INSTITUT UNIVERSITAIRE DE HAUTES ETUDES INTERNATIONALES
THE GRADUATE INSTITUTE OF INTERNATIONAL STUDIES, GENEVA

HEI Working Paper No: 05/2002

What do Theories of Tax Competition Predict for Capital Taxes in EU Countries?

A Review of the Tax Competition Literature

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Abstract

The paper reviews the theoretical literature on capital tax competition relevant for capital taxation in the European Union. The basic tax competition model a la Zodrow and Mierzkowski (1986) is presented, and the arguments of the literature are subsequently integrated into the framework of the basic tax competition model. The review includes models of tax competition where countries are assumed large, asymmetric, when there are more than one tax instrument, where there are more than one tax base, when government is assumed self-serving, and where democratic elections and political equilibrium are allowed for. Moreover, the consequences of agglomeration economies for tax competition pressures are reviewed and incorporated into the standard tax competition model.

What do Theories of Tax Competition Predict for Capital Taxes in EU Countries? A Review of the Tax Competition Literature

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1 Introduction

The notion of international capital tax competition originates from an extensive theoretical literature on tax competition, with roots back to Tiebout (1956) and Oates (1972), and which took shape with the seminal papers of Zodrow and Mierzkowski (1986) and Wildasin (1988). The aim of this literature is to investigate what interregional capital mobility means for regionally set capital taxes, and the general result is that source taxes on mobile capital will be competed downward while taxation of labor and other less mobile tax bases will have to finance more of the public spending when capital mobility increases. These results are, however, based on a set of rather restrictive assumptions about the economies in which tax competition takes place. The assumptions include the simplification that the regions between which tax competition takes place are identical; that capital is taxed only at source; that there are no other sources of tax revenues than capital taxation; that the government choosing the tax rate does this with the only aim of maximizing welfare for its citizens; that changes in capital mobility does not bring about political change; and that there are region-level decreasing returns to capital (and hence no agglomeration forces in play).

This paper reviews the theoretical literature on capital tax competition, relaxing each of the above-mentioned assumptions in turn, and summarizes the implications for the theoretical predictions about capital income taxes in the European Union countries. The regions levying capital tax rates are termed "countries" in the remainder of the paper, since European Union countries, and not regions or other jurisdictions, are in focus here. The first section presents the central arguments of the tax competition literature. These arguments are illustrated by the tax competition modeling framework a la Zodrow and Mierzkowski (1986) on tax competition for productive capital between an infinity of symmetric countries, where the only production input and tax base is capital, and the government is assumed benevolent in choosing the tax rate on capital. The assumption of an infinity of countries, or equivalently, that countries are small, is relaxed in Section 3, where national policy makers are assumed to have an effect on the international after-tax return to capital through their tax policy. Section 4 looks at the consequences for equilibrium capital tax rates of letting the competing countries be asymmetric in size while Section 5 summarizes the differences of residence and source based capital taxes and what the consequences are for tax policy if residence taxation is available as a tax

[⊥] The author would like to thank Richard Baldwin and Gianmarco Ottaviano for valuable comments and suggestions.

instrument. The effect on capital income taxation of access to more than one tax base is presented in Section 6. Section 7 relaxes the assumption that the government is benevolent, and looks at how tax rates are set by a "leviathan government" maximizing own utility or income and not that of its citizens. Section 8 adds elections to the model and looks at how the political equilibrium may change the outcome for capital income taxation. Finally, Section 9 reviews the recent arguments concerning capital income taxation derived from an entirely different theoretical framework, namely that of new economic geography literature, and illustrates these arguments in the framework of the traditional tax competition literature. This is done by relaxing the assumption of country wide decreasing marginal product of capital, and assuming increasing returns to scale as a proxy for agglomeration economies. Section 10 sums up the predictions of the presented models for capital income taxation in the EU. The final section concludes.

When possible, the arguments laid out in the different strands of the literature are incorporated into a single modeling framework, namely that of Zodrow and Mierzkowski (1986), which has become the traditional - or standard - model of tax competition, and will henceforth be referred to as such. The overview is limited to the major part of the literature concerned with the effects of capital mobility on national capital taxes and national capital tax revenues. There is thus no explicit discussion of labor and commodity tax competition issues, or the literature proposing corrective measures (subsidies, etc), strategic tax policy concerning specific sectors, harmonization or coordination, although all these issues are highly relevant in the context of European integration. Finally, it should be pointed out that the review is aimed at, and limited to, deriving theoretical predictions for capital taxation in EU countries. Issues concerning the rest of the world are therefore left out in spite of their importance for EU capital taxation.

2 A Basic Model of Tax Competition

The basic tax competition model presented by Zodrow and Mieszkowski (1986) investigates the effects of capital mobility on capital income taxation in a simplified - and hence restrictive - framework, and leads to the central conclusion of the literature: Capital mobility results in sub-optimally low capital taxation and under-provision of public goods.

An infinity of identical countries play a one-shot game in capital tax rates. Capital is perfectly mobile internationally, and no country can affect ρ, the international after-tax return to capital. The same number of identical residents live in each country, and all variables are measured in per capita terms. Each country has three sectors: production, the representative citizen and the government, and all countries have access to the international financial market.

There are two inputs in production: mobile capital and a fixed factor which Zodrow and Mierzkowski call land, but which can just as well be thought of as labor. The fixed factor is supplied by the representative citizen, who hence alternatively can be viewed as the owner of a production process, which only uses mobile capital, or as a worker in domestic production, since there are no pure profits (per assumption). Capital enters the production process with decreasing marginal productivity:

$$(0\text{-}1) \qquad y_i = f(k_i), \quad f_{k_i} > 0, \quad f_{k_i k_i} < 0$$

where k_i is the amount of capital per head invested in production in country *i*.

The representative citizen in country *i* will hence receive income from invested savings, $\bar{k}$, and wage income from domestic production. The budget constraint of the representative citizen is thus[1]:

$$x_i = f(k_i) - f_{k_i} \cdot k_i + \rho \cdot \bar{k} \quad (0\text{-}2)$$

Where ρ is the after-tax return to capital in country *i*. Since there is no tomorrow, the representative citizen will spend all her/his current income on private consumption, *x*, hence the equality sign. The utility of the representative citizen depends positively on public and private spending:

$$u(g_i, x_i), \quad u_{g_i}, u_{x_i} > 0, \quad u_{g_i g_i}, u_{x_i x_i} < 0, \quad u_{g_i x_i}, u_{x_i g_i} = 0 \quad (0\text{-}3)$$

The population size is scaled to one, such that the total amount of capital in each country is equal to $\bar{k}$. The government provides public goods *g*, which is financed with source taxes *t* on capital employed within the borders of the country in question. The government budget constraint of country *i* is thus:

$$t_i \cdot k_i = g_i \quad (0\text{-}4)$$

The Government's Problem under Zero Capital Mobility

The government is benevolent and chooses the tax rate that maximizes the utility of the representative citizen subject to the government budget constraint, and taking the tax rates of other countries as given. If capital cannot be moved abroad in response to a domestic tax rate increase, taxation of capital resembles a lump sum tax. In this case, the cost of increasing public spending by one unit in terms of lost private spending is one to one. The government will hence increase the tax rate as long as the marginal utility of public spending is higher than that of private spending. The first order condition for optimum is therefore:

$$\frac{u_g(g,x)}{u_x(g,x)} = 1 \quad (0\text{-}5)$$

[1] The model chosen here does not include the lump sum transfer from the representative citizen to the government, as is the case in Zodrow and Mierzkowski (1986).

