interest elasticity of capital supply, the elasticity of substitution between union and non-union assets, and the social preference for redistribution. With an inelastic capital supply, a low degree of capital mobility between the tax union and the rest of the world, and a strong social preference for redistribution, the welfare gains from regional tax coordination will be somewhat higher than reported above. Still, I find that it would take rather extreme parameter values to generate gains from regional coordination in excess of 1% of GDP.

As I explained in Section 2.3, the 'social' welfare gains from coordination reported here may be interpreted as the individual welfare gains for the median voter. It should be stressed that even though the gain for the median voter may be modest, the gains for the poorer sections of society are more substantial, assuming a realistic degree of inequality in wealth distribution. Simulations of the model have revealed that regional coordination within a group of countries like the EU could easily generate welfare gains of 2–3 percentage points of disposable income to the poorest quintile of the income distribution (see Sørensen, 2000, section 5.4)). Coordination on a global scale would of course magnify these gains. From the viewpoint of policy makers with rather egalitarian preferences, the benefits from tax coordination may, therefore, be considerably larger than suggested in this paper.

5. Conclusions

In an effort to overcome several limitations of the previous literature on capital income tax competition, this paper has presented a general equilibrium model of tax competition

and tax coordination featuring endogenous supplies of capital and labor; (possibly imperfect) international capital mobility; international cross-ownership of firms and the existence of pure profits accruing partly to foreigners; productive government spending on infrastructure as well as spending on public consumption; an unequal distribution of human and non-human wealth providing a motive for redistributive taxes and transfers; (possible) cross-country asymmetries in economic structures; and an endogenous fiscal policy process which can be given a political economy interpretation. The model was solved analytically for the case of symmetric countries to study the factors determining the level and pattern of public spending and the source of the welfare losses arising under fiscal competition. I then simulated the model to give a rough idea of the likely order of magnitude of the gains from various forms of international tax coordination, with particular emphasis on the crucial distinction between regional and global coordination.

The main implications of the model can be summarized as follows: (1) unfettered fiscal competition will generate an inefficiently high level of public infrastructure spending and an inefficiently low level of capital taxation and redistributive transfers. When the government can freely adjust the level of transfers, the problem with tax competition is not that it causes an underprovision of public goods, but that it generates more inequality. (2) If all countries in the world could agree to exchange information to enforce residence-based taxation, or if they could agree to a binding minimum source-based capital income tax rate, they would be able to reap the bulk of the potential gains from full global coordination of all fiscal instruments. (3) With perfect capital mobility throughout the world economy, the welfare gains from regional tax coordination among a subgroup of countries will be only a small fraction of the gains from global coordination, even if the coordinating region is large relative to the world economy. (4) With imperfect capital mobility between the tax union and the rest of the world, the gains from regional tax coordination could be much larger, amounting to a substantial fraction of the potential gains from global coordination. Regional coordination would also benefit countries outside the tax union. (5) Simulations nevertheless suggest that, even with imperfect capital mobility between the tax union and the rest of the world, the welfare gains from regional coordination may be well below 1% of GDP. (6) With cross-country asymmetries in economic structures, the welfare gains from capital tax coordination mainly accrue to countries with high initial capital income tax rates, and some countries may even lose from coordination, making it politically infeasible. (7) If the level of income transfers is tied down by explicit or implicit social contracts, tax competition will lead to underprovision of public goods and a shift of the tax burden from capital to labor. Simulations indicate that the gains from global coordination are roughly 1.5 times as large when marginal public revenue is spent on public goods rather than on transfers.

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