

Standard Tax Competition and Increasing Returns

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Abstract

The standard tax competition literature predicts that capital taxes will race to the bottom as capital become mobile, while new economic geography models allow for economic integration to lead to a race to the top in tax rates. This paper shows that the race to the top result can be obtained from within the standard tax competition modelling framework augmented with agglomeration forces. Agglomeration forces work to mitigate tax competition pressures, and capital taxes are instead driven by tax exporting incentives.

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1 Introduction

The standard tax competition literature predicts that capital taxes will be competed downward as economic integration increases (Zodrow and Mieszkowski, 1986, Wilson, 1986), with negative welfare effects as the pressure on tax rates causes public good provision to suffer. The last couple of decades have seen an unprecedented increases in international economic integration, and following the standard tax competition theory, we should therefore expect to see taxes on mobile capital plummeting around the world. But the data suggests that the story is less clearcut than what the standard tax competition theory implies. There is evidence of strategic interaction among governments in setting capital tax rates (Devereux et al., 2004), but the jury is still out on whether such strategic interaction has led to the predicted downward pressure on capital tax rates. Taxes on mobile capital have either increased, decreased or did not change over the past 30-40 years depending on how capital tax rates are measured (Krogstrup, 2003). Moreover, while a couple of studies find a negative impact of indicators of financial integration on corporate tax rates (Slemrod, 2004; Swank and Steinmo, 2002), other studies suggest that capital taxation has increased with the degree of capital mobility (Quinn, 1997; Garrett and Mitchell, 2001).

The new economic geography (NEG) literature has recently come up with an alternative to the standard tax competition model, pointing out that as economic integration increases, the scope for agglomeration of economic activity increases as well (Ludema and Wooton, 2000; Andersson and Forslid, 2003; Baldwin and Krugman, 2004; Kind et al., 2003; Ottaviano and Van Ypersele, 2005). When agglomeration rents accrue to mobile factors, these can be taxed non-distortionarily, as the mobile factor is locked in to the geographical location of the agglomeration rents. The mobile factor as such becomes “quasi-fixed”. Since agglomeration forces are found to be bell-shaped in the degree of economic

integration¹, NEG models find that tax competition occurs – and can be very fierce – for relatively low and high levels of economic integration, but that tax competition is reduced and may even be reversed for intermediate levels of economic integration - hence the reference to a "race to the top" in Baldwin and Krugman (2004). NEG models thus find that tax competition pressures are U-shaped in economic integration.

The standard and the NEG scenarios for tax competition are not directly comparable due to the notable differences between modelling frameworks of two literatures. In particular, NEG models generally define economic integration as a lowering of trade cost² given zero barriers to capital flows, while standard tax competition models analyze the move from zero to perfect capital mobility under free trade.

Given the importance of the chosen analytical framework for the outcome of the tax game and the associated policy implications³, a synthesis of the two approaches is desirable. A few attempts have been made to include agglomeration forces into the standard tax competition modelling framework. Fernández (2005) augments the standard workhorse tax competition model with external economies of scale, and Burbidge and Cuff (2005) allow for increasing returns to scale on both the firm and the aggregate level in an otherwise standard tax competition model. Both find that tax competition intensifies when allowing for agglomeration forces, since the cost of capital flight increases as scale economies are lost. Neither Fernández (2005) nor Burbidge and Cuff (2005) find that including agglomeration forces allows tax rates to escape tax competition pressures.

Does this mean that "race to the top" result of the NEG literature does

¹Baldwin et al. (2003) give a general overview of the findings of the NEG literature

²The term "trade costs" should be understood in the most general sense of the world, as covering tariffs, non tariff barriers and transportation costs alike.

³See Baldwin and Krugman (2004) for a discussion how the policy implications of the two strands of literature differ.

not survive when the modelling setup and central assumptions are those of the standard tax competition model? This paper shows that the answer is no. It turns out that the main driver of the results of Fernández (2005) and Burbidge and Cuff (2005) is the assumption that agglomeration forces are of moderate strength (in a sense that will become clear in Section 3 below). In the light of the NEG literature, this assumption can be interpreted as requiring that agglomeration forces are outweighed by dispersion forces, which implies that capital movements between jurisdictions remain stabilizing and the dispersed equilibrium, which is typical of the standard tax competition model, persists. The assumption of moderate agglomeration forces precludes the formation of core-periphery equilibria, just as is the case when dispersion forces outweigh agglomeration forces in NEG models. When the opposite assumption is made, namely that agglomeration forces are relatively strong, an equilibrium emerges within the standard tax competition model in which all capital is located in one jurisdiction, reminiscent of the core-periphery equilibrium of NEG models. In this equilibrium, the agglomeration rents to capital can be taxed within limits without inducing a capital outflow.