The Government's Problem under Perfect Capital Mobility

When capital is perfectly mobile, the representative citizen can move his/her capital abroad to attain the world after-tax return to capital if the domestic net return to capital is lower. The international financial market is therefore characterized by the equilibrium condition:

$$f_{k_i} - t_i = \rho \qquad (0\text{-}6)$$

for all *i*, where ρ is the world after-tax return to capital, considered fixed by the small countries. An increase in the tax rate on capital would have to be met by an identical increase in the before-tax rate of return to capital in order for the after-tax rate of return to be equal to the world rate of return. Therefore, an increase in the tax rate initially triggers a capital outflow, which will only stop when the marginal return to capital has increased by the same as the increase in the tax rate. How much capital has to flow out of the tax-increasing country to re-gain equilibrium depends on the second derivative of the production function[2]:

$$\frac{\partial k_i}{\partial t_i} = \frac{1}{f_{k_i k_i}} \qquad (0\text{-}7)$$

For later use, the elasticity of capital to the tax rate is defined as:

$$\varepsilon^S{}_{k_i} = -\frac{t_i}{k_i \cdot f_{k_i k_i}} > 0 \qquad (0\text{-}8)$$

Where the superscript S denotes the small country case. $\varepsilon^S{}_{k_i}$ is assumed to be smaller than one, which ensures staying on the left side of the laffer curve[3].

In the case of perfect capital mobility, there are two costs associated with an increase in the domestic tax rate besides the direct cost of decreasing private spending. First, the associated outflow of capital lowers the gross return to the fixed factors of production and in turn reduces private spending. The second cost is the tax base erosion effect: the reduced domestic employment of capital would leave less capital to tax, which isolated from the tax revenue due to the higher tax rate applied to the infra-marginal units of capital would lower public spending. These two distortionary effects of a tax increase are not present when capital is immobile because a higher tax rate would translate into a one for one reduction in the after-tax return to capital, leaving the overall cost of capital as well as the amount of taxable capital unchanged.

Consequently, when a government increases the tax rate, each unit of additional tax revenue costs not only one unit of private income, but also the two costs described above. One additional

[2] Found by totally differentiating the financial market equilibrium condition with respect to the tax rate.
[3] The assumption ensures that the derivative of tax revenues with respect to the tax rate is always positive. To see this, differentiate the budget constraint with respect to the tax rate and rearrange.

unit of public expenditure therefore costs more than one unit of private expenditure for the country as a whole, or said with the terminology of public finance, the marginal cost of public funds is greater than one. This argument is summarized in the first order condition for the government's problem, derived by maximizing the utility of the representative citizen (0-3) with respect to the tax rate, and subject to the two budget constraints (0-2) and (0-4) and the financial market equilibrium condition (0-6)[4]:

$$\frac{u_g(g,x)}{u_x(g,x)} = \frac{1}{1-\varepsilon^{S}{}_{k}} > 1 \qquad (0\text{-}9)$$

where $\frac{1}{1-\varepsilon^{S}{}_{k}} = \frac{k}{k+\frac{t}{f_{kk}}} = MCPF$ is the marginal cost of public funds, and is always larger than one when the elasticity of capital with respect to the tax rate is positive.

The government will set the tax rate where the marginal cost of increasing public spending by one unit, the *MCPF*, is equal to the marginal utility increase of switching resources from private spending to public spending through an increase in the tax rate. Since the price of increasing public spending in terms of lost private consumption is larger than one, the marginal utility of public spending must be larger than the marginal utility of private consumption in equilibrium. This is the source of inefficiency in the model. If the government had access to a lump sum transfer tool to move resources from private to public consumption, utility would be increased.

Tax Competition Equilibrium

Under zero capital mobility each country employs its own endowment of capital and taxes are set optimally in that the marginal utility of private and public spending are equal. This changes when capital becomes mobile. The term “tax competition” describes how the countries compete for the fixed international amount of capital by undercutting each other's tax rates, effectively engaging in a “race to the bottom” in tax rates. Each country sets its tax rate assuming that tax rates in all other countries remain unchanged, but each time a tax rate is lowered in one region, the other countries will lose capital to that country and will have an incentive to decrease their tax rate as well. The "bottom" describes the symmetric equilibrium level of tax rates on capital. At this "bottom", the cost of decreasing the tax rate in terms of lost tax revenue is perfectly balanced

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[4] Country subscripts are left out. The second order condition is fulfilled as long as the third derivative of the production function is not too large, i.e. as long as the curvature of the marginal product of capital is not too bent. The intuition for this result is that if the elasticity of capital to the tax rate falls sufficiently when the tax rate increases, the marginal cost of public funds may actually decline faster than the fall in the marginal utility of public relative to private consumption when the tax rate is increased. Formally, the second order condition for optimum states that the derivative of the tax elasticity of capital with respect to the tax rate has to be too negative:

$\frac{\partial \varepsilon^{S}{}_{k}}{\partial t} > \frac{k}{u_g}\left[u_{xx} + u_{gg}(1-\varepsilon^{S}{}_{k})\right] < 0$. This corresponds to a condition for the third derivative of the production function: $f_{kkk} < \frac{(f_{kk})^2}{t} - \frac{f_{kk}}{k} - \frac{(f_{kk})^2 \cdot k}{\varepsilon^{S}{}_{k} \cdot u_g}\left[u_{xx} + u_{gg}(1-\varepsilon^{S}{}_{k})\right] > 0$. Making the assumption that the third derivative of the production function is zero, simplifies the calculations, does not change the conclusions and satisfies the second order condition.

with the benefit of the capital inflow that such a decrease would entail, given all other tax rates on capital in the world. Notice that in this setting, the "bottom" is not a zero tax on capital, but a positive although sub-optimally low level of capital taxation[5]. Since the model is symmetric, each country will employ $\bar{k}$ amount of capital, as in the case of zero capital mobility, and all countries will set the same tax rate and provide the same sub-optimal level of public goods.

Gains from Cooperation

If all countries could credibly commit to increasing the tax rate marginally from the tax competition equilibrium level, such that the international allocation of capital would remain unchanged, overall utility in all countries would increase. Such a coordinated increase in the tax rate would be Pareto-improving, since resources would be moved one to one from private spending to public spending. Coordinated tax increases would be Pareto improving as long as the marginal utility of public spending exceeds that of private spending. The Pareto-optimal tax rate would be the one, which equates the marginal utility of private spending with that of public spending.

Predictions of the Basic Model of Tax Competition

To summarize, tax rates on capital income in European Union countries are set nationally, with no explicit cooperation among the governments in setting these tax rates. The basic model of tax competition therefore predicts that European Union countries will increasingly compete for productive capital by lowering the tax rates on capital. In equilibrium, capital mobility will result in capital income taxes and public spending being sub optimally low compared to the situation with zero capital mobility.

3 When Countries are Large

The basic tax competition model presented above assumes an infinite number of countries such that the world after tax return to capital is not influenced by the decisions of any government. Wildasin (1988) modifies the above basic modeling framework to include a finite number of countries that can influence the after-tax return to capital with tax policy. The assumption of a finite number of countries turns out not to affect the results of the model qualitatively, i.e. capital taxes are still found to be sub optimally low, but there are quantitative differences. To see this, assume the simplest case of two identical countries competing for a fixed and internationally mobile amount of capital. Each country is characterized as the countries of the infinite country model above. The total amount of capital is now the sum of capital employed in country 1 and 2:

$$k_1 + k_2 = 2\bar{k} \quad (0\text{-}10)$$

where k_i is capital employed in the country i and $\bar{k}$ is the amount of capital owned by the representative citizen in each country (still normalizing the size of the population to one). The financial market equilibrium condition is now given by:

[5] Since the marginal utility of public spending goes to infinity when the tax rate approaches zero

(0-11) $$f_{k_1} - t_1 = f_{k_2} - t_2$$

Totally differentiating (0-11) with respect to the tax rate gives the elasticity of capital employed in country 1 to the domestic tax rate:

(0-12) $$\varepsilon^{L}{}_{k_1} = -\frac{t_1}{k_1 \cdot (f_{k_1 k_1} + f_{k_2 k_2})} > 0$$

Where the superscript *L* denotes the large country case. Clearly, the elasticity of capital with respect to the domestic tax rate is smaller under the large country assumption than under the small country assumption, and this is the key to the difference between the outcome of the two models.

Under the large country assumption, an increase in the tax rate and the subsequent capital outflow will depress the interregional after tax rate of return by changing the interregional supply of capital. This in turn has two effects on the marginal cost of public funds. First, a tax-induced capital outflow will reduce ρ, in turn mitigating the capital outflow and hence reducing $\varepsilon^{L}{}_{k}$. Therefore, if the country by tax policy can affect ρ, the tax base effect mentioned above is smaller, and the *MCPF* associated with the tax increase is lower than when the country is too small to affect ρ. Second, when an increase in the tax rate induces a capital outflow and a subsequent fall in ρ, the savings income of the representative citizen falls by the fall in the marginal product of capital, as seen in (0-2). At the same time, since the capital employed in domestic production is remunerated by its gross rate of return, *f'*, the cost of capital increases by less, and the income from production of the representative citizen falls by less than would have been the case if the tax change were not affecting ρ. Hence, the income effect of the change in the world after tax return to capital will tend to increase the marginal cost of public funds compared to the case of constant after-tax world returns *if* the country is a net capital exporter, and the opposite holds true if the country is a net capital exporter. This is well illustrated by the first order condition for the government's problem when only two countries are competing:

(0-13) $$\frac{u_g}{u_x} = \frac{1 - \varepsilon^{L}{}_{k} \cdot \left[(\bar{k} - k_1) \cdot \frac{f_{k_2 k_2}}{t_1} \right]}{1 - \varepsilon^{L}{}_{k}}$$

The second term of the numerator represents the differential effect on private income compared to the infinite country case. In symmetric tax competition equilibrium, the capital accounts of the two countries will balance and the two income effects will cancel out, leaving only the tax base effect:

(0-14) $$\frac{u_g}{u_x} = \frac{1}{1 - \varepsilon^{L}{}_{k}}$$

(0-14) illustrates that since the marginal cost of public funds is clearly lower compared to the infinite countries case due to the lower elasticity of capital to the tax rate, the tax rate which fulfills (0-14) will be higher than in the infinite countries case. But the tax rate will still be inefficiently low since the marginal cost of public funds continue to be greater than one[6].

Predictions when Countries are Large

To summarize, the predictions for capital income taxation in the European Union derived from the model where countries are allowed to have an impact on the after-tax return to capital are qualitatively the same as for when countries are assumed small: Capital income taxes levied at the source should exhibit a downward trend in response to increased capital mobility. The downward pressure, however, is predicted to be smaller than under tax competition between countries taking the after-tax return to capital as given. The question is, can European Union countries be considered as large and with an effect on the after-tax return to capital on international capital markets, or should EU countries rather be modeled as small price takers? It could be argued that some countries may be large enough to have an effect on the world after-tax price of capital while most of the EU countries are too small in this sense. Models of asymmetric country size and tax competition analyze the tax competition interaction between large and small countries and are reviewed in the next paragraph.

4 Asymmetric Tax Competition Models

Symmetry has been used as a tool to simplify the derivation of equilibrium in models of tax competition. But symmetry hardly reflects the real world, and in particular does not reflect the countries of the European Union. Several studies set out to analyze how the conclusions of the standard tax competition models presented above change when the assumption of symmetry is relaxed. Asymmetric models have been limited to differences in the size of the competing countries (Bucovetsky (1991)) or asymmetries in the endowment of capital per capita of the competing countries (Wilson (1991)). Moreover, Kanbur and Keen (1991) study commodity tax competition with asymmetric endowments. The conclusions of these models are largely the same. The larger country faces a lower elasticity of capital to the tax rate, and hence a lower marginal cost of public funds, and therefore chooses a higher tax rate than the smaller country. Krogstrup (2002) derives a model in which public debts differ across competing countries, with leads to tax, spending and distortion asymmetries across countries in the tax competition equilibrium, but apart from these contributions, other types of asymmetry between countries engaged in tax competition has not been analyzed theoretically.

Bucovetsky's (1991) argument is presented below in order to show how asymmetry in the size of tax competing countries affects the tax competition equilibrium[7]. Bucovetsky derives a model of two countries, which only differ in their population size, and where all per capita variables within each country are otherwise identical. This asymmetry implies that when the large country

[6] The analogy to the Cournot oligopoly model of trade and cross hauling is clear. The traded good is capital and the price is the after-tax return to capital. The oligopoly model teaches us that the more countries (i.e. firms) there are, the closer we get to perfect competition situation where each country takes the after-tax return to capital (i.e. the price of the traded good) as given.

[7] Wilson (1991) reaches the same conclusions.

changes its tax rate, relatively more capital will flow from the country to the world capital market than when the small country increases its tax rate by the same amount. Hence, a change in the tax rate of the large country changes the world after-tax return to capital more than a similar change in the tax rate of a small country. The large country will therefore perceive the elasticity of capital - the tax base effect of a change in the tax rate - to be lower than the small country, and will therefore have a lower marginal cost of public funds associated with a tax rate increase.

Let the two countries' per capita variables be described as in the basic model. When s_1 (s_2) is the population of country 1 (country 2) and normalizing s_1+s_2 to one, the financial market equilibrium condition is equal to (0-11) and the elasticity of capital with respect to the tax rate is equal to[8]:

$$(0\text{-}15) \quad \varepsilon^{A}{}_{k_1} = -\frac{t_1}{k_1 \cdot (f_{k_1k_1} + \frac{s_1}{s_2} f_{k_2k_2})} > 0$$

Where the subscript *A* denotes the tax elasticity of capital in the asymmetric model. (0-15) shows clearly that when country 1 is larger than country 2 ($s_1>s_2$), then the tax elasticity of capital is smaller in country 1 and vise versa. The first order condition for country 1 in the asymmetric model is:

$$(0\text{-}16) \quad \frac{u_{g_1}}{u_{x_1}} = \frac{1 - \varepsilon^{A}{}_{k_1} \cdot \left[(\bar{k} - k_1) \cdot \frac{f_{k_2k_2}}{t_1} \right]}{1 - \varepsilon^{A}{}_{k_1}}$$

The similarity with the first order condition for the symmetric two-country model is clear. In order to see the difference that the asymmetry results in, assume an initial situation of symmetric allocation of capital between the two countries, such that $\bar{k} = k_1 = k_2$, thus abstracting from income effects of changes in tax rates. The first order condition reduces to:

$$(0\text{-}17) \quad \frac{u_{g_1}}{u_{x_1}} = \frac{1}{1 - \varepsilon^{A}{}_{k_1}}$$

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[8] Insert the definition of the capital stock: $k_2 = \frac{\bar{k} - s_1 \cdot k_1}{s_2}$ into the financial market equilibrium condition $f_{k_1}(k_1) - t_1 = f_{k_2}(k_2) - t_1$, differentiate with respect to the tax rate to get the derivative of capital. Rearrange. Notice here that not only are all variables in per capita terms, but the production function is also in per capita terms.