This paper thus shows that the main results of the NEG literature for tax competition are fully compatible with the standard tax competition model augmented with agglomeration forces: When the agglomeration forces are assumed to be of moderate strength, the standard tax competition model produces fierce tax competition akin to the dispersed equilibrium outcome of NEG models. When the strength of the agglomeration forces exceeds a critical level, the standard tax competition model produces a core periphery equilibrium in which tax competition pressures are reduced or undone, similar to the core periphery equilibrium outcome for the tax game in NEG models.

The assumption that agglomeration forces are relatively strong changes the

nature of the standard tax competition model quite drastically, as core-periphery equilibrium allocations of capital emerge. One consequence of this is that tax exporting incentives form endogenously and play a central role in driving tax rates as tax competition pressures subside. The model also allows for the unusual combination of binding tax competition and excessively high tax rates to emerge in equilibrium.

The paper is structured as follows. The next section presents a standard tax competition model a la Zodrow and Mieszkowski (1986), augmented with external economies of scale following Fernández (2005). The model setup differs from that of Fernández (2005) in several ways. The assumption on the strength of the external economies of scale is relaxed, there are only two jurisdiction, and an additional tax instrument, non-distortionary head taxes, is added. Note that the inclusion of an additional source of tax revenue is not necessary for the results (which are driven entirely by the relative strength of external economies), but head taxes allow both jurisdictions to provide public goods in a core-periphery equilibrium, in spite of the periphery not possessing a capital tax base. Section 3 briefly illustrates the intensified tax competition result obtained in Fernández (2005) and Burbidge and Cuff (2005). The core-periphery equilibrium and the possibility of a “race to the top” in capital taxes are illustrated in Section 4, and the final section concludes.

2 The Model

The model is a two-jurisdiction version of Zodrow and Mieszkowski (1986), augmented with external economies. The two identical jurisdictions together form the world. There is an infinity of firms and households in each jurisdiction. Each firm is owned by a household and produces a homogenous good, the price of which is normalized to one. The produced good is traded freely

between the two jurisdictions at no trade or transportation costs and, hence, jurisdictional production does not have to equal jurisdictional consumption. This assumption is implicit in the standard tax competition model where equilibria between equally sized jurisdictions are symmetric with zero trade. It becomes central in the present setup, since trade accounts do not necessarily balance (rather, the current account balances) in asymmetric equilibria. There are two inputs in production: mobile capital and a fixed factor, which is provided by the owner household. Similarly to Fernández (2005), agglomeration economies are introduced as external economies deriving from the aggregate amount of capital invested in the economy. External economies is the simplest possible way of allowing for agglomeration economies⁴, and can be interpreted as a summary measure of the strength of agglomeration forces relative to dispersion forces given the stock of capital invested in the jurisdiction in question⁵. Normalizing the total amount of households to one, the per household production function equals the aggregate production function and can be written as

$$y_i = f(k_i)h(k_i) \tag{1}$$

where $f' > 0$, $f'' < 0$ and $h' > 0$, and where k_i is the amount of capital per household invested in production in jurisdiction i , $i = 1, 2$. $f(k_i)$ is a constant returns to scale per capita production function index, where the fixed factor is left out for ease of exposition. $h(k_i)$ gives the external economies of scale of capital accumulation in the jurisdiction in question. In making decisions regarding input demand and output supply, firms treat the aggregate amount of capital invested in the jurisdiction, and hence $h(k_i)$, as given. (1) thus reflects

⁴It is, in fact, the way agglomeration forces were modelled in the "old" economic geography literature.

⁵As noted in the introduction, the relative strength of agglomeration and dispersion forces depends, among other things, on trade cost in NEG models, and as such, the model here can also be interpreted as having non-zero trade cost which are modeled implicitly as part of the aggregate production function rather than being explicitly imposed.