Note that a symmetric allocation of productive capital can not be an equilibrium situation when population size differ, since this symmetry would imply identical tax rates and distribution of resources between private and public spending, and hence identical *LHS* of (0-17) across the two countries, while differences in population size imply that the *RHS* of (0-17) - the marginal cost of public funds - would differ across countries. Assuming that the smaller country fulfills (0-17) in such an out-of-equilibrium symmetric situation, the larger country would have an incentive to increase its tax rate, and conversely, if the larger country fulfills (0-17), the smaller country would have an incentive to lower its tax rate. Both changes in tax rates would make the smaller (larger) country a capital importer (exporter), additionally increasing the smaller (larger) country's incentive for cutting (increasing) the tax rate as explained in the two country symmetric model above. In equilibrium, the larger country therefore sets a higher tax rate due to its relatively low marginal cost of public funds compared to that of the smaller country, and the smaller country will set a lower tax rate for the opposite reasons. Bucovetsky shows that higher taxes in the larger country compared to the smaller country is in fact a Nash equilibrium by assuming quadratic production functions and proving the existence of such an equilibrium analytically.

The small country enjoys a lower cost of capital and will employ a greater amount of capital per fixed factor in equilibrium, with the consequence that the returns to these fixed factors is higher compared to the larger country. The representative citizen of the smaller country therefore enjoys a higher net income than the representative citizen of the larger country. Since the tax base is larger and the tax rate is lower in the small country, it depends on the parameters of the model whether public good consumption is higher or lower in the smaller country relative to the larger country. But it can be shown that in any case, the small country is better off than the large country in equilibrium. If the small country is small enough, it may have so high returns to the fixed factors owned by the residents that they are better off under tax competition with a larger country than it would be if taxes were set cooperatively to maximize overall welfare between the two countries. This result is called "the advantage of smallness" in the literature, and has been put forward as a possible explanation for why tax coordination is so difficult to agree on in the European Union.

The interaction of the two countries on the common capital market is solely responsible for the asymmetric outcome. If capital mobility is assumed zero in the otherwise identical model of two asymmetrically populated countries, both countries irrespective of size choose the same tax rate, namely the one which equates the marginal utilities of private and public spending.

Predictions from Asymmetric Tax Competition Models

The central message of tax competition models allowing for differences in the size of the countries is that larger countries have higher tax rates of capital compared to smaller countries when capital is mobile across countries. In contrast, if capital is immobile, all countries irrespective of size choose the same tax rate. Combining these two findings allows posing the hypothesis that the higher the mobility of capital becomes in the European Union, the more the tax rates on capital differs between large and small countries. In the case of the European Union, this would mean that over the last 20 years, when capital has become increasingly mobile, the difference between tax rates of the larger countries such as Germany, France and Italy, and smaller countries such as the Benelux countries, Denmark and Portugal should have increased in

addition to the overall downward pressure on these tax rates predicted by the basic tax competition model.

5 Residence vs. Source Based Capital taxes

Capital tax competition models in general study the consequences of tax base mobility when taxes are levied at the source. There are many justifications for not focusing on residence taxation of capital, the most important one being that residence taxation, where is it implemented, is hard to enforce due to lack of information sharing among countries[9].

Since there is no time dimension and consumption/savings trade-off in the basic tax competition model, including a residence based tax on capital is wholly non-distortionary and amounts to allowing for a head-tax. In this case, the marginal cost of public funds would be unity and the first order condition would be equal to (0-5). The allocation of resources between private and public spending would be Pareto optimal. If the residence tax on capital is not enforceable, i.e. if the tax authorities cannot observe the foreign capital income of their residents and the residents do not declare this income (which is generally the case for capital income taxation), source based taxation would be used as in the basic model above.

Regimes where both residence and source taxation are allowed have been investigated in more complex models allowing for saving/consumption trade-offs. Razin and Sadka (1991) assume two small competing countries (taking the international after-tax return to capital as given and in this way ignoring effects on the elasticity of capital to the tax rate) allowing both source and residence taxation of capital as well as taxation of internationally immobile labor in a two period model with savings. Both labor and savings are assumed elastic to their after-tax returns. Tax competition results in a symmetric Nash equilibrium where the withholding tax rate on capital is zero and only the residence tax on capital is used to tax capital. Moreover, this equilibrium is second best – there are no gains to be made from coordination between the two countries. These conclusions depend crucially on the assumption that capital can effectively be taxed at residence. This is not the case in the model of Frenkel et al. (1991)[10], who use the same model augmented with a rest of the world (ROW) to which capital may flow freely. Assuming that ROW does not provide information about foreign investors' capital income to the tax authorities of these investors, and assuming that investors do not declare their overseas capital income, capital income will not be taxed at all, and the entire tax burden will be switched to labor. Moreover, cooperation between the small number of countries would be futile as long as there is a non-cooperative ROW. The complete absence of capital taxation in this model depends on the assumption of an alternative tax base - here in the form of labor income. Situations where other tax bases are available are briefly considered in the simple model framework in the following section.

Predictions for Residence Taxation

If residence taxation of capital is enforceable, the above analysis shows that the source principle for taxation of capital income should not be used. Taxation of capital would in this simple setup

[9] There are many reasons for why sovereign countries do not provide information to the tax authorities of a foreign investor, the most important being that information provision is costly and there is no incentive for the provider to provide the information. For a small survey of reasons for the lack of information sharing, see Tanzi 1995.
[10] Chapter 11.

be non-distortionary and hence optimal, and there would be no gains from international cooperation in setting taxes. If residence taxation is not enforceable, however, the basic models predict the use of distortionary and hence inefficiently low source based capital income taxes. If an income tax on immobile labor is available, all the tax burden will be put on labor, which we also see in the following section.

The results of zero capital income taxation and no gains from cooperation have strong implications for the debate over future coordination or harmonization of the European Union member countries' capital income tax systems.

6 Allowing for More Than One Tax Instrument

Assume two inputs, labor and capital, in the constant returns to scale technology production in the basic model of section 1:

(0-18) $y_i = f(k_i, l_i)$

Assume moreover that the representative citizen provides a fixed amount of labor, $\overline{l}_i$, which is remunerated by its marginal product and allow for unit taxation of labor. These alterations change the private and public budget constraints[11]:

(0-19) $x_i = f(k_i, \overline{l}_i) - f_{k_i} \cdot k_i + (f_{k_i} - t_i) \cdot \overline{k} - t^w{}_i \cdot \overline{l}_i$

(0-20) $t^r{}_i \cdot k_i + t^w{}_i \cdot \overline{l}_i = g_i$

The government maximizes (0-3) with respect to the two tax rates and subject to (0-19) and (0-20). The first order conditions for the labor tax and the capital tax are respectively equal to (0-5) and (0-9). (0-5) and (0-9) can only be fulfilled simultaneously when the tax rate on capital is equal to zero. Capital will therefore not be taxed at all in equilibrium. This is because labor tax works like a lump sum tax when the labor supply is assumed inelastic, and the result only confirms the inverse elasticity rule of optimal taxation: the optimal tax rate is inversely proportionate to the elasticity of the tax base. Razin and Sadka (1991) show that if labor supply elasticty is allowed for in a small open economy, the entire tax burden will still be levied on labor in spite of the positive elasticity. The reason is that the capital elasticity goes to infinity in a small open economy while labor supply elasticity remains finite. Bucovetsky and Wilson (1991), also allowing for labor supply elasticity, look at a finite number of countries and show that this implies that capital supply elasticity is also finite, which in turn implies that capital is taxed in equilibrium, in addition to labor income. Moreover, they show that when the number of countries goes to infinity, the tax on capital goes to zero, i.e. the border case of small countries modeled by

[11] Due to constant returns to scale, labor is paid the rest of the production when capital is paid its marginal product. There is therefore no reason to change notation from the basic model above and include the marginal product of labor in expression for private income.