that firms on the micro level perceive to be operating with a constant returns to scale technology, while technology and/or pecuniary spillovers of agglomeration of production leads to external economies of scale. In all other respects, the framework is the same as in the standard tax competition model. The representative household in jurisdiction i receives net of tax income from invested savings, \bar{k} , and income from ownership of the fixed factor. The budget constraint of the representative household is given by:

$$x_i = f(k_i)h(k_i) - f'(k_i)h(k_i)k_i + \rho\bar{k} - T_i, \quad (2)$$

where x_i is the total income net of tax of the representative household, ρ is the after-tax return to capital owned by households in jurisdiction i and T_i is a lump sum head tax paid to government in jurisdiction i . The utility of the representative household depends positively on public spending and private consumption according to:

$$u(g_i, u_i), \quad u'_g, u'_x > 0, \quad u''_{gg}, u''_{xx} < 0, \quad (3)$$

where g_i is spending on public goods in jurisdiction i . The government provides this public good, which is financed with source taxes t_i on mobile capital and head taxes on households located within the jurisdiction. The government budget constraint of jurisdiction i is given by:

$$g_i = t_i k_i + T_i \quad (4)$$

The total amount of capital available in the world is the sum of capital employed in the two jurisdictions, and assuming that all savings are invested in production,

the resource constraint becomes:

$$k_1 + k_2 = 2\bar{k} \tag{5}$$

The tax game is a two stage complete but imperfect information game. In the first stage, the governments play a one shot game in tax rates, taking the initial allocation of capital across the two jurisdictions as given. Both governments are assumed to be benevolent, and thus to have as strategy to choose the tax rate that maximizes the utility of the representative household of their jurisdiction, subject to the government and private budget constraints. The governments have complete information when selecting their optimal tax rates. In the second stage, households observe the tax rates chosen by the governments, and the initial net returns to capital in the two jurisdictions, which in turn depend on the initial allocation of capital between the two jurisdictions. They then reallocate capital toward the jurisdiction with the highest net return to capital (thereby changing the gross return to capital). Capital is reallocated to an extent that ensures capital market equilibrium, defined as the situation in which all capital receives the same net of tax return. Capital market equilibrium requires either that net returns to capital are equalized across jurisdictions, or that all capital is invested in the high-return jurisdiction. Note that the reallocation of capital in the second stage of the game happens instantaneously. There are no dynamics in this model. Finally, the equilibrium concept is that of a sub-game perfect Nash equilibrium unless otherwise specified.

3 The Race to the Bottom

Start by making the assumption, as in Fernández (2005), that the effect on the return to capital from agglomeration economies is dominated by the decreasing

marginal productivity of capital⁶:

$$\frac{\partial}{\partial k} [f'(k)h(k)] < 0 \tag{6}$$

Assumption (6) implies that a reallocation of capital between the two jurisdictions in the second stage of the game will lead to a lower return to capital in the receiving jurisdiction, and to a higher return to capital in the jurisdiction of origin. Given the properties of the production function, there will hence be only one interior allocation of capital between the two jurisdictions corresponding to capital market equilibrium. This capital market equilibrium is characterized by an equalization of net returns to capital across jurisdictions:

$$\rho = f'(k_i)h(k_i) - t_i = f'(k_j)h(k_j) - t_j \tag{7}$$

Fernández (2005) shows that in this case, the tax competition game between the two jurisdictions becomes fiercer, since attracting capital is even more desirable when scale economies are added. To illustrate this point, assume for a moment that there is a non-trivial ceiling for the level of the non-distortionary head tax, \overline{T}_i , such that governments will want to complement their tax revenues with the use of source based capital taxes⁷. The equilibrium in tax rates is found by solving the government's maximization problem and imposing symmetry across

⁶To interpret this assumption on the relative strength of the external economies, note that in the NEG literature, trade and transportation costs determine the size of agglomeration rents accruing to the mobile factor, in this case the steepness of $h(k_i)$. These rents are generally found to be bell-shaped in trade and transportation costs, so assumption (6) could be interpreted as setting a specific range for these costs (i.e. either low are high, but not mid range).

⁷The assumption of a non-trivial head-tax ceiling is akin to the assumption made in Zodrow and Mieszkowski (1986).

jurisdictions, which yields⁸:

$$\frac{u'_g(g_i, x_i)}{u'_x(g_i, x_i)} = \frac{1}{\varepsilon_{k_i} + 1} \left(1 - \frac{f(k_i)h'(k_i)}{k_i} \frac{\partial k_i}{\partial t_i} \right) > 1 \quad (8)$$

where $\varepsilon_{k_i} = \frac{\partial k_i}{\partial t_i} \frac{t_i}{k_i} < 0$ and $\frac{\partial k_i}{\partial t_i} = \frac{1}{2(f''(k_i)h(k_i) + f'(k_i)h'(k_i))} < 0$ ⁹. The right hand side of (8) is the marginal cost of public funds associated with the capital tax instrument. Note that the marginal cost of public funds is greater than one because the capital tax distorts the investment decision of the households. (8) shows that in equilibrium, the governments will select tax rates which ensure that the marginal cost of public funds is equal to the marginal rate of substitution between private and public spending (the left hand side of (8)), and hence, $u'_g > u'_x$. If the jurisdictions could agree to increase their capital tax rates marginally, the allocation of capital would be unaffected, and utility would increase. Capital taxes are therefore too low relative to social optimum. This conclusion is qualitatively identical to that derived from the standard tax competition literature, but the presence of external economies, which adds the second term in the parenthesis on the right hand side of (8), magnifies this result: as Fernández (2005) and Burbidge and Cuff (2005) find, tax competition becomes fiercer when we allow for moderate agglomeration forces.

When the head tax is free to vary, on the other hand, the result is identical to that of the standard tax competition literature. The governments will levy only non-distortionary head taxes. The equilibrium outcome for taxes, public

⁸The government's problem is to maximize the household utility function with respect to capital taxes and head taxes, subject to the private and public budget constraints, the resource constraint and the financial market equilibrium condition. The symmetric solution is found by imposing $k_i = k_j = \bar{k}$.

⁹ $\frac{\partial k_i}{\partial t_i}$ is found by totally differentiating the resource constraint (5) and the financial market equilibrium condition (7) with respect to t_i .

spending and capital allocation is correspondingly socially optimal¹⁰:

$$\frac{u'_g(g_i, x_i)}{u'_x(g_i, x_i)} = 1 \quad (9)$$

Note that when the head tax is free to vary, the level of capital taxes (i.e. zero) is unaffected by the presence of external economies, as long as the strength of the external economies conform with assumption (6).

As shown in the next section, the nature of the equilibrium changes drastically when assumption (6) is relaxed.

4 The Race to the Top

Assume now that

$$\frac{\partial}{\partial k} [f'(k)h(k)] > 0. \quad (10)$$

(10) implies that external economies of scale have a stronger influence on the return to capital than the firm level decreasing marginal productivity of capital¹¹. This assumption completely alters the impact of capital reallocation on the returns to capital: As capital is reallocated toward the high-return jurisdiction, the initial return differential is widened. Note that assumption (9) implies that the gross return to capital in the jurisdiction with relatively more capital is always greater than the return to capital in the jurisdiction with relatively less capital. In particular, and for later use, note that:

$$f'(2\bar{k})h(2\bar{k}) \gg f'(0)h(0). \quad (11)$$

¹⁰This latter property is due to the assumption that all households own capital and pay head taxes, thus eliminating any potential for redistributive consequences of the change in the tax mix.

¹¹In the light of the NEG literature, this assumption can be interpreted as setting the range of implicit trade and transportation costs to intermediate levels, for which agglomeration forces dominate dispersion forces.

The game now unfolds as follows. In the second stage, all capital locates in the jurisdiction with the highest initial net return (which in turn magnifies the net return differential between the two jurisdictions). If the net return to capital is initially equal in the two jurisdictions, no relocation of capital takes place in the second stage. There are now two types of sub-game perfect Nash equilibria in tax rates in the first stage, depending on whether the initial capital allocation is symmetric or whether all capital is invested in just one jurisdiction (the core periphery equilibrium). The symmetric equilibrium only exists under certain conditions on the aggregate production function and is characterized by zero tax rates in both jurisdictions. Moreover, the symmetric allocation of capital is unstable and inefficient. The symmetric Nash equilibrium is hence delegated to appendix and not considered further here.

Consider the case in which the economy is initially characterized by a core-periphery allocation of capital. Accordingly, all capital is invested in the production of one jurisdiction - the core - while the other jurisdiction - the periphery - does not have any production at all¹². The net of tax income of the representative household in the core and the periphery are now given by:

$$x_c = (f(2\bar{k}) - f'(2\bar{k})2\bar{k})h(2\bar{k}) + (f'(2\bar{k})h(2\bar{k}) - t_c)\bar{k} - T_c \quad (12)$$

$$x_p = (f'(2\bar{k})h(2\bar{k}) - t_c)\bar{k} - T_p$$

where p and c subscripts denote core and periphery values. The government budget constraints in the two jurisdictions are given by:

$$g_c = t_c 2\bar{k} + T_c \quad (13)$$

¹² As is typical for NEG models, the model does not answer which jurisdiction becomes core and which becomes periphery. This is put down to “accident of history”

$$g_p = T_p$$

The representative household of the periphery divides its net income from capital on imports of the private good and on paying head taxes to the government.