Razin and Sadka (1991). If increasing capital mobility is interpreted as an increase in the elasticity of capital to the tax rate, Bucovetsky and Wilson's model can then be taken to imply that the higher the mobility of capital, the more of the tax burden will fall on labor relative to capital.

Predictions From Adding a Second Tax Base to the Model

When taxation of labor is allowed for in a model of tax competition among small countries, the entire tax burden switches to labor irrespective of whether labor is elastically supplied or not. The result changes somewhat if the countries engaged in tax competition are large and can affect the world after tax return to capital. In this case, capital elasticity is no longer perfect and some scope for capital income taxation will remain although this capital income taxation will be lower than when labor income taxation is not available, or when capital is not mobile. Overall, the literature analyzing the effects of capital tax competition when other tax instruments are available predicts that as mobility of capital increases, labor tax rates will increase relative to capital tax rates.

7 Tax Competition and the Leviathan Policymaker

In spite of the compelling arguments of the models presented above, no consensus exists as to whether tax competition is good or bad for welfare. This disagreement has its roots in the view of government objectives and/or efficiency. The conclusion that tax competition lowers welfare crucially depends on the assumption that the policymaker is benevolent, and hence aims at maximizing welfare under the resource and behavioral constraints of the economy. Another branch of the tax competition literature, taking its starting point in the public choice literature, models government as a self-serving "Leviathan"[12] and looks at how tax competition affects tax rates and welfare.

In Leviathan models, the government has as objective either the maximization of the size of the state (tax revenue) or the maximization of own consumption or utility, which in turn may depend on several things in combination. In most cases, tax competition is efficiency enhancing when the government is modeled as a Leviathan. The intuition for this result is straightforward. In the absence of tax competition, a government maximizing the size of the state will most likely be imposing sub-optimally high tax rates from a welfare point of view. Symmetric tax competition provides a downward pressure on the tax rate, which in turn increases the utility of the representative citizen without changing the capital allocation between competing countries in equilibrium. The government Leviathan can also be modeled as maximizing a combination of the probability of reelection and own wasteful consumption, where wasteful consumption can be thought of as spending tax revenue in a manner that does not enter into the utility function of the representative citizen. Spending on public good provision or lowering the tax rate so as to increase the representative citizen's utility increases the reelection probability. Again, tax competition provides a check on the overall tax revenue, but the effect on welfare (defined by the utility of the representative citizen) is not unambiguous in this case. Depending on the policymaker's trade off between reelection probability and wasteful consumption, the representative citizen may suffer or gain from this check.

Edwards and Keen (1996) reconciles the two different views of government by including in the basic model a government objective function including a Leviathan term and a benevolent term.

[12] Reference to Hobbs' Leviathan State

The policymaker derives utility from own wasteful consumption, *c*, and from the representative citizen's utility from public good provision and private consumption, *u*:

$$V = V(c, u(g, x)) \quad (0\text{-}21)$$

The policymaker maximizes utility with respect to wasteful consumption and the tax rate (hence letting public spending be determined by the budget constraint as a residual). The two resulting first order conditions are equal to (0-9) and:

$$V_c = U_g \cdot V_u \quad (0\text{-}22)$$

The former first order condition is known from the basic model above, and is due to the fact that the utility of the representative citizen is included in the objective function. If (0-9) is not fulfilled, then for a given level of wasteful consumption, the government can increase utility by changing the tax rate and private and public spending, without changing the utility derived from wasteful consumption. The latter first order condition states that the marginal utility derived from public spending (the right hand side of (0-22)) should equal the marginal utility of wasteful consumption, since there is no distortionary cost involved in transferring resources from public to wasteful consumption.

In the case of the closed economy where capital is not mobile, the two first order conditions for government optimization are (0-5) and (0-22). Tax competition changes the equilibrium by decreasing the tax rate given the symmetric amount of capital which remains in the country in equilibrium. If the fall in tax revenue is entirely financed by lower spending on public goods, the utility of the representative citizen will fall. To see this, remember that the marginal utility of private and public consumption are equal before the fall in tax revenue. The fall in tax revenue translates into a one to one increase in private consumption, of which the marginal utility is decreasing. If it also translates into a one-to-one fall in spending on public goods, the marginal utility of this public good provision will increase, subtracting more utility from the representative citizen than the increase in private consumption added. On the other hand, if the entire fall in tax revenue translates into a decrease in wasteful consumption, the representative citizen obviously gains. Depending on the parameter values of the policymakers objective function, the outcome lies somewhere in between.

Predictions from Leviathan Tax Competition Models

To sum up, tax competition increases the marginal cost of public funds and therefore limits the possible tax revenue which can be attained from capital income. The downward pressure of tax competition will therefore also take place when the government is not modeled as benevolent. Thus, Leviathan models of tax competition also predict that capital income taxes in European Union countries should have been subject to a downward pressure due to increased tax competition. Public spending may or may not fall depending on how the Leviathan is modeled (tax revenue maximizing or wastefully spending). The main differences between the conclusions of Leviathan models and models where the government is benevolent are normative. Both types of models predict a fall in the tax rate due to an increase in capital mobility, but in the Leviathan

model, this fall enhances efficiency by constraining a tendency to spend too much and too wastefully, while if the government is benevolent, the downward pressure on the rate leads to a sub-optimally low provision of public goods.

8 Tax Competition and Political Economy

The political science literature on the effects of globalization explicitly deals with financial integration as part of a current ongoing globalization, and as part of this looks at the effects of increased capital mobility on tax rates. In this branch of the literature[13], increasing financial integration is usually supposed to have two opposite effects on tax rates. First is the tax competition effect, which Swank (1998) calls diminished democracy, reflecting the decreasing power of a democratically elected government to collect tax revenues from mobile capital. The second effect is the compensation hypothesis, stating that the more open a country is to the rest of the world, the greater are the fluctuations in economic activity, and the greater the public demand for social insurance will be, in turn requiring higher tax rates for financing[14]. Increasing capital mobility can hence both mean higher and lower tax rates, depending on which of the two forces is greater. Persson and Tabellini (1992) touch on similar issues with a more formal approach, when modeling tax competition in a two-country median voter setup, where the policy maker is elected democratically from the population. While the policymaker is modeled to take the tax rate of the other country as given in choosing the optimal tax rate (the Nash equilibrium concept), the median voter takes the equilibrium tax rate as given and associated with the policymaker's preferences, and hence elects a policymaker with preferences which will maximize his/her utility. The policymaker is therefore not necessarily the median voter, and Persson and Tabellini show that the higher the capital mobility is, the further to the left the elected policymaker will be, hence counteracting the downward pressures of tax competition. In this model, the political "move to the left" effect mitigates the downward tax competition pressure on tax rates, but the tax competition effect is shown to always outweigh the political effect.

Predictions from Political Models of Tax Competition

The branch of the literature taking into account the political reaction to increased capital mobility predicts that tax competition pressures are mitigated, but not outweighed, by a popular demand for more social insurance and in turn higher taxes for financing. Hence, according to these arguments tax rate should be expected to fall when capital mobility increases, but less than predicted by traditional tax competition models.