In this setup, the jurisdiction hosting the core is able to tax capital within certain limits (see below) without risking that capital relocates to the other jurisdiction, since according to (11), the difference between the marginal gross return to capital in the core and the potential marginal gross return to capital of the periphery is strictly positive. As long as the capital tax rate does not exceed this difference, the net return to capital will stay greater in the core. The upper limit to the capital tax rate in the core depends on the periphery's capital tax rate according to:

$$t^{trig} = f'(2\bar{k})h(2\bar{k}) - (f'(0)h(0) - t_p) > 0. \quad (14)$$

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 locate in the periphery. Below t^{trig} , however, capital is effectively immobile, and can be taxed without distortions.

The government in the core chooses the head tax and the capital tax rate such that the utility of the representative household in the core is maximized, given the core's private and government budget constraints, and assuming that capital is immobile within the limit given by t^{trig} . Consider first an interior solution, i.e. a solution in which the optimal capital tax rate in the core is below t^{trig} . The resulting first order conditions with respect to the head tax is

equal to (9) and the first order condition with respect to the capital tax becomes:

$$\frac{u'_g(g_c, x_c)}{u'_x(g_c, x_c)} = \frac{1}{2} \quad (15)$$

(9) and (15) imply that the government in the core derives all tax revenues from the capital tax while setting head taxes to zero¹³. The intuition for this is straightforward. Both taxes are locally non-distortionary in the interior equilibrium, due to the quasi-fixed nature of capital below t^{trig} . But while the entire tax burden of the head tax falls on domestic households, domestic households only pay half of the tax revenue accruing from the capital tax. The rest is paid by foreign capital owners whom the government in the core does not care about. The capital tax instrument in this sense allows the government to export half the tax burden of the capital tax¹⁴.

The periphery will have the same tax exporting incentive to use the capital tax, if it is able to set it low enough to attract capital to the periphery in the second stage of the game. If

$$\tilde{t}_c \leq t_{t_p=0}^{trig} = f'(2\bar{k})h(2\bar{k}) - f'(0)h(0) > 0 \quad (16)$$

where \tilde{t}_c is the core capital tax rate which satisfies (15), then there is no non-negative level of the capital tax rate in the periphery which will be low enough to attract the stock of capital. In this case, the capital tax yields no tax revenues in the periphery irrespective of its level. Consequently, the level of the capital

¹³The first order conditions for the government's problem in the interior equilibrium case is to set T_c according to (9), and t_c according to (15). This is only achieved simultaneously by setting either $T_c = 0$ or $t_c = 0$. Setting $T_c = 0$ yields the highest level of utility.

¹⁴In some NEG models, the potential for tax exporting is precluded by the assumptions regarding the government objective function (Ludema and Wooton, 2000, and Andersson and Forslid, 2003, assume that governments do not care about the owners of the mobile factor, Baldwin and Krugman, 2004, assume that government preferences are defined over taxes and tax revenue per se, rather than over the utility of the representative citizen.). Kind et al. (2000) and Ottaviano and van Ypersele (2005) do find tax exporting effects as a main driver of tax rates in the core periphery allocation of capital.

tax rate of the periphery is not pinned down in equilibrium. The periphery's head tax, on the other hand, is set optimally according to (9).

Multiple equilibria of this type are a typical feature of NEG models, and can be dealt with through a refinement of the equilibrium concept¹⁵. Following Ludema and Wooton (2000) the periphery tax rate under assumption (16) is pinned down by requiring that if it were possible that households could make a mistake and locate in the periphery in the second stage of the game, in spite of the net return to capital being lower in the periphery, then the periphery would not want to change its capital tax rate if it were given the option to do so¹⁶. In this case, the periphery would set its capital tax rate according to (15). Because the periphery sets a non-zero head tax while the core does not apply head taxes under assumption (16), this "shadow" capital tax rate in the periphery will be positive, but lower than in the core.

The interior core-periphery Nash equilibrium in tax rates is hence characterized by assumption (16) being satisfied, \tilde{t}_c and \tilde{t}_p being set according to (15), $\tilde{T}_c = 0$ and \tilde{T}_p being set according to (9).