9 Agglomeration Economies and Tax Competition

The downward pressure on capital tax rates due to tax competition has often been argued to be counterbalanced by the many other factors relevant for the location decision of a firm. Among such other factors are the level of education of the work force, infrastructure and market access (both for final products and intermediates). Recently, an entirely different theoretical setup, namely that of new economic geography models, has been used to analyze capital taxation issues. These contributions to the tax competition literature generally show that a race to the bottom in capital tax rates does not have to take place even though capital is becoming increasingly mobile.

[13] See for example Swank (1998) and Garreth and Mitchell (2001).

[14] In this branch of the literature, which is rather informal, it is usually assumed and not questioned that increased openness means increased economic instability. The possibility that increased openness increases diversification and in turn increases stability is not touched on.

One reason is the presence of agglomeration economies and the possibility of differential economic rents across countries. The implications of agglomeration forces for capital tax competition in new economic geography models are presented and surveyed in Baldwin et.al (2003). Ludema and Wooton (1997), followed by Andersson and Forslid (1999) and Baldwin and Krugman (2003), using economic geography models with two countries and two sectors, imperfect competition and costly trade in the manufactured good, mobile skilled and immobile unskilled labor, have pointed out the possibility of taxation of the mobile factor under the presence of agglomeration rents, without triggering an outflow of this factor to other countries. Moreover, and more in line with the traditional tax competition models, Kind et al. (1999) and Ottaviano and Van Ypersele (2002) assume that the mobile factor is capital and allow the purchasing power of the income of capital to be detached from the location of investment. They find that when all economic activity is agglomerated or clustered in one country, the gross return to capital in that country is higher than the potential return to capital in the other country. This cross-country difference in gross returns to capital allow for a positive taxation of capital in the country hosting the agglomeration/cluster without giving an incentive for capital to flow out. Additionally, both studies find that if production activity is not completely clustered in one of the two countries, both countries will use their tax rate to compete for capital and will end up with negative tax rates in equilibrium. This result is not qualitatively different from ordinary tax competition models allowing for the lump sum taxation of another factor (see Section 6 above).

However, both Ottaviano and Van Ypersele (2002) and Kind et al. (1999) assume perfect capital mobility and do therefore not look at the effects of a direct change in the cross border mobility of capital, other than showing that perfectly mobile capital can be viewed as quasi-immobile in core-periphery equilibria. Rather, the models analyze changes in trade costs and the effect on other variables, notably capital taxes, and are thus treating a different question from that treated in traditional tax competition models, which assume zero trade and analyze the effects of an either continuous or discrete increase in capital mobility[15]. The results of economic geography models in this sense do not dispute the results of the traditional tax competition literature stating that capital taxes are pushed downward when capital becomes more mobile, and will be taxed more if it is immobile. Rather, economic geography models add to the literature on determinants of capital taxes by showing that agglomeration forces such as market access also affect capital income taxes, and that these agglomeration forces may run counter to the underlying assumptions concerning production of traditional tax competition models.

[15] Ludema and Wooton (1997), in looking at skilled labor tax competition, do model the degree of skilled labor mobility explicitly, and find that increasing labor mobility has the same effect as in traditional tax competition models when the equilibrium is dispersed, while under the core-periphery pattern, increasing labor mobility just increases the potential for agglomeration/clustering rents and hence increases the potential for taxation of labor in the country hosting the agglomeration/cluster. Carrying the analogy over to the model with capital as a mobile factor, this would mean that higher capital mobility would render an agglomeration more likely, and hence would increase the likelihood of taxing agglomeration rents. When agglomeration rents are not present, i.e. when the equilibrium allows for production in all (both) countries, the conclusion for capital is the same as those found in the traditional models: competition for productive capital results in a downward pressure on capital tax rates. In brief, capital mobility would have a u-shaped relationship with capital income taxation: The higher the capital mobility, the lower the tax rate on capital until a certain point, after which the tax rate on capital would increase in countries of agglomeration. These conjectures could be checked analytically by including imperfect capital mobility in the model of, for example, Ottaviano and Van Ypersele (2002), and would be an interesting extension of the new economic geography contributions to the tax competition literature.

In order to link the results of the new economic geography literature for tax competition to the traditional modeling framework, the effects of agglomeration economies and changes in capital mobility on capital taxation are analyzed in a reduced form in the traditional two country basic modeling framework of Section 23. Assume that capital is the only input in production. As a proxy for agglomeration economies, assume increasing returns to capital by assuming a positive second derivative of the production function. In effect, this means proxying agglomeration economies by external economies of scale of the aggregate production function, while on the micro level, each firm still perceives to be in a perfect competition environment[16]:

$$y_i = f(k_i) \qquad f(0) = 0;\ f'(k) > 0;\ f''(k) > 0 \tag{0-23}$$

The no-profit condition is assumed to hold for individual firms, and a unit of capital is hence paid its average product:

$$R = \frac{f(k_i)}{k_i} \tag{0-24}$$

where R is the gross return to capital. Assume also that the produced good is traded freely between the two countries at no cost and, hence, that domestic production does not have to equal domestic consumption. In all other respects, the framework is the same as in Section 2.

Under the assumption of agglomeration economies, a capital outflow from one country into another as a response to a net capital return differential does not have the equilibrating effect of increasing the net return to capital in the country of origin of the capital flow and decreasing the net return in the recipient country, as in the model of Section 2. On the contrary, a capital flow from one country to another will increase the net return differential and create stronger incentive for further capital flows. There are two possible Nash equilibria in tax rates in this setup; a symmetric equilibrium where capital is evenly distributed between the two countries and an asymmetric equilibrium in which all capital and production is located in only one of the countries. The latter will henceforth be called the core-periphery equilibrium following the economic geography terminology.

Symmetric Equilibrium:

In the symmetric equilibrium, capital is evenly distributed between the two countries and capital income taxes are zero. The net return to capital is equal across countries and there is no incentive for capital flows. But the symmetric equilibrium is not stable. A small flow of capital from one country into the other, or a small change from zero to positive in one of the two countries' tax rate, would produce a net capital return differential which in turn would result in further capital flows, and this would continue till all capital is agglomerated in one of the two countries. This

[16]Since the two countries are identical in terms of endowment or capital and labor, it does not matter whether a per capita representation or an aggregate representation is used. The two representation will perfectly represent each other.

reasoning also explains why capital taxes must be zero in this symmetric equilibrium. If capital tax rates where positive but equal in the two countries, capital would not have an incentive to move but each country would have an incentive to lower its capital tax rate ever so slightly and thereby trigger a self enforcing capital inflow, in the end attracting all productive capital to that country[17]. Due to its instability, the symmetric equilibrium will not be considered any further here.

The Core-Periphery Equilibrium:
In the core-periphery equilibrium on the other hand, all capital is invested in the production of one country - the core - while the other country – the periphery - does not have domestic production at all. The core-periphery equilibrium is stable in that a small outflow of capital or a small increase in the tax rate in the core would not trigger further capital outflows, since the gross return to capital in the core would be higher than that of the periphery under increasing returns to capital.

The representative citizen of both countries has income from ownership of capital, of which the endowment is symmetrically distributed across countries. Net of tax income is therefore the same in the two countries in the core-periphery equilibrium:

$$x_c = x_p = \left(\frac{f(2\bar{k})}{\bar{k}} - t_c\right)\cdot\bar{k} \quad (0\text{-}25)$$

Where *c* and *p* subscripts stand for core and periphery respectively. Tax revenues and the government budget constraint in the core are:

$$g_c = t_c \cdot 2 \cdot \bar{k} \quad (0\text{-}26)$$

While tax revenues and government spending in the periphery are zero:

$$g_p = 0 \quad (0\text{-}27)$$

The citizens of the periphery are only able to spend their net income on imports of the private good, with no public good provision since there is no tax base. Moreover, the level of the capital income tax in the periphery would be irrelevant and is therefore arbitrarily set to zero with the rationale that the periphery is allowing for the possibility that the core exceeds the upper limit for the tax rate and loses the agglomeration (see below).

The country hosting the agglomeration, however, is able to levy positive taxes on capital without risking to lose the production agglomeration to the other country, since there is a positive

[17] Capital income taxes cannot be negative in this setup, since financing subsidies is not possible when there is no other tax to finance it. Labor income taxation could be allowed for in this model but would not change the conclusions drastically. In symmetry, labor taxation would allow for identical subsidies to capital, as is found in the economic geography literature, while the asymmetric equilibrium conclusions would not change at all since the periphery country would not have any labor income to tax.

difference between the gross return to capital in the core and the potential gross return to capital of the periphery. As long as the tax rate does not exceed this difference, the net return to capital will stay greater in the core. The upper limit to the tax rate in the core is therefore given by the condition (remembering that the marginal gross return to capital in the periphery is $\left.\frac{f(k)}{k}\right|_{k\to 0} = f'(0)$ according to L'Hôpital's rule.):

$$t^{trig} = \frac{f(2\cdot\bar{k})}{2\cdot\bar{k}} - f'(0) > 0 \quad (0\text{-}28)$$

t^{trig} is always positive given that the average product of capital always exceeds the initial marginal product of capital when the first and second derivatives of the production function are positive. If the capital tax rate in the core is set above t^{trig}, the potential net return to capital will be higher in the periphery and this will trigger a capital outflow from the core. Moreover, the process will be irreversible; all capital will flow to the periphery and only if the periphery (the new core) sets a tax rate above the limit will the former core regain its prior production agglomeration. Below t^{trig}, however, capital is effectively immobile, and can be taxed lump sum.

Comparing the core-periphery equilibrium with the no capital mobility case.
If capital mobility is assumed to be zero, each country will use its own endowment of capital in production, and capital would be taxed optimally according to the first order condition of the closed economy, (0-5). The income of the representative citizen and the government budget constraint under zero capital mobility are:

$$x_{ncm} = f(\bar{k}) - t_{ncm}\cdot\bar{k} \quad (0\text{-}29)$$

$$g_{ncm} = t_{ncm}\cdot\bar{k} \quad (0\text{-}30)$$

where the subscript *ncm* identifies the symmetric no capital mobility equilibrium value of the variable under increasing returns[18]. The tax rate will be determined by the first order condition known from the basic tax competition model, equation (0-5), as the taxation of capital is lump sum and non distortionary.

There are three main differences between the zero capital mobility equilibrium and the perfect capital mobility core-periphery equilibrium.

First, since all capital is concentrated in the core when capital mobility is perfect, global production increases due to the agglomeration rents attained by this concentration of production. The gross revenues from this global production are equally split between core and periphery

[18] NB! t^{ncm} is not necessarily the same as that of Section 1, since production and hence income behaves differently.

citizens, which both have higher gross income from capital. How much higher is determined by the degree of agglomeration rents, or external economies of scale[19].

Second, since the capital of both the core and the periphery is taxed in the core in the core-periphery equilibrium, the tax base is doubled in the core compared to that of the no capital mobility situation. The tax base as well as tax revenues are zero in the periphery.

Third, since half the capital which is taxed in the core-periphery equilibrium is of foreign ownership, and the welfare of these private citizens is not taken into account by the policy maker when choosing a utility maximizing tax rate in the core, the income from foreign capital can be viewed in a sense as "free". In other words, for every unit of tax revenues raised, only half of that unit comes from a decrease in private consumption by the domestic citizen. The other half is paid by the foreign capital owner. Hence, the marginal cost of public funds is below unity from the viewpoint of the policy maker in the core. This feature of the core-periphery equilibrium is of great importance for the equilibrium choice of public spending and tax rate, and can be referred to as the "taxing the foreigner" effect. Since public goods are only half the price of private goods, the first order condition for choosing the optimal tax rate in the core becomes[20]:

$$\frac{u_g(x_c, g_c)}{u_x(x_c, g_c)} = \frac{1}{2} \qquad (0\text{-}31)$$

Since the tax base increases, private income increases and the preferences for provision of public goods increase, it is not possible a priori to identify whether the tax rate is lower or higher in the core periphery equilibrium compared to the tax rate in the no capital mobility situation. It depends on the degree of economies of scale made by the concentration of production in the core, as well as the preferences for public vs. private goods, and thus, on the parameters of the model.

An example with functional forms:
As an example of a possible analytical solution of the model, assume that production is characterized by a quadratic production technology and that the preferences of the representative citizen are represented by a log-linear utility function as follows:

$$f(k) = \frac{1}{2}k^2 \qquad (0\text{-}32)$$

[19] It would be interesting to investigate analytically the welfare aspects and the potential for coordination of tax rates in this model. Compared to the symmetric equilibrium, world production would be increased in the cluster equilibrium due to the increasing returns to capital. The clustered equilibrium would hence Pareto dominate the symmetric outcome in the presence of adequate redistribution between the two countries, since there are no trade costs. (If trade implied wasted resources, the clustered equilibrium would not necessarily be a Pareto improvement from the symmetric equilibrium). The possibility of creating an institution for redistribution from the clustered country to the periphery would hence Pareto dominate the symmetric non-cooperative equilibrium, but the clustered country would be locally better of in the uncoordinated clustered equilibrium, and would therefore not be interested in cooperating in creating such an institution. An analytical investigation of these issues is left for another time.
[20] This first order condition can be derived formally by maximizing (0-3) subject to (0-25) and (0-26).

(0-33) $u(x,g) = \ln(x) + \omega \cdot \ln(g)$

where ω is a positive weight attached to public spending. In the case of zero capital mobility, government spending and private net income are:

(0-34) $x_{ncm} = \frac{1}{2}\bar{k}^2 - t_{ncm} \cdot \bar{k}$

(0-35) $g_{ncm} = t_{ncm} \cdot \bar{k}$

Using the first order condition (0-5), the equilibrium capital tax rate becomes:

(0-36) $t_{ncm} = \frac{1}{2} \cdot \frac{\omega}{1+\omega} \cdot \bar{k}$

In the core-periphery case, the private net income is the same in both locations. Government tax revenues are zero in the periphery as shown above, and double in the core:

(0-37) $x_{core} = x_{peri} = \bar{k}^2 - t_{core} \cdot \bar{k}$

(0-38) $g_{core} = t_{core} \cdot 2\bar{k}$

The tax rate is assumed zero in the periphery. The optimal tax rate in the core, given that there are no corner solutions, is found by using the first order condition (0-31):

(0-39) $t_{core} = \frac{\omega}{1+\omega} \cdot \bar{k}$

Since $t^{trig} = \bar{k}$ and ω is positive, the solution will be internal and given by (0-31)[21].

In conclusion, with the present example of log linear utility and quadratic production, the taxing the foreigner effect and the agglomeration economies dominate the effect of the increased tax base, and the tax rate on capital doubles in the core compared to the situation of zero capital mobility. At the same time, the capital tax rate falls to zero in the periphery, but this tax rate is of no importance to the tax burden on capital since there is no capital to be taxed in the periphery. Thus, in the present model of tax competition and agglomeration economies, a shift from zero to perfect capital mobility is associated with an increase in the overall tax burden on capital.

[21] The t^{trig} is found by inserting the functional form of the production function in (0-28).