The head tax plays a very small role in this equilibrium. Imposing an upper ceiling on the head tax, as in Zodrow and Mieszkowski (1986), would have no impact on t^{trig} or on the equilibrium tax rates in the core. The head tax instrument allows for public goods provision in the periphery in the absence of a capital tax base, and constraining it hence only affects the shadow capital tax rate set in the periphery. If head taxes were not available at all, as in Fernández (2005) and Burbidge and Cuff (2005), the shadow capital tax rate in the periphery would be equal to the capital tax rate in the core, and there would be no public goods provision in the periphery¹⁷. Irrespective of the

¹⁵Alternatively, Baldwin and Krugman (2004) solve this problem by assuming that both capital and labor are taxed by the same tax rate, leaving the labor tax base in the periphery as the determinant of the periphery tax rate.

¹⁶This is a so-called "trembling hand" perfect equilibrium refinement.

¹⁷The core-periphery equilibrium of Ludema and Wooton (2000) exhibits a similar feature

assumptions regarding the head tax, the interior Nash equilibrium in tax rates is characterized by a complete absence of tax competition pressures. Quite the opposite, capital tax rates are set too high from a social optimum point of view, due to tax exporting incentives.

These findings change slightly if (16) is not satisfied. In that case, the core's optimal choice of capital tax rate is directly constrained by the possibility that the periphery sets a capital tax rate which is low enough to have all capital relocating to the periphery in the second stage of the game. An element of tax competition thus returns. This case is akin to the limit taxing equilibrium of Baldwin and Krugman (2004). The core will wish to set the highest possible tax rate which allows it to keep the core, given the capital tax rate of the periphery. The core government hence sets its capital tax rate equal to t^{trig} ¹⁸. The periphery government sets its capital tax rate to zero so as to pressure the capital tax rate of the core, thus increasing the net of tax capital income of its citizens. Since the periphery still does not have any capital tax base, the periphery head tax is set optimally as in the interior equilibrium. The equilibrium level of the head tax in the core now depends on the strength of the tax competition pressures from the periphery. If the pressure is strong enough to reduce the core capital tax rate to a level below that which would ensure an optimal provision of public goods in the core, i.e. if $\frac{u'_g(g_c, x_c)}{u'_x(g_c, x_c)} \leq 1$ for $\tilde{t}_c = t_{t_p=0}^{trig}$, then head taxes will be employed to raise additional tax revenues in the core. Otherwise, core head taxes remain unused.

The limit taxing Nash equilibrium is given by $\tilde{t}_c = t_{t_p=0}^{trig}$, $\tilde{T}_c \geq 0$, $\tilde{t}_p \leq 0$ and \tilde{T}_p set according to (9). While tax competition pressures are present in the

due to their assumption that only the mobile factor is taxed. Most other NEG contributions to the tax competition literature allow for an additional tax instrument on immobile factors and hence allow for public good provision in the periphery.

¹⁸Note that the core's capital tax rate in the limit taxing equilibrium should be understood as equal to $t^{trig} - \varepsilon$, where ε is defined as the smallest possible value ensuring stability of the core-periphery allocation of capital.

limit taxing equilibrium, the core's capital tax rate may still be too high from a social optimum point of view, which gives rise to the possible coexistence of tax competition pressures on the margin, and excessively high tax rates due to tax exporting. Tax competition pressures are welfare improving in this case, as they counteract the tendency to overtax. This is counter to the traditional findings of the tax competition literature, where the assumption of non-benevolent "Leviathan" type governments is usually needed for tax competition to increase social welfare.

The combination of tax competition pressures and excessively high tax rates is new to the new economic geography literature¹⁹, and only occurs when cross border ownership of capital is assumed exogenously in the standard tax competition literature (Eijffinger and Wagner, 2001).

5 Conclusion

The new economic geography literature finds that for intermediate levels of economic integration, agglomeration forces are strong and have the potential to mitigate or reverse tax competition pressures, producing a potential race to the top in capital tax rates as economic integration increases. The standard tax competition literature, on the other hand, finds that tax competition pressures increase in the degree of economic integration, leading to a race to the bottom in capital tax rates. Moreover, allowing for moderate agglomeration forces in the standard tax competition model only reinforces this result. By extending the standard tax competition model with increasing returns, this paper has shown that the potential race to the top in NEG models does extend to the standard tax competition model augmented with agglomeration forces, as long

¹⁹The combination of tax competition and too high tax rates could possibly arise in the model of Kind et al. (2000), which has the potential for both tax exporting and a limit taxing equilibrium, but it does not seem to be the case for the parameter values chosen in their numerical simulations.

as the agglomeration forces are sufficiently strong to produce core periphery equilibria.

Two additional insights have emerged from the exercise. First, the inclusion of agglomeration forces in the standard tax competition model results in equilibrium net trade in capital between initially identical jurisdictions. This is different from standard tax competition models, which only produce equilibrium trade in capital when the competing jurisdictions are assumed to differ in size or capital endowments (Wilson, 1991; Kanbur and Keen, 1993), or when gross trade in capital is assumed exogenously (Huizinga and Nielsen, 1997, Eijffinger and Wagner, 2001). The emergence of net trade in capital has strong implications for equilibrium tax rates. As agglomerated jurisdictions are capital importers and the constraints imposed by tax competition pressures are relieved by the presence of agglomeration rents, tax exporting incentives end up driving the capital tax rate above its socially optimal level in agglomerations.

A second insight which has emerged is that an equilibrium outcome with simultaneous tax competition pressures and excessive capital tax rates has the potential to occur endogenously (the limit taxing equilibrium). Tax competition is beneficial in this case, as it acts to limit the harm done by tax exporting incentives. An important policy implication is that measures designed to reduce tax competition pressures (e.g. capital tax floors) could be potentially harmful.

References

- [1] Andersson F., and R. Forslid, 2003. Tax Competition and Economic Geography. *Journal of Public Economic Theory*. April 2003; 5(2): 279-303
- [2] Baldwin, R and P. Krugman, 2004. Agglomeration, Integration and Tax Harmonization, *European Economic Review* 48(1)

- [3] Baldwin, R, R. Forslid, P. Martin, G. Ottaviano and F. Robert-Nicoud, 2003. *Economic Geography and Public Policy*. Princeton University Press.
- [4] Burbidge, J. and K. Cuff, 2005. Capital tax competition and returns to scale. *Regional Science and Urban Economics* 35: 353-373
- [5] Devereux, M.P., R., B. Lockwood and M. Redoano, 2004, Do Countries Compete over Corporate Tax Rates? Mimeo, University of Warwick
- [6] Eijffinger, S. and W. Wagner, 2001. Taxation if Capital is not Perfectly Mobile: Tax Competition versus Tax Exportation. CEPR Discussion Paper: 3084
- [7] Fernández, Gonzalo E., 2005. A Note on Tax Competition in the Presence of Agglomeration Economies. *Regional Science and Urban Economics*, vol. 35(6): 837-47
- [8] Garrett, G. and D. Mitchell, 2001. Globalization, Government Spending and Taxation in the OECD, *European Journal of Political Research* 39(2): 145-177
- [9] Huizinga, H and S.B. Nielsen, 1997. Capital income and profit taxation with foreign ownership of firms. *Journal of International Economics* 42(1-2): 149-65
- [10] Kanbur, R. and M. Keen, 1993, Jeux sans frontières: Tax competition and tax coordination when countries differ in size, *American Economic Review* vol 83, p. 877-892
- [11] Kind, H., K.H. Midelfart Knarvik and G. Schjelderup, 2000. Competing for Capital in a Lumpy World. *Journal of Public Economics*, 78 (3): 253-274.

- [12] Krogstrup, Signe, 2003, Are Capital Taxes Racing to the Bottom in the European Union? HEI Working Paper 1/2003. Graduate Institute of International Studies, Geneva.
- [13] Ludema, R.D. and I. Wooton, 2000. Economic Geography and the Fiscal Effects of Jurisdictional Integration. *Journal of International Economics*, Vol. 55 No. 2 December: 331-357.
- [14] Ottaviano, G.I.P. and T. Van Ypersele, 2002. Market access and tax competition. CEPR Discussion Paper 3638, London, U)
- [15] Quinn, Dennis, 1997. The Correlates of Change in International Financial Regulation, *American Political Science Review* 91 (3): 531-552
- [16] Slemrod, Joel, 2004, Are corporate tax rates, or countries, converging? *Journal of Public Economics* 88; 1169-1186
- [17] Swank, Duane, and Sven Steinmo, 2002, The New Political Economy of Taxation in Advanced Capitalist Democracies, *American Journal of Political Science* 46(3); 642-655
- [18] Wilson, J.D., 1999. Theories of Tax Competition. *National Tax Journal* 52(2), p. 269-304.
- [19] Wilson, J.D., 1991, Tax Competition with Interregional Differences in Factor Endowments, *Regional Science and Urban Economics* vol. 21, p. 423-52
- [20] Wilson, J.D., 1986, A theory of interregional tax competition, *Journal of Urban Economics* vol. 19, p. 296-315
- [21] Zodrow, G.R. and P. Mieszkowski, 1986. Pigou, Tiebout, Property Taxation, and the Underprovision of Local Public Goods. *Journal of Urban Economics* 19(3), p. 356-70.

Appendix

Consider the game described in Section 4 when it sets off in a starting point with a symmetric allocation of capital. Given an initial symmetric allocation of capital between the two jurisdictions, the government's problems looks as follows:

$$\begin{aligned}
 & \max_{T_i, t_i} U(x_i, g_i) & (17) \\
 \text{s.t. } (a) \quad & x_i = f(\bar{k})h(\bar{k}) - t_i\bar{k} - T_i, \quad g_i = t_i\bar{k} + T_i \quad \text{for } t_i = t_j \\
 & (b) \quad x_i = f(2\bar{k})h(2\bar{k}) - f'(2\bar{k})h(2\bar{k})\bar{k} - t_i\bar{k} - T_i, \quad g_i = t_i2\bar{k} + T_i \quad \text{for } t_i < t_j \\
 & (c) \quad x_i = (f'(2\bar{k})h(2\bar{k}) - t_j)\bar{k} - T_i, \quad g_i = T_i \quad \text{for } t_i > t_j
 \end{aligned}$$

Since the distribution of capital is “lumpy”, the expressions for the private and government budget constraints depend on the allocation of capital in the second stage of the game, which in turn depends on the capital tax rates chosen by the two jurisdictions in the first stage of the game. If jurisdiction i sets a lower capital tax rate than jurisdiction j , jurisdiction i will win the core, i.e. attract all the capital to jurisdiction i (case b in (17)). The opposite holds true if jurisdiction i sets a higher capital tax rate than jurisdiction j (case c). If the two jurisdictions choose the same capital tax rate, the outcome will be a symmetric allocation of capital (case a in (17)). First, note that the first order condition with respect to the non-distortionary head tax is given by (9), which means that public good provision can be carried out at a marginal cost of public funds of one. Hence, jurisdiction i will only use its capital tax instrument if the marginal cost of public funds associated with the use of this tax is less than one (i.e. subsidized). Second, note that given an initial symmetric allocation of capital and the assumption that the two jurisdictions are identical, a possible Nash equilibrium must also be symmetric in capital tax rates and hence in the

equilibrium allocation of capital.

Consider first whether a symmetric set of strictly positive capital tax rates could constitute a Nash equilibrium. In a Nash equilibrium, it must be the case that if jurisdiction i reduces its capital tax rate marginally, the change in private net income must be less than the change in tax revenues since otherwise, the government will want to use its head tax rather than the capital tax to gain tax revenues. Now, because of agglomeration economies, an infinitesimal reduction in the capital tax rate in jurisdiction i will attract all capital to that jurisdiction, thereby doubling the tax revenues from the capital tax. At the same time, private net income increases due to the increase in returns to the fixed factor, and the returns to capital increase due to agglomeration economies. The marginal cost of public funds associated with the capital tax is therefore negative in all symmetric set of strictly positive capital tax rates, which means that both governments will want to reduce their capital tax rate in such a situation. In conclusion, a symmetric set of strictly positive capital tax rates cannot constitute a Nash equilibrium. This leaves the situation of zero tax rates, in which it is not possible to reduce the capital tax rate further. In the symmetric zero-tax rate case, we have that private net income in the two jurisdictions is given by $x_k = x_k = f(\bar{k}) h(\bar{k}) - T_k$, $k = i, j$. If zero capital tax rates constitute a Nash equilibrium given head taxes, it must not be the case that the government in jurisdiction i can increase utility of its representative household by raising its capital tax rate, thereby triggering a migration of all capital to the other jurisdiction, which would increase the returns to capital, but reduce the returns to the fixed factor of the representative household. Hence, if $f'(2\bar{k}) h(2\bar{k}) \bar{k} > f(\bar{k}) h(\bar{k})$, the symmetric zero tax situation is not an equilibrium either, and a Nash equilibrium in pure strategies does not exist. These considerations leave one possible pure strategy symmetric Nash equilibrium in

tax rates, which is characterized by $t_i = t_j = 0$ satisfying (9) and $t_i = t_j = 0$, and it only exists if $f'(2\bar{k}) h(2\bar{k}) \bar{k} < f(\bar{k}) h(\bar{k})$. Finally, note that a small divergence from the zero capital tax rate in any of the two jurisdictions will trigger a complete agglomeration of capital in the other jurisdiction. The symmetric Nash equilibrium allocation of capital in other words remains unstable.