Predictions From Economic Geography Models

The conclusions drawn concerning capital income taxation from the literature of economic geography are here restricted to those of the basic tax competition model modified to allow for agglomeration economies in production. Agglomeration economies allow for taxable agglomeration rents in locations of concentrated production. Moreover, such agglomeration rents are more likely when capital mobility is higher. Hence, when capital mobility is zero, the simple model of external economies predicts that capital income tax rates are equal across countries. When capital mobility increases, the capital tax rate should be expected to fall in countries with low concentration of production while in countries with high concentration of production should be able to sustain a higher level of capital income taxation. The model does not give a clear prediction for the level of the tax rate in countries of concentrated economic activity, however. The conclusions are similar to those of the asymmetric tax competition models, which predict increasing asymmetries across countries due to increases in capital mobility, with the difference that the degree of concentration of production and not country size is determining the level of the tax rate[22].

10 Predictions of the Tax Competition Literature for Capital Income Taxation in the European Union

The general result of the traditional tax competition literature is that the equilibrium tax rate on capital is sub-optimally low and that public goods are under-provided when capital mobility is high. This conclusion builds on a set of restrictive assumptions which this review of the theoretical literature on capital tax competition has relaxed one after one and looked at the implications for capital taxes. The conclusions for capital income taxation in the European Union are summarized below and five predictions about capital income taxation and capital mobility in the European Union are derived.

The central predictions concerning capital taxation in the European Union derived from the tax competition literature are:

H1: The higher the capital mobility, the lower the provision of public goods.

H2: The higher the capital mobility, the lower the tax revenues from and tax burden on capital taxed at the source.

When residence taxation of capital is enforceable, capital income taxation at the source is predicted to be zero under perfect capital mobility. However, since there is no real measure of whether residence taxation of capital is enforceable, and since residence taxation is usually argued to not be enforceable in the European Union, this prediction is not empirically testable

[22] It would be interesting to investigate analytically the welfare aspects and the potential for coordination of tax rates in this model. Compared to the symmetric equilibrium, world production would be increased in the cluster equilibrium due to the increasing returns to capital. The clustered equilibrium would hence Pareto dominate the symmetric outcome in the presence of adequate redistribution between the two countries, since there are no trade costs. (If trade implied wasted resources, the clustered equilibrium would not necessarily be a Pareto improvement from the symmetric equilibrium). The possibility of creating an institution for redistribution from the clustered country to the periphery would hence Pareto dominate the symmetric non-cooperative equilibrium, but the clustered country would be locally better of in the uncoordinated clustered equilibrium, and would therefore not be interested in cooperating in creating such an institution. An analytical investigation of these issues is left for another time.

and will not be considered any further here. When assuming that also labor income can be taxed, increasing capital mobility will result in a partial or full switch of the tax burden from capital to labor income. The prediction concerning capital taxation in the European Union derived from models allowing taxation of imperfectly mobile labor is therefore:

H3: The higher the degree of capital mobility, the higher the tax revenues from and tax burden on labor income relative to that of capital income.

Relaxing the assumption that countries are small gives each of the competing countries market power to affect the world after-tax rate of return to capital when setting the capital tax rate. This does not change the conclusion that the tax rate is too low and that public goods are under-provided in equilibrium, however, but it does mitigate the under-provision result so that the equilibrium Pareto-dominates the small-country equilibrium. Hence, the first two predictions of the tax competition literature are not affected by the assumption concerning the size of the countries.

When the assumption of symmetry of the competing countries is relaxed, and differences in the size of capital endowments or population are allowed for, the elasticity of capital to the tax rate is perceived to be higher by smaller countries. The larger country will therefore set a higher tax rate relative to the smaller country, although still too low to be efficient, and the smaller country will be better off than the larger one. In extreme cases, the small country may even be better off than under coordination. Asymmetric models have no clear answer to how asymmetry affects public good provision compared to the symmetric case. The third prediction concerning capital taxation in the European Union derived from the tax competition literature is therefore:

H4: The larger the country, the smaller the downward pressure of capital mobility on the tax rate

When assuming that the government is motivated partly, or fully, by self-interest, the inefficiency result may be reversed, so that the coordination result is inefficient and tax competition enhances efficiency. But the predictions for the tax rate on capital remain the same as for the basic model where government is assumed benevolent.

Allowing for democratic elections, it is shown that increasing capital mobility also moves the political equilibrium toward the left side of the political spectrum, thus counterbalancing the downward pressure on tax rates. However, the move to the left does not outweigh the tax competition pressure and the net effect of increasing capital mobility on capital income taxes is still found to be negative. Hence, allowing for democratic elections mitigates the sup-optimality result but does not eliminate it and the qualitative predictions are the same as those of the basic tax competition literature.

When agglomeration rents are allowed for, the conclusions change since attracting industry to one location creates agglomeration rents which can then be taxed without capital fleeing, in spite of capital being perfectly free to move. Agglomeration rents make capital a quasi-fixed factor, and thus create a margin between the return to capital of the agglomeration and other locations, within which a positive tax rate can be set without reaching the limit where capital flees to another location.

H5: The more concentrated production is in the country, the smaller the downward pressure of capital mobility on the tax rate

As the theoretical literature suggests, there are many ways of taxing capital and not all of these are prone to tax competition.

11 Conclusion

This paper has reviewed the theoretical literature on tax competition in the light of what the predictions of the literature are for capital income tax competition in the European Union, and derived five predictions concerning how capital mobility should be expected to affect capital taxation in the European Union.

The standard tax competition theory, based on restrictive assumptions such as small countries, benevolence of government, source taxation of capital as the only means of taxation, symmetry and decreasing returns to capital, predicts a downward pressure of capital mobility on capital tax rates – the co-called race to the bottom. Relaxing each of these restrictive assumptions shows that the race to the bottom is not the only possible consequence of increasing capital mobility. Allowing for countries to be able to affect the world after tax return to capital through their tax policy mitigates the predicted race to the bottom, although it is not eliminated. Relaxing the assumption of symmetry shows that the economic size of a country may have significant influence on that country's tax response to increasing capital mobility, with larger countries reacting less than small countries. But, overall, a downward pressure on tax rates is still present. Allowing for other, and immobile tax based implies that increasing capital mobility will shift the tax burden from capital toward immobile tax bases, not necessarily inflicting on the overall level of taxation of a country. If the assumption of benevolence is relaxed, and the policy maker is assumed to maximize own utility, the tax race to the bottom is still predicted to take place, but found to be welfare improving, in that tax competition will restrain the self-serving policy maker.

Finally, two amendments to the standard model, namely those of allowing for democracy combined with a popular demand for social insurance, and increasing returns to capital, both counteract the capital tax race to the bottom prediction. Political economy models show that elections and electorate aware of the effects of capital mobility, may mitigate if not overturn the race to the bottom result. Moreover, allowing for increasing returns to capital leads to the creation of economies of scale on country level, and hence to the clustering of economic activity in one location. Since this location will have higher returns to capital than in other less clustered locations, there is a margin within which a positive tax rate can be applied on capital, which does not induce an outflow of capital. In the extreme, capital mobility and the clustering of economic activity may lead to a higher level of capital taxes.

In the context of the European Union, assumptions such as symmetry and lack of clustering effects of capital mobility clearly are not satisfied. EU countries do have other tax bases than capital and evidently use these substantially, in addition to not always taxing capital at the source but also according to the residence principle. They do have democratically elected governments, and moreover, are clearly not symmetric in size. Whether the assumption of benevolence of

government or the Leviathan model fits EU countries is an article of faith and will not be discussed further here. In brief, it is not possible to conclude with theory alone that increasing capital mobility in the European Union must lead to a race to the bottom in capital tax rates.

